Assessing Language Abilities in Young Bilinguals: Parent Report versus Examiner-Administered Measures

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Abstract of Thesis

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The course of language development among bilingual children continues to be challenging to describe and assess due to the heterogeneity among bilingual populations. This study aims to explore best practices for clinical assessment of lexical abilities among young bilingual children as well as the roles that parent proficiency in English and children's exposure to each language play in accurate assessment of expressive language abilities. Results of the EOWPVT (Expressive One-Word Picture Vocabulary Test), the CDI (Communicative Development Inventories), its Spanish counterpart, the IDHC (Inventario del Desarrollo de Habilidades Comunicativas), children's percent exposure to English, and parent proficiency in English of 46 Spanish-English bilingual children at 30-months were examined using hierarchical multiple regression analysis. Results indicated that parents with low English proficiency underestimated their children's expressive vocabularies using English and composite English-Spanish measures. Adjusting composite vocabulary scores to account for low English proficiency resulted in a decreased number of children scoring below a conservative clinical cut-point for risk of language delay. Findings support previous research that relative exposure influences lexical development of young bilinguals and highlights the importance of developing assessment norms that represent varying degrees of language exposure. Furthermore, proficiency and exposure are critical to consider during assessment of dual language learners and classifying bilingual children as developing within a normal or delayed trajectory.

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Chapter 1: Introduction and Literature Review

The number of children in the United States who are exposed to more than one language at home continues to increase. According to the Federal Interagency Forum on Child and Family Statistics, the percentage of children (5 to 17 years old) who spoke a language other than English at home grew from 18% in 2000, to 22% in 2010. Many of these children have at least one foreign-born parent. It is common for children from immigrant families to enter school with poor language skills, putting them at risk for academic failure (Castro, Paez, Dickinson, & Frede, 2011). These patterns point to the importance of identifying young bilingual children who are at risk for language delay as early as possible. The course of language development among bilingual children continues to be challenging to describe and understand, perpetuating difficulty in accurately identifying those who are developing within a normal trajectory and those who are at risk for language disorder or delay. Best practices for assessing language abilities in young children continues to be debated. In addition to the challenges posed by selecting an examiner-administered versus parent report tool (observable behavior, attention span of young children, unfamiliar clinical settings, personality, parental bias, parent education, and social factors), there are several factors that make bilingual language assessment even more complex (Bedore & Peña, 2008; Core, Hoff, Rumiche, and Señor, 2013; Feldman et al., 2005; Gathercole, Thomas, & Hughes, 2008; Genesee, 2006; Hammer, 2009; Hoff & Core, 2013; Kohnert, 2008; Law & Roy, 2008; Mancilla-Martinez, Pan, & Vagh, 2011; Place & Hoff, 2011). Variation in language experience, degree of acculturation, proportion of English and Spanish input, and education level of

parents are all factors that impact bilingual children's language experience and development.

Influences on Bilingual Language Development

Gradually, some influential factors in bilingual language development are beginning to be described and better understood. Recent studies indicate that the relative language exposure (or language experience in each language) is predictive of both lexical (single-language and total vocabulary) and grammatical (combining words, complexity, and mean length utterance) abilities in each language (Hoff et al., 2012). While longitudinal studies have considered the course of language development among monolingual children, few similar studies exist for young bilingual children (Hoff et al., 2012; Hoff, Rumiche, Burridge, Ribot, and Welsh, (under review). Syntactic and lexical abilities develop separately in each language, reflecting the amount of exposure a child has to each language (Conboy & Thal, 2006; Hoff et al., 2012; Pearson, Fernandez, Lewdeg, Oller; 1997). The input a child receives is dependent on language experiences determined by the parents and potentially also on parent language proficiency.

Another recent study, Hoff, Rumiche, Burridge, Ribot, and Welsh, (under review) demonstrated disparate trajectories in expressive vocabulary for bilingual children 2 to 4 years old based on family constellation. Children with two native Spanish speaking parents, children with one native Spanish speaking parent and one native English speaking parent, and children from monolingual English speaking were found to have variation in expressive vocabulary development, reinforcing the premise that relative quantity as well as quality of input impact development in dual language learners. In order to accurately assess, describe, and identify young bilinguals who are developing

within a normal trajectory or who are at risk for language delay, the interconnected factors of relative language exposure and family constellation must be considered when selecting assessment tools and analyzing results for clinical decision making.

Current Assessment Tools and Limitations

Multiple studies have pointed out the challenges and potential problems associated with using monolingual norms to describe bilingual performance (Bedore & Peña, 2008; Gathercole, Thomas, & Hughes, 2008; Kohnert, 2008; Mancilla-Martinez, Pan, & Vagh, 2011; Pearson, Fernandez, Oller, 1993). Although there has been increasing awareness and understanding of bilingual language development, it remains very difficult to accumulate normative data due to the heterogeneity of dual language learning populations (Kohnert, 2008). In the absence of normative data for young bilingual children, language assessments generally exclusively use monolingual norms, which often results in overidentification of dual language learners who are at risk for language delay or disorder (Kohnert, 2008). Gathercole, Thomas, & Hughes, (2008) suggested that standardized tests for bilinguals should include norms for a general population that includes both monolingual and bilingual speakers, as well as norms that allow for comparison with other bilingual children who have similar relative exposure. Dual language learners are likely to appear to be underperforming when compared to expectations developed for monolingual peers (Gathercole, Thomas, & Huges, 2008; Hoff et al., 2012). Bedore and Peña (2008) support the proposal to compare bilingual performance to an appropriate sample as well as using conceptual scoring to measure across language abilities. In summary, avoiding both content and linguistic bias when

using standardized assessments with bilinguals can be challenging. It is important to remember that each dual language learner is raised in a unique environment which must be taken into account during the assessment and clinical decision-making process.

Current diagnostic tools for young bilingual children include parent report surveys for children up to 30 months of age and examiner-administered assessments beginning at 24 months, creating a small window when both tools can be used during assessment. Vocabulary measures are often utilized when assessing young children's language abilities. In addition to providing insight about a child's overall language abilities, lexical measures have been found to forecast comparable abilities in morphology, syntax, and later language abilities in both monolingual and bilingual children (Conboy & Thal, 2006; Core, Hoff, Rumiche, & Señor, 2013; Gathercole, Thomas, & Hughes, 2008). As a child's vocabulary grows, their syntax and morphology becomes increasingly complex. In bilingual children, this process occurs in each language as opposed to across languages, thus accurate assessment of vocabulary in each language is important and can be used for a wide range of purposes including identification of children that may be at risk for language delay (Core, Hoff, Rumiche, & Señor, 2013; Gathercole, Thomas, & Hughes, 2008, Marchman, Martinez-Sussman, & Dale, 2004; Pearson, Fernandez, Oller, 1993). Both parent report and examiner-administered vocabulary assessment tools are standardized and norm-referenced, and can be used to assess a child's abilities in a single language, however, limitations still exist.

