Language Use in the Natural Environment of Spanish-English Bilingual 3- and 4-Year-Olds

Rachel Whittington Saffo
THE FLORIDA STATE UNIVERSITY
COLLEGE OF COMMUNICATION AND INFORMATION

LANGUAGE USE IN THE NATURAL ENVIRONMENT OF SPANISH-ENGLISH
BILINGUAL 3- AND 4-YEAR-OLDS

By
RACHEL WHITTINGTON SAFFO

A Dissertation submitted to the
School of Communication Science and Disorders
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Degree Awarded:
Fall Semester, 2010
The members of the committee approve the dissertation of Rachel Whittington Saffo defended on June 28, 2010.

______________________________
Juliann J. Woods
Major Professor

______________________________
Mary Frances Hanline
University Representative

______________________________
Amy M. Wetherby
Committee Member

______________________________
Carla Wood Jackson
Committee Member

Approved:

______________________________
Kenn Apel, Director, School of Communication Science and Disorders

______________________________
Lawrence C. Dennis, Dean, College of Communication and Information

The Graduate School has verified and approved the above-named committee members.
à toute ma famille
pour tout ton amour
Je vous aime
ACKNOWLEDGEMENTS

Thank you, my committee, Drs. Woods, Wetherby, Wood Jackson, and Hanline. Without your support and consideration, this study would not have been possible. You have each taught me much during my doctorate, not just about scholarly work but also about life. Dr. Woods, thank you for giving me this opportunity of a lifetime. I am very appreciative of the grants that have supported my education: Leadership in Family Centered Early Intervention Doctoral Leadership Grant, Autism Doctoral Leadership Grant, and The Florida State University Doctoral Dissertation Grant.

To my “outside-outside” committee member, Dr. Chris Schatschneider, thank you so much for giving of your time to mentor me through HLM. Syntax, syntax, syntax! You are a gifted scholar and teacher. I really enjoyed this process and will continue to use HLM in future studies. Dr. LaPointe, thank you for your mentorship, friendship, and humor.

To the families and teachers who participated in this study and the many research assistants, muchas gracias.

To my dear friends, afar and local, I miss you and appreciate your loving kindesses. I cannot wait to spend more time with each of you! Angie, Laurie, Shannon, David, Naomi, Elizabeth, Erin, Alisha, Janine, and all the doctoral students, you each mean so much to me. I am grateful for your friendships and look forward to our futures as scholars. With courage, faith, patience, and belief in yourself, you can move mountains! Becca, merci pour ton amitié; Je la chéris.

Mom, Dad, Ms. Annie, Matt, Giselle, Paulo, Mere, Mawmaw, Pawpaw, Pops, Cris, John, and Heather, we did it! Thank you so much for unconditionally loving me through this marathon and for your prayers. I’m coming home soon!

Sweet, Dae, you have now gone through two doctorates. Sigh. Thank you for the deep love and care you have shown me. I cannot wait for the rest of our lives and muddy toes. I love you!

Thank you, Mary and Jesus! Amen.
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Tables</td>
<td>vi</td>
</tr>
<tr>
<td>List of Figures</td>
<td>vii</td>
</tr>
<tr>
<td>Abstract</td>
<td>vii</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. METHOD</td>
<td>15</td>
</tr>
<tr>
<td>3. RESULTS</td>
<td>25</td>
</tr>
<tr>
<td>4. DISCUSSION</td>
<td>54</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>67</td>
</tr>
<tr>
<td>Appendix A</td>
<td>67</td>
</tr>
<tr>
<td>Appendix B</td>
<td>70</td>
</tr>
<tr>
<td>Appendix C</td>
<td>72</td>
</tr>
<tr>
<td>Appendix D</td>
<td>74</td>
</tr>
<tr>
<td>Appendix E</td>
<td>77</td>
</tr>
<tr>
<td>Appendix F</td>
<td>78</td>
</tr>
<tr>
<td>Appendix G</td>
<td>80</td>
</tr>
<tr>
<td>Appendix H</td>
<td>81</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>82</td>
</tr>
<tr>
<td>BIOGRAPHICAL SKETCH</td>
<td>90</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1. Summary of participant demographics ................................................................. 17
Table 2. Summary of developmental characteristics .......................................................... 18
Table 3. Child vocalization count descriptive statistics across contexts per child ............. 27
Table 4. HLM descriptive statistics for modeling CVC ......................................................... 32
Table 5. Two level conditional model showing estimation of fixed effects.  
  Child vocalization counts is the outcome variable ......................................................... 34
Table 6. Bayesian adjusted correlations among assessments  
  and child vocalization counts ....................................................................................... 36
Table 7. HLM descriptive statistics for modeling CVC ......................................................... 38
Table 8. Two level conditional model showing estimation of fixed effects.  
  The outcome variable is CVC ....................................................................................... 41
Table 9. Two level conditional model showing estimation of fixed effects.  
  Child vocalization counts is the outcome variable ......................................................... 45
Table 10. Predicted number of child vocalization counts per hour .................................. 51
Table 11. Pairwise group difference \( p \)-values in number of  
  child vocalization counts per hour .............................................................................. 52
LIST OF FIGURES

Figure 1. Child vocalization count differences per 15 min by gender ........................................... 26
Figure 2. Adult word count differences per 15 min across contexts .............................................. 29
Figure 3. Conversational turn count differences per 15 min across contexts ............................... 30
Figure 4. The relationship between adult word counts and child vocalizations across contexts .......................................................................................................................... 35
Figure 5. Scatter plot of child vocalization counts (n = 35) across a single day .................... 47
Figure 6. Scatter plot of adult word counts (for n = 35 children) across a single day ............. 48
Figure 7. Scatter plot of conversational turn counts (for n = 35 children) across a single day................................................................................................................................. 49
ABSTRACT

Early identification and assessment of possible language-learning difficulties are needed to help young children who are bilingual attain proficiency in both their languages. Typical language development of sequential bilinguals is not widely understood. Young sequential bilinguals below the age of 5 years are in the dynamic stages of language learning. The home language (L1) acts as an essential foundation for the child’s first (L1) and second (L2) language development. The relationship between L1 and L2 fluctuates within and across children, decreasing the value of standardized single language measures that lead to under- or over-estimation of a bilingual’s skills. The purpose of this study was to examine and compare repeated samples of sequential bilinguals’ language use in the natural environment with standardized and criterion-referenced measures of their two languages. A two-level hierarchical linear model was employed (time points across the day nested in children). Child vocalization counts differed significantly across home and school environments. Adult word counts were negatively related to child vocalization counts; however, conversational turns positively predicted the number of child vocalizations per 15 min interval. These results contribute to the limited research on sequential bilinguals’ development of typical home and community language use.
CHAPTER 1

INTRODUCTION

According to the 2006 American Community Survey from the United States Census Bureau, 34,547,077 people