The MacArthur-Bates Communication Development Inventories (CDI) (Fenson et al., 1993**)** is a parent report tool that is widely used to assess lexical and grammar abilities in young children and has been proposed for use with bilingual populations in

conjunction with the Spanish adaptation, The Inventario del Desarrollo de Habilidades Comunicativas ([IDHC], Jackson-Maldondo et al., 2003) (Hoff et al., 2013; Core et al., 2013; Marchman & Martinez-Sussmann, 2002; Pearson & Ferrnandez, 1994). By adding raw scores of the CDI and IDHC, a child's Total Vocabulary (TV) can be calculated, reflecting language abilities in both English and Spanish. Results from recent studies support the use of TV, because it shows vocabulary growth of bilingual children to be commensurate with that of monolingual children and it identifies the same proportion of bilingual children below the 25th percentile as monolingual children (Core, Hoff, Rumiche, & Señor, 2013). Parent report measures are cost-effective and efficient, and may describe a child's abilities more accurately as they can be completed over extended time periods in a natural setting with typical communication partners (Feldman et al., 2000; Feldman et al., 2005). In addition, parent report measures such as the CDI and IDHC can be administered by monolingual clinicians, where as tools such as the EOWPVT require examiners to be proficient in the language being tested.

Examiner administered assessments, including the Expressive One-Word Picture Vocabulary Test (EOWPVT, Brownell, 2000), are based on observable behaviors and thus may not be representative of a child's abilities due to an unnatural environment, an unfamiliar communication partner, as well as the limited attention capacities of a preschool aged child (Feldman et al., 2005). The EOWPVT consists of presenting pictures of objects, actions, or concepts and asking the examinee to name the picture. When administering the EOWPVT to bilingual children, conceptual scoring allows for responses to be accepted in either language. Studies considering use of conceptual scoring with bilingual children's performance on semantic and lexical tasks have

advocated to better represent the range of language abilities of bilingual children than when tested in one language against monolingual norms (Bedore & Peña, 2008, Bedore, Peña, Garcia, & Cortez, 2005).

Multiple studies have pointed out the need to use caution with such parent report tools which can be prone to bias and rely on normative information that may not be relative to all populations, particularly when being used to identify children at risk for language delay at a young age (Boyce, Akers, Innocenti, Ortiz, & Cook, 2008; Conboy & Thal, 2006; Doyle, Campbell, & Dempsey, 2009; Feldman et al., 2000; Marchman & Martinez-Sussmann, 2002). Tools such as the CDI rely on parents' sensitivity to evolving language abilities; because of this the validity of the CDI has been questioned, especially with minority and low socioeconomic status (SES) groups who were underrepresented in the standardization sample for the CDI. Previous studies have determined that parents are sensitive to children's changing language abilities. Moderate to strong correlations have been found between parent reports and various examiner-administered assessments, however these studies included only monolingual typically developing 18- to 30-month olds (Feldman et al., 2005; Law & Roy, 2008). Studies using large diverse samples found that mothers of lower SES backgrounds over-estimated language abilities when completing the CDI (Pan et al., 2004; Reese & Read, 2000). Roberts, Burchinal, & Durham (1999) found that African American parents with low SES were underreporting children's vocabulary with the use of parent report tools. These varied findings from studies considering the validity of the CDI demonstrate a need for caution when using parent report measures to identify children at risk for disorder or

delay or when evaluating the effectiveness of intervention with children whose profiles are different from the sample used for the normative data.

Impacts of parent proficiency on child language development and parent reporting

Findings from recent studies have indicated that non-native input is less supportive of language learning (Paradis, 2011; Place & Hoff, 2011). Hoff, Rumiche, Burridge, Ribot, and Welsh (under review) proposed that the amount of English used at home predicted English vocabulary for bilingual children only when a child had a native-English speaking parent. These recent findings suggest that parent proficiency affects the course of language development among dual language learners. In addition, with the range of family constellations that exist for native and non-native speakers of English, it is possible that proficiency plays a role in the ability to accurately report a child's language abilities in addition to the role it plays in children's language development in English. Martinez, Pan, & Vagh showed that bilingual parent report vocabulary measures (CDI and IDHC) administered by families with low SES were valid; however, this was concluded without specifically considering exposure and parent proficiency. The authors highlighted the need for more in depth consideration of patterns of relative exposure than obtained in the study, and did not address parent proficiency in English, beyond that the parents should only report on languages that they "felt confident they could report on" (p 340, 2011). A parent who is a nonnative English speaker likely speaks less English and that may be reflected in their child's abilities, but can they accurately report on the child's abilities given other sources of English exposure**?**

Bilingual children score lower on vocabulary tests than monolingual children because their language knowledge is distributed across two languages (Hoff & Core, 2013; Pearson, Fernandez, & Oller, 1993). Relative amount of exposure affects vocabulary size and performance on lexical assessments, and thus exposure needs to be considered when interpreting test scores. Gathercole, Thomas, & Hughes (2008) found that bilingual children scored differently on vocabulary measures based on exposure. The authors of the study go on to advocate that norms should be developed that include relative amount of exposure. Parent proficiency and relative exposure should be considered when assessing language skills of bilingual children as these factors could affect accuracy of reporting and clinical interpretation of test results.

Increased understanding of how the quantity and quality of input shape bilingual language development leads us to consider how bilingual parent proficiency could impact accuracy of reporting lexical and grammar abilities. Do parents accurately report their children's abilities when they have low proficiency in one of the languages their child is exposed to? The CDI is a widely used tool that has shown to have strong potential with bilingual children because it allows for a composite vocabulary score and a comprehensive measure of a child's abilities. Additionally, the EOWPVT is an examiner-administered assessment used with bilingual populations because it allows for conceptual scoring across languages (Anthony et al., 2009; Bandel, Atkins-Burnett, Castro, Wulsin, & Putnam, 2012). The difference in these assessments lies in that one depends on parent report. Parent report measures may be more likely to encapsulate genuine abilities a child in their natural setting. These may be missed during a standardized norm-referenced assessment. Furthermore, parent reporting may be more at risk for bias and frame of

reference than a tool administered by experienced clinician. It is difficult to assess language skills in young bilingual children and there is a small window of overlap when parent reports and examiner-administered measures are both used. It is critical to know if parents with low English proficiency are reporting children as having smaller vocabularies because it can be an indicator of language delay. We aim to consider the role that parent proficiency and exposure play in accurate assessment and interpretation of language abilities by comparing results of examiner-administered tests and parent reports at a single point in time. Based on Gathercole, Thomas, and Hughes' (2008) conclusions that assessment scores should be compared to other bilingual children with similar exposure, we also aim to describe performance on the CDI, IDHC, TV, and EOWPVT-English and Spanish based exposure to each language at 30 months.

Research Questions

Studies in bilingual language development have led to greater potential for identifying young children who are at risk for language delay. These improvements are based on the use of parent report surveys to generate a composite lexical measure including abilities in both English and Spanish, as well as considering the amount of exposure a child has to each language, and the family constellation of native and non-native speakers (Core et. al, 2013; Hoff et al, 2013; Hoff et al, 2010). Parent proficiency may influence the accuracy of reporting on a child's abilities and also affect which children may be identified as at risk for language delay. The current study aims to:

1. Describe expressive vocabulary abilities of native bilingual children at 30 months of age based on performance on the CDI, IDHC, EOWPVT-English, EOWPVT-Spanish, and relative exposure to each language.

2. Determine the relationship between parent proficiency in English and parent reported vocabulary size using the CDI, IDHC, and TV at 30 months as compared with the EOWPVT, an examiner administered instrument.
3. Explore whether parents' language proficiency in English affects the number of children who score below a clinical cut-point on an expressive vocabulary parent report measure that identifies them as at risk for language delay.

Based on previous studies and recent examiner observation during home visits with families, we expect that parents with lower proficiency in English will underreport their children's lexical abilities using the CDI at 30 months of age. We are uncertain what impact proficiency will have on TV scores using the CDI and IDHC because of the lack of research utilizing TV as a lexical measure. Additionally, we expect that the impact of English proficiency on TV may vary based on relative exposure to English and Spanish. For a parent with low English proficiency who primarily speaks Spanish with his/her child, proficiency may not have a significant impact on TV score. We do not anticipate that English proficiency will affect parent reporting for the IDHC, as this measure is dependent upon parents' Spanish language skills. All of the parents in this study are native speakers of Spanish or native bilingual speakers of English and Spanish. For one child, it was not reported which parent completed the IDHC, however both parents reported high proficiency in Spanish. Lastly, if parent proficiency in English affects their estimate of a child's vocabulary size in English, that may affect TV scores relative to a conservative clinical cut-point.

Chapter 2: Methods

Participants

Participants in the study included 46 bilingual Spanish and English-learning children (28 boys and 18 girls). All children were reported to be full term and born without health complications or hearing loss. The participants were selected from a larger cohort of bilingual Spanish and English-learning children at 30 months who were enrolled in a longitudinal dual language development study (Ribot & Hoff, (in press). The Language Development Lab at The Florida Atlantic University recruited families by advertising in child-care centers, libraries, the university's web page, word of mouth, and parent-oriented magazines and newspapers. All of the children were born in the U.S, resided in South Florida, and were exposed to both Spanish and English since birth. Each child had at least one immigrant parent from a Spanish-speaking Latin American country that is a native speaker of Spanish. Inclusion criteria for bilingual exposure required at least 10 percent of the child's total input to be in the less frequently heard language. Families that participated in the study were compensated, and children received a small age-appropriate gift. The Florida Atlantic University Institutional Review Board approved subject participation in this study, as well as obtaining consent from families involved in the study.

Procedure and Instruments

Data collection in English and Spanish took place at participants' homes, testing in each language on separate days with native speakers administering or explaining the assessments. Measures of the children's language development were collected at 30

months of age utilizing the English *MacArthur-Bates Communicative Development Inventory: Words and Sentences* (CDI, Fenson et al., 1993), and its Spanish equivalent, *Inventario del Desarollo de Habilidades Comunicativas:Palabras y Enunciados* (IDHC, Jackson-Maldonando et al., 2003). The same caregiver completed the CDI and IDHC vocabulary checklists when possible. Examiner administered language development measures included the *Expressive One-Word Picture Vocabulary Test* (*EOWPVT*) in English and Spanish. Administration procedures for the Spanish-English bilingual version of the *EOWPVT* generally allow for responses in either language. This procedure was modified to allow only English responses to label pictures during the English assessment and Spanish responses during the Spanish assessment. In addition, the procedure was adapted to eliminate establishing a basal for the *EOWPVT* due to the observation that many of the children from bilingual backgrounds could not label items included in the first 8 stimuli, but were able to continue and appropriately label items beyond the initial stimuli. In this study, raw scores from the *EOWPVT* indicate the number of items a child successfully labeled from the start of the test until missing 6 items consecutively. Data was analyzed using raw scores from the CDI and IDHC, as well as the sum of the two scores to form a composite TV raw score. Raw scores from the EOWPVT-English and Spanish and percentile rankings were compared against English monolingual norms for children at 30-months of age. TV and CDI raw scores were compared to English monolingual norms provided by the CDI for children at 30-months, while IDHC raw scores were compared to monolingual Spanish speaking children at 30-months.

Parents (37 mothers and 9 fathers) who completed the CDI and IDHC for their children also participated in an interview designed to describe the child's linguistic environment at 30 months of age. The interview utilized the Home Language Environment Questionnaire (LEQ), which was adapted from a questionnaire by Marchman and colleagues (e.g. Marchman & Martínez-Sussmann, 2002). The LEQ includes several self-reported measures of proficiency, measures of relative exposure of the child to Spanish and English within the home, parent age of arrival, and parent education.

Children's Relative Exposure to English and Spanish

Parents estimated their children's exposure to both English and Spanish heard in the home. Based on caregiver estimates of English and Spanish in the home, 28 children were exposed to more English than Spanish, 8 children were exposed to more Spanish than English, and 10 children had equal exposure to English and Spanish. Mean exposure to English and Spanish for the 30-month bilingual children was 35% and 64.93% , respectively (SD = 24.98).

Parent Proficiency in English

Proficiency measures of oral/spoken English were obtained on the LEQ using the following 0 to 2 self-rating system:

> 0 – Cannot speak the indicated language, has a few words or phrases, cannot produce sentences, understand only a few words

1 – Limited proficiency with grammatical errors, limited vocabulary, understand the general idea of what is being said

2 – Good proficiency with few grammatical errors, good vocabulary, understand most of what is said

Similar self-rating scales for English proficiency had been found to generate sufficiently sensitive and specific values when predicting word recognition in bilingual adults (Shi, 2013). Proficiency ratings for those mothers and fathers who completed the CDI and IDHC were categorized into high and low groups based on self-rating of spoken English. Ratings of 0 and 1 were grouped together to form low proficiency respondent group (12 parents) and a rating of 2 formed the high proficiency respondent group (34 parents). Forty-one parents in the study are native speakers of Spanish, 4 are native bilinguals, and 1 father identified as a native speaker of English, however reported that he speaks both Spanish and English to his child and self-identified as having "limited" English proficiency. Parents also reported their age of arrival to the United States when completing the LEQ. In this study, English proficiency rating and age of arrival of the parent who completed the CDI were used in analyses describing parent characteristics as well as the impact of proficiency on reporting on child expressive vocabulary skills in English.

Parent Education Level

In addition to information regarding exposure and proficiency, parents who completed the LEQ shared their highest level of education based on the following groupings:

- Less than high school
- High school
- 2 year degree
- 4 year degree
- Advanced degree

Initial descriptive analyses were completed to describe the parents who completed the CDI for their child based on parent proficiency, age of arrival to the United States, and education. Results of independent samples T-Tests demonstrated that parents with high English proficiency had an earlier mean age of arrival, but similar levels of education as parents who had low self-ratings of proficiency in English. Average exposure to English within the home for children of parents with high and low English proficiency was 37% and 30%, respectively. The discrepancy in age of arrival to the United States is consistent with what we would expect based on self-reported proficiency ratings. See Table 1 for descriptive and independent samples T-test results for parent age of arrival, education level, and amount of English used in the home based on degree of parent proficiency in English.

Chapter 3: Results

Describing Expressive Vocabulary Abilities at 30 Months

Results of independent samples t-tests indicate that children in the sample have a similar overall degree of exposure to English and Spanish, regardless of self-reported parent proficiency in English (*t= -1.10, p = .26)*. Average exposure for children with a high English proficiency parent was 36.91% (SD=24.5) compared with 29.83% (SD=26.69) for children with a low English proficiency parent. There was a significant difference in age of arrival for the group with high English proficiency compared with the group with low English proficiency, as indicated by independent samples t-tests *(t= 2.94, p = .005).* Average age of arrival for parents with high proficiency in English was 11.9 years-old versus 22 years-old for parents with low proficiency in English. Thus, age of arrival to the United States appears to be strongly related to an individual's proficiency in spoken English while level of education does not appear to differ significantly across groups *(t= -1.19, p = .23)*. Comparing the high and low proficiency parents in the areas of education, age of arrival, and percentage English exposure for their child leads us to believe that children's performance on the CDI and EOWPVT in English does not reflect differences based only on amount of English input a child has. See Table 1., *Parent Age of Arrival, Education Level, and Percentage of English used in the Home,* for descriptive statistics and results of independent samples t-tests. Accounting for degree of English exposure allows us to consider the relationship between parent proficiency in a language and the child's CDI score at 30 months as compared with the EOWPVT, an examiner administered instrument.

Descriptive statistics based on raw score and percentiles from the CDI, IDHC, TV (TV is the sum of CDI raw score and IDHC raw score), and EOWPVT-English and Spanish raw scores for the whole group are shown in Table 2, *CDI, IDHC, TV, and EOWPVT-English (EOWPVT- E) and Spanish (EOWPVT-S) scores at 30 months*. Parent report measures for TV indicate scores range from below the 5th percentile to greater than the 99th percentile. Similarly, EOWPVT-E and EOWPVT-S scores range from below the 1st percentile to the 96th percentile. While these ranges are extremely broad, when considering both the parent report measures (CDI, IDHC, and TV) and the examiner administered measures (EOWPVT-English and Spanish), on average, subjects in the sample scored at or below the 20th percentile for each of the five tasks. Mean percentile rank for the CDI and IDHC scores were 5th and 15th, respectively. EOWPVT-English and Spanish mean percentiles are both below the 1st percentile, however, it is important to note that scores were compared to monolingual English peers of the same age.

Descriptive statistics and independent samples t-tests for raw scores and percentiles of the CDI, IDHC, TV, and EOWPVT-English and EOWPVT-Spanish were also completed after grouping subjects by high or low English proficiency of the parent who completed the CDI. Results on independent samples t-tests indicated significant differences on the CDI ($t = -2.445\ (44),\ p = .019$), TV ($t = -2.900\ (44),\ p = .006$), and TV percentile ranking (TV) ($t = -2.491\ (44),\ p = .017$) between parent groups with low and High English proficiency. Children with a respondent who had low English proficiency attained a mean score below the15th percentile for TV and IDHC, and below the 5th percentile on the CDI. Utilizing a conservative clinical-cut point, (at or below the 10th percentile), 58% of the subjects with a low English proficiency respondent and 21%

of children with a high English proficiency respondent would be identified as being at risk for language delay or disorder, based on TV raw scores as compared to monolingual norms for the CDI at 30 months. While the group with a respondent with high English proficiency achieved a mean raw score on the EOWPVT-English that was approximately 5 points more than the low proficiency group, all subjects, regardless of parent English proficiency rating, scored at or below the 1st percentile on both English and Spanish EOWPVT measures. Average raw scores and percentiles ranks for all expressive vocabulary tasks grouped by parent proficiency are summarized in Table 3, *CDI, IDHC, TV, and EOWPVT-English and Spanish Raw Scores based on CDI Respondent's Proficiency Rating*.

In order to describe children's expressive lexical abilities at 30 months in relation to exposure, subjects were grouped based on amount of exposure to English in the home (less than 30%, between 30% and 60%, and greater than 60% exposure to English). Raw scores, percentile range, and percentile mean were calculated for each group for the CDI, IDHC, TV, EOWPVT-English, and EOWPVT-Spanish. Results indicate that CDI and TV raw scores and percentile ranking of expressive vocabulary increase as amount of exposure to English increases, while the inverse is true for raw score of the IDHC. Considering CDI and IDHC scores alone suggests subjects' scores were at or below the 20th percentile for all exposure bands, with the lowest percentile ranking in the language with the least exposure. TV percentile rankings ranged from 5 to 99%, with a mean percentile ranking of 40%. EOWPVT raw scores and percentiles based on exposure demonstrated overall lower percentile rankings when compared with age matched monolingual peers, while average raw scores and percentiles on the EOWPVT-English

increased with greater exposure to English. Raw score and percentile rank data for all expressive vocabulary tasks grouped by relative exposure to English are displayed in Table 4, *Mean CDI, IDHC, TV, EOWPVT-English, and EOWPVT-Spanish Raw Scores based on Relative Exposure to English in the Home.*

Relationship between Parent Proficiency and Reporting

To determine the relationship between parent proficiency in English and parent reported vocabulary size, hierarchical multiple regression analyses were conducted to predict CDI raw score based on EOWPVT-English raw score, proportion of English Exposure in the home, and parent proficiency. These analyses would also demonstrate which variables accounted for the greatest variance in the model. We used hierarchical multiple regression analyses with three different dependent variables to determine the impact of parent proficiency on predicting 1) CDI scores, 2) IDHC scores and 3) TV scores. In all three models, we used three predictor variables: Child's total proportion of exposure to English (% Exposure English), Raw EOWPVT-English (EOWPVT-Spanish was used for the IDHC model) Score, and Parent Proficiency in English (High or Low). Prior to running the model, we included a variable to account for possible interaction between CDI score and Parent Proficiency. The interaction between CDI score and parent proficiency was not a significant predictor in the model (*Beta = .488, p = 0.051*), and thus analyses were completed without the interaction effect variable.

In our first model, we looked at the effect of parent proficiency on CDI scores. A significant model emerged ($F_{3, 42} = 38.435$, $p < .0005$). Adjusted R square = .714, indicating the predictor variables explained a significant proportion of the variance in the

CDI scores. Predictor variables and significance are shown in Table 5, *EOWPVT-English, English Exposure, and Proficiency, as Predictor Variables for CDI Score*. EOWPVT-English scores and parent proficiency both significantly contributed to the model, while relative amount of exposure to English was not a significant predictor in the model. The proportion of variance accounted for by EOWPVT raw score and % English Exposure when predicting CDI raw score ($R^2 = .693$) increases ($R^2 = .733$) when parent proficiency is added to the regression model, indicating parent proficiency predicts CDI raw score above and beyond EOWPVT raw score, when exposure has been accounted for.

Hierarchical multiple regression analysis was also completed with raw IDHC score as the outcome variable. As with previous analyses, possible interaction between IDHC score and Parent Proficiency was tested for and found not to be significant in the model. (*Beta = .-0.033, p = 0.847*). We did not expect to find a significant model when considering IDHC as the outcome measure, because we did not expect high or low English proficiency to affect reporting of children's Spanish abilities, and parents who completed the IDHC were either native speakers of Spanish or had high Spanish proficiency. Results produced a model similar to what we anticipated, ($F_{3, 42} = 6.680$, $p < .001$), indicating the EOWPVT-Spanish was a significant predictor of the IDHC, while amount of exposure to English and parent proficiency in English were not. Results considering predictor variables for raw IDHC score are displayed in Table 6, *EOWPVT-Spanish, Exposure, and Proficiency as Predictor Variables for IDHC Score*.

We conducted hierarchical multiple regression analysis with raw Total Vocabulary score as the outcome variable and three predictor variables: Child's total proportion of exposure to English (% Exposure English), Raw EOWPVT-English Score,

Parent Proficiency in English (High or Low). Prior to completing regression analyses, testing for possible interaction between TV score and Parent Proficiency was conducted. There was not a significant interaction effect between proficiency and TV (*Beta= .560, p= 0.161)*, so this variable was excluded in further analyses. A significant model emerged ($F_{3, 42} = 6.987$, $p < .005$), indicating EOWPVT and parent proficiency were significant predictors, while relative amount of exposure to English was not a significant predictor (*Beta= -.175, p = 0.272*). Results are summarized in Table 7, *EOWPVT-English, English Exposure, and Proficiency, as Predictor Variables for TV Score*.

Clinical Significance of Parent Proficiency in English on Parent Reported Vocabulary

To explore possible consequences of parents with low English proficiency underestimating their children's vocabularies, we used our results from the regression analyses to create adjusted raw scores and percentiles on the CDI and TV that accounted for parent proficiency in English, allowing us to determine if the influence of proficiency could affect a child's score in relation to a clinical cut-point for being at risk for language delay or disorder. Results of multiple regression analyses considering the impact of proficiency on CDI raw score yielded an unstandardized coefficient Beta value of 73.75. This value represents the difference between high proficiency parent-report scores on the CDI and low proficiency parent-report scores. Based on previous research questioning reporting accuracy of CDI when used with underrepresented minority populations, and the reliability and validity that has been demonstrated with the CDI when used with monolingual speakers, we act under the expectation that low proficiency parents are underestimating their children's vocabularies as opposed to high proficiency parents overestimating their children's vocabularies. Speakers with less experience and

proficiency in English may have more difficulty identifying words used by their children in English. In addition, the inflated proportion of children ranking below the 10th percentile on TV measures before adjusting for proficiency supports our hypothesis that scores of children with CDI respondents who have low English proficiency are underestimating their children's vocabulary in English.

In order to examine the possible effects of underestimating expressive vocabulary scores on clinical decision-making, we generated adjusted CDI and TV raw scores by adding 73.75 points to account for low parent proficiency in English. The adjusted scores were compared to monolingual CDI norms to determine the number of subjects who fall below the 10th percentile before the adjusted score and after, allowing us to examine the potential clinical significance of parent proficiency. Raw CDI and TV scores and percentiles for subjects with a low proficiency parent appear in Table 8, *CDI and TV Raw Scores and Percentiles for Subjects with a Parent with Low English Proficiency*. Scores for the same children, which have been adjusted for parents' low proficiency in English, are displayed in Table 9, *CDI and TV Raw Scores and percentiles Adjusted for Influence of Low English Proficiency.*

Compared to monolingual English peers at 30 months, all bilingual children who have a parent with low English proficiency scored at or below the 5th percentile on the CDI. Combining English and Spanish expressive vocabulary yielded TV raw scores, which ranged from the 1st to the 45th percentile on the CDI. After adjusting raw CDI and TV scores of children with a parent with low English proficiency based on the unstandardized coefficient *(Beta ≈ 74),* adjusted TV percentiles were calculated for each subject based on CDI norms for age and gender matched peers. Using the adjusted

percentiles, the proportion of subjects who were at or below the clinical cut-point for being identified as at risk for language delay or disorder (10^{th} percentile) decreased from 7 of 12 (58%) of the sample to 3 of 12 (25%) when TV raw scores were adjusted for proficiency. For example, subject R01ED408 had an initial TV raw score of 163 words, which increased to 237 words after adjusting for the parent's low English proficiency. R01ED439 had a TV score of 234 before accounting for low English proficiency, and an adjusted score of 304. Both of the aforementioned subjects had score in the 5th percentile ranking for TV before adjusting for parent proficiency, and had adjusted scores that placed them between the 10^{th} and 14^{th} percentile for TV. Subjects R2130Mo132 and R2130Mo141 had TV scores that placed them in the 5^{th} and 10^{th} percentile for their age, and with adjusted scores ranked between the 15^{th} and 20^{th} percentile for TV using the CDI norms for 30 month-olds. Considering the whole sample, after accounting for the parents who reported low proficiency in English, 10 of 46 (22%) of the subjects achieved raw TV scores that places them at or below the 10^{th} percentile ranking when compared to age matched monolingual peers.

Chapter 4: Discussion

The present study contributes new information for describing bilingual language development, informing assessment procedures as well as clinical decision-making for young bilinguals. Data from parent report measures (CDI, IDHC, and TV) and examiner-administered assessments (EOWPVT-English and Spanish) validate the importance of considering lexical abilities in both English and Spanish, relative exposure to English and Spanish, and parent proficiency in a language when analyzing performance on assessments. Our results provide information about the expressive vocabularies of 46 bilingual children that can serve as local norms based on relative exposure to Spanish and English. This study also contributes specific information regarding the quantitative impact low English proficiency has on reporting expressive vocabulary abilities in English. Parents with low English proficiency underestimate vocabulary by an average of 74 words when using total vocabulary as a parent report tool. Lastly, this study has important clinical implications because the impact that proficiency has on parent reporting in conjunction with factors such as exposure, could influence clinical decision-making relative to clinical cut-points for being at risk for language delay or disorder. These findings are discussed as they address the research objectives that guided this study.

1) Describe expressive vocabulary abilities of native bilingual children at 30 months of age based on performance on the CDI, IDHC, EOWPVT-English, and EOWPVT-Spanish.

On average, children in the sample achieved lower scores than age-matched monolingual peers on all single-language expressive vocabulary assessment measures, a finding consistent with previous studies (Hoff et al., 2012; Mancilla-Martinez, Pan, &

Vagh, 2011; Pearson & Fernandez, 1994**).** While there is a broad range of scores within the sample, mean performance on all tasks was at or below the 20th percentile. Percentile rankings are even lower when expressive vocabulary in only one language is considered. For example, average CDI percentile rank for the 46 bilingual children was 5th and average IDHC percentile rank was 15th; however, average TV percentile rank for the group was at the 20th percentile. This is significant because previous studies have pointed out that assessing bilingual children in one language is less valid than utilizing a composite score such as total vocabulary (Core, Hoff, Rumiche & Señor, 2013; Pearson & Fernandez, 1994). It is also important to note the broad range of performance among bilingual children (from below the 5th percentile to the 95th percentile rank on CDI) on all measures. Bilingual children scoring low across various measures reinforces the need to dig deeper and consider explanation behind low expressive vocabulary scores to understand a child's language development in the context of family background and exposure. Dividing the sample into groups based on proficiency and exposure allowed us to consider possible reasons for low score averages across all measures.

Descriptive analyses suggest that as a whole, the group scored low on the expressive measures included in this study. It is important to keep in mind that there is a great deal of variability within typically developing monolingual preschool-aged children, as well as with children from bilingual environments. There were children with a parent who has high English proficiency that achieved a low TV scores and percentile rankings, as well as and children with a parent who had low proficiency in English that achieved relatively high TV and percentile rankings. Utilizing TV as a composite vocabulary score

and taking exposure into account generated mean vocabulary scores for the bilingual sample that are overall similar to that of English-speaking monolingual peers.

Considering results based on the examiner administered assessment, subjects' scores appeared very low for children at 30 months. Sixty-three percent of the children in the sample scored at or below the 1st percentile on the EOWPVT- English and 87% ranked at or below the 1st percentile on the EOWPVT- Spanish. Although on average children with high exposure to English scored within normal limits on the EOWPVT-English test, mean percentile rank for the EOWPVT- Spanish was at or below the 1st percentile for all children. Administering the EOWPVT separately in English and Spanish, as we did in this study, did not yield clinically useful information for describing bilingual children's expressive vocabulary at 30 months. Comparing children's performance to a clinical cut-point at the 10th percentile, 80% and 90% of the children in this sample would identify as at risk for language delay or disorder compared to English monolingual norms It has been recommended that utilizing conceptual scoring with the EOWPVT may yield scores that are more representative of young bilingual children's expressive vocabulary abilities (Bedore & Peña, 2008, Bedore, Peña, Garcia, & Cortez, 2005).

Grouping children based on the proficiency of the parents who completed the CDI, demonstrated significant differences in children's performance on the CDI and TV expressive vocabulary tasks as well as TV percentile ranking when compared to English monolingual norms. Additionally, when considering children's average vocabulary size as a whole group or by parent proficiency, Spanish vocabulary appears to be larger than English when using parent report measures, but not when looking at results from the examiner administered tool. The EOWPVT-Spanish relied on the same (translated)

stimuli and norms used for English, which may impact performance and percentile ranking of bilingual children's scores. These concerns support previous assertions that translation of language tests is problematic in that the course of development is not consistent across languages and thus linguistic targets cannot be assumed to be similar at a given age (Bedore & Peña, 2008). In addition, scores on the EOWPVT-Spanish and English versions were compared to monolingual English norms. Due to the lack of norms for bilingual or Spanish speakers and the literal translation of vocabulary words, analysis of children's performance on the EOWPVT-Spanish is challenging to interpret. These findings support previous proposals for reducing bias while gathering data in terms of collecting information that is not representative of an individual's skills (Kohnert, 2008). During assessment of language abilities of bilingual children, stimuli should be used that is consistent with language experiences. We must keep in mind that relative language abilities are dependent on the contexts of parent language use. Results of this study support suggestions to minimize content and linguistic bias by making use of testing materials that can reliably measure abilities in both languages and be compared with bilingual peers with similar language experiences.

Grouping children based on relative exposure to English and Spanish led to a clear connection between exposure and expressive lexical abilities for children in the sample. This data supports previous research that lexical skills of bilingual children are correlated with relative exposure in each language (Hoff et. al, 2012). Children with the greatest exposure to English scored highest on the CDI and EOWPVT-English while children with the greatest exposure to Spanish scored highest on the IDHC and EOWPVT-Spanish. A composite TV measure demonstrated that on average children in the sample with 60%

or greater exposure and between 30% and 60% exposure to English achieved scores within normal limits compared to monolingual peers. Children with less than 30% exposure to English had a mean percentile ranking of 15% for TV, indicating a score slightly more than 1 standard deviation below the mean for English-speaking monolingual peers. Performance on the EOWPVT-English demonstrated a similar percentile ranking for those subject with more than 60% exposure to English, but for all other degrees of exposure, and all groups for the EOWPVT-Spanish resulted in mean scores at or below the 1st percentile ranking. This reiterates the possibility that the lack of a Spanish-designed test and bilingual norms may impact the scores here as well as the huge influence exposure to a language has on vocabulary growth. Our findings are similar to those of Gathercole, Thomas, & Hughes (2008), highlighting differences in performance based on exposure and supporting the proposal that standardized assessments should include norms that allow for comparison both with a monolingual sample, as well as a bilingual sample with similar relative exposure.

2) Determine the relationship between parent proficiency in English and parent reported vocabulary size using the CDI, IDHC, and TV at 30 months as compared with the EOWPVT, an examiner administered instrument.

Findings from the present study indicate that a parent's proficiency in English is a significant predictor for raw CDI and TV score, above and beyond the contribution of a child's EOWPVT-English score and relative exposure to English. Hierarchical multiple regression analyses demonstrated that the proportion of variance accounted for increases when adding parent proficiency (hi or low) to the model to predict English CDI score (R^2

$= 0.693)$ for EOWPVT-English, increasing to ($R^2 = 0.733)$ with parent proficiency added to the model. Hierarchical regression analyses for which TV score is the outcome revealed that parent proficiency remains a significant predictor in the model, notwithstanding the proportion of variance accounted for ($R^2 = .303)$ either based on EOWPVT-English or parent proficiency of English. The significance of parent proficiency and the amount of variance accounted for likely decreases based on the fact that TV combines English and Spanish vocabulary. Parents may be more accurate completing the Spanish IDHC than the English CDI if they have high proficiency in Spanish than English. Additionally, if English accounts fro a smaller proportion of some bilingual children's TV size, proficiency will account for a smaller proportion of variance in the TV model.

Further analyses predicting IDHC raw scores based on EOWPVT-Spanish score, relative exposure to English and Spanish, and parent proficiency in English confirmed our hypothesis that these variables would not produce a significant model. We did not expect a parent's proficiency in English to influence reporting on their child's vocabulary in Spanish. While exposure and proficiency were not significant predictors, raw score on the EOWPVT-Spanish did contribute significantly to the model. Our findings point to the importance of utilizing a bilingual English-Spanish assessment that includes appropriate stimuli in each language as well as norms based on bilingual children with similar relative exposure as previous research has suggested (Gathercole, Thomas, & Huges, 2008).

3) Does parent proficiency affect the number of children who score below a clinical cut-point identifying them as at risk for language delay?

Based on the findings that degree of parent proficiency in English contributes to predict CDI and TV raw score, there are clinical implications for describing, assessing, and clinical decision-making when using parent report measures with bilingual children. In the present study we found that parents with low English proficiency underestimated their child's vocabulary by an average of 74 words when using total vocabulary as a composite expressive lexical measure. We generated adjusted TV raw scores and percentiles based on this finding which significantly decreased the number of children with a score that placed them below a conservative clinical cut-point (10^{th} percentile). Before adjusting for low parent English proficiency, seven subjects had TV scores below the 10^{th} percentile based on CDI monolingual norms. After adjusting scores for low parent English proficiency, three children remained below the 10^{th} percentile. These three subjects TV scores placed them in the 1^{st} percentile before adjusting for parent proficiency and between the 1^{st} and 10^{th} percentile after adding 74 points to each of their scores. After accounting for the impact of parent proficiency in English on parent reported expressive vocabulary, the language development of these three children stands out as requiring further consideration. Current estimates of the prevalence of language disorders suggest that between 2% and 19% of preschool children have language difficulties (ASHA, 2008). Based on this estimate, it is more likely that 25% of this sample be considered further for possibility of language delay or disorder than 58% as initially would be identified as needing further assessment, based on the conservative clinical cut-point at the 10^{th} percentile ranking. Results in this study support previous

research that suggest a need for caution when using the CDI with populations who are not robustly represented in the norms (Pan et al., 2004, Reese & Read, 2000, Feldman, 2005). With that said, we are not recommending that our findings based on parent proficiency be taken literally and 74 points should be added to every bilingual child's TV score if the parent has low proficiency in English. Instead we suggest exercising discretion when using English parent report measures when families have limited English proficiency. Both relative exposure and parent proficiency in English need to be taken into account during a comprehensive assessment of a young child's abilities.

In order to describe, assess, and make decisions based on expressive vocabulary abilities of young bilinguals, several factors must be taken into account. A child's family constellation influences their English exposure, vocabulary growth, and vocabulary assessment. Parents in this study with low English proficiency who completed the CDI for their children had a similar level of education as parents in the high English proficiency group, but had significantly different average age of arrival to the United States. Parents who immigrate to the United States at a late age are more likely to have self-reported low English proficiency. Considering age of arrival in our study, all seven children with TV raw scores that place them at or below the 10^{th} percentile before accounting for low English proficiency, have mothers who immigrated to the United States at 22 years of age or older.

Additionally, English proficiency of both parents should be considered when analyzing lexical abilities as it has been found in previous research that children with two parents who are nonnative speakers of English are likely to have smaller English vocabularies than children who have a native English speaking parent in the household

(Hoff, et al., 2014). Considering the children in our sample who have a parent with low English proficiency completing the CDI; three of four children with the lowest TV percentile rankings have parents who are both nonnative English speakers and self-identified as having low English proficiency. With this in mind, we would expect lower expressive vocabulary scores on the CDI. When examining the exposure of children below the 10th percentile before accounting for proficiency, half of the children in this group have 10% or less exposure to English within the home. This needs to be taken into account when considering vocabulary abilities.

Clinical example for utilizing proficiency and exposure data with the CDI and IDHC

To provide a clinical example of how proficiency data may be used, we consider two specific children from this study, R2130Mo122 and R2130Mo132. Both had mothers complete the CDI who self-reported as having low English proficiency. Both mothers arrived to the United States at or after 20-years of age, and both have husbands who also rated themselves as having low English proficiency. Both subjects 122 and 132 both have raw CDI and TV scores that place them at or below the 5th percentile compared to English-speaking monolingual peers. After adjusting scores for proficiency, subject 122 has a TV score that places him between the 5th and 10th percentile (below a conservative clinical cut-point), while subject 132 has a TV score that places him between 15th and 20th percentile (above the conservative cut-point) after adjusting for proficiency. Additionally, subject 122 has a reported exposure of 90% English inside the home, while 132 has 50% exposure to English in the home. Based on exposure, adjusted scores for proficiency, subject 122, who had 90% English exposure at home and ranked between the

5th and 10th percentile for TV, would be identified as needing further assessment and possibly at risk for language delay or disorder. On the other hand, subject 132, who had 50% exposure in the home and ranked between the 15th and 20th percentile for TV would not be as likely to be identified as at risk for language delay. Data for subjects 122 and 132 is summarized in Table 10.

In this study we propose an explicit way to consider parent proficiency when interpreting a young bilingual child's observed or reported abilities in relation to their home language environment. We expect that utilizing our findings to adjust expressive vocabulary scores for proficiency will identify children who score significantly below average milestones for vocabulary development with respect to a conservative clinical cut-point. In our clinical example, adjusting TV scores to account for low parent proficiency, subject 132 moved above the clinical cut-point. Subject 122 continued to rank very low for TV performance even after adjusting for low parent proficiency; this combined with the child having exposure to a large quantity of English at home, indicates that there is cause for concern.

Assessment of young bilingual children remains to be a challenging task. This study provides specific guidance on how to use proficiency and exposure data to interpret parent reported vocabulary tools used with young bilingual children. We build upon previous suggestions to include parent proficiency and child exposure data in addition to gathering information about a child's abilities in both languages from multiple sources and points in time to best understand a linguistic environment and accurately identify children as being within a normal trajectory or at risk for delayed language development (Kohnert, 2008; Gathercole, Thomas, & Huges, 2008; Hoff et al., 2012).

Conclusion

Guidelines put forth by the American Speech and Hearing Association (ASHA, 2004) and The Individuals with Disabilities ACT (IDEA, 2004) impart sweeping recommendations for assessment of individuals who are bilingual. Our proposals help provide a concrete solution to the challenge of assessing and interpreting language abilities of young bilingual children. This paper presents quantitative findings to guide assessment of bilingual children with regard to proficiency and exposure when using expressive vocabulary parent report tools such as the CDI. This study recommends an assessment process that judiciously considers family constellation factors such as parent proficiency in English in conjunction with consideration of a child's relative exposure to each language. Table 3., *Exposure to English in the Home and Average Lexical Raw Scores for CDI, IDHC, TV, EOWPVT-E and EOWPVT-S* can serve as an initial guideline for clinicians in terms of children's vocabulary size relative to degree of exposure to English and Spanish. Our study puts forth specific guidance on how to best assess expressive vocabulary of young bilingual children by providing a much-needed quantitative description of abilities on several widespread vocabulary measures based on relative exposure to English and Spanish. We explain the influence of parent proficiency in English on parent reported vocabulary size, as well as offer realistic advice on how to utilize proficiency and exposure data when provided with monolingual norms alone, for the purposes of identifying children as below a clinical cut-point and potentially at risk for language delay. Further work is needed to develop robust normative data that is representative of the range of abilities of bilingual children based on exposure as well as

change in abilities over time. In the meantime, however, clinicians must make their best effort to maintain a valid assessment process by using a combination of methods and analyzing performance in a manner that minimizes potential for bias.

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Tables

Table 1.
Parent Age of Arrival, Education Level, and Percentage of English used in the Home

	High Proficiency Parents	*Low Proficiency Parents*	*Independent Samples T-Test*
Mean Age of Arrival	11.9 years old (SD 10. 76)	22 years old (SD 10.97)	t = 2.94, p = .005
Mean Education Level	2 to 4 years of college (SD 1.1)	2 to 4 years of college (SD .87)	t = -1.2, p =.23
Child's Mean Exposure to English in the home	36.91% (SD 24.5)	29.83% (SD 26.69)	t = -.84, p = .40

Table 2.
CDI, IDHC, TV, and EOWPVT-English (EOWPVT- E) and Spanish (EOWPVT-S) scores at 30 months

	M	*SD*	*Minimum*	*Maximum*	*Percentile Rank**
CDI Raw Score	175.54	161.62	5	677	<5 – 95% 5%
IDHC Raw Score	231.61	145.56	8	560	<5 – 75% 15%
Total Vocabulary	407.15	210.54	61	1017	<5 - >99% 20%
EOWPVT-E Raw Score	8.15	9.5	0	39	<1 -87% 1%
EOWPVT-S Raw Score	4.57	7.22	0	46	<1 – 96% <1%

**Percentile rank norms provided include minimum - maximum, and mean percentiles for the sample*

Table 3.
CDI, IDHC, TV, and EOWPVT-English and Spanish Raw Scores based on CDI Respondent's Proficiency Rating

	Children with High Proficiency Respondent	*Children with Low Proficiency Respondent*	*Independent Samples T-Test based on Parent Proficiency*
Mean CDl Raw Score *Mean Percentile Rank*	208.38 (173.96) 5 – 10%	82.5 (57.42) <5%	t = -2.445 (44), p = .019 t = -1.647 (44), p = .107
Mean IDHC Raw Score *Mean Percentile Rank*	247.71 (140.513) 15 – 20%	186 (156.10) 10 – 15%	t = -1.271 (44), p = .210 t = -1.013 (43), p = .317
Mean Total Vocabulary *Mean Percentile Rank* *(Using English CDI Norms)*	456.09 (208.51) 30 – 35%	268.5 (150.14) 10 – 15%	t = -2.900 (44), p = .006 t = -2.491 (44), p = .017
Mean EOWPVT-E Raw Score *Mean Percentile Rank*	9.15 (10.22) 1%	5.33 (6.62) <1%	t = -1.277 (40), p = .209
Mean EOWPVT-S Raw Score *Mean Percentile Rank*	4.62 (6.30) <1%	4.42 (9.71) <1%	t = -.128 (44), p = .899

(Standard Deviation in Parentheses)

Table 4.
CDI, IDHC, TV, EOWPVT-English, and EOWPVT-Spanish Raw Scores based on Relative Exposure to English in the Home

	Less than 30% Exposure to English (17 of 46 subjects)	*30 to 60% Exposure to English (23 of 46 subjects)*	*Greater than 60% Exposure to English (6 of 46 subjects)*
CDI			
Raw score Mean (SD)	85 (57.88)	183.17 (128.88)	402.83 (247.29)
Percentile Rank Range	0 – 5%	<5 – 60%	<5 – 95%
Percentile Rank Mean	<5%	5%	20%
IDHC			
Raw score Mean (SD)	273.41 (158.42)	227.96 (132.02)	127.17 (120.79)
Percentile Rank Range	<5 – 75%	<5 – 55%	<5 – 30%
Percentile Rank Mean	20%	15%	5%
TV			
Raw score Mean (SD)	358.41 (158.42)	410.7 (177.74)	519.17 (332.49)
Percentile Rank Range	<5 – 99%	<5 – 99%	<5 – 99%
Percentile Rank Mean	15%	20%	40%
EOWPVT-E			
Raw Score Range	0 – 15	0 - 26	1 - 39
Raw score Mean (SD)	2.76 (4.67)	8.83 (7.7)	20.83 (13.7)
Percentile Rank Range	<1 – 13%	<1 – 53%	<1 – 87%
Percentile Rank Mean	<1%	1%	34%
EOWPVT-S			
Raw Score Range	0 – 34	0 – 15	0 - 3
Raw score Mean (SD)	8.88 (9.59)	2.43 (3.96)	0.5 (1.23)
Percentile Rank Range	<1 – 77%	<1 – 14%	<1%
Percentile Rank Mean	1%	<1%	<1%

(Standard Deviation in Parentheses)

Table 5.
EOWPVT-English, English Exposure, and Proficiency, as Predictor Variables for CDI Score

Predictor Variable	*Standardized Beta Coefficient*	*p*
EOWPVT-E Raw Score	*.702*	*p = 0.000*
% English Exposure	*.144*	*p = 0.156*
Parent Proficiency (High or Low)	*.203*	*p = 0.016*

Table 6.
EOWPVT-Spanish, Exposure, and Proficiency as Predictor Variables for IDHC Score

Predictor Variable	*Standardized Beta Coefficient*	*p*
EOWPVT-S Raw Score	*.356*	*p = 0.018*
% English Exposure	*-.266*	*p = 0.076*
Parent English Proficiency (High or Low)	*.217*	*p = 0.098*

Table 7.
EOWPVT-English, English Exposure, and Proficiency, as Predictor Variables for TV Score

Predictor Variable	*Standardized Beta Coefficient*	*p*
EOWPVT-E Raw Score	*.506*	*p = 0.003*
% English Exposure	*-.175*	*p = 0.272*
Parent Proficiency (High or Low)	*.327*	*p = 0.014*

Table 8.
CDI and TV Raw Scores and Percentiles for Subjects with a Parent with Low English Proficiency

Participant ID	*CDI Raw Score*	*CDI Percentile Rank*	*TV Raw Score*	*TV Percentile Rank*
R01ED408	57	1	163	5
R01ED439	45	1	230	5
R01ED443	119	1	281	15
R2130Mo104	46	1	82	1
R2130Mo118	190	5	355	20
R2130Mo122	53	1	61	1
R2130Mo123	5	1	509	45
R2130Mo127	125	1	467	25
R2130Mo130	58	1	123	1
R2130Mo131	17	1	441	30
R2130Mo132	151	5	271	5
R2130Mo141	124	1	229	10

Table 9.
CDI and TV Raw Scores and percentiles Adjusted for Influence of Low English Proficiency

Participant ID	*Adjusted CDI Raw Score*	*Adjusted CDI Percentile Rank*	*Adjusted TV Raw Score*	*Adjusted TV Percentile Rank*
R01ED408	131	5	237	10 - 15
R01ED439	119	<5	304	10 - 15
R01ED443	193	5	355	20 - 25
R2130Mo104	120	<5	156	1 - 5
R2130Mo118	264	10	429	30 - 35
R2130Mo122	127	<5	135	5 - 10
R2130Mo123	79	<5	583	70 - 75
R2130Mo127	199	<5	541	40 - 45
R2130Mo130	132	5	197	5 - 10
R2130Mo131	91	<5	515	30 -35
R2130Mo132	225	5	345	15 - 20
R2130Mo141	198	5	303	15 -20

Table 10.
A Clinical Example Considering Exposure and Proficiency data

Subject	*English Parent Proficiency*		*Age of Arrival*		*% English Exposure at Home*	*TV Percentile Rank (Adjusted for low English Proficiency)*
	Mother	*Father*	*Mother*	*Father*		
R2130Mo122	Low	Low	29	0	90	5 – 10
R2130Mo132	Low	Low	20	2	50	15 – 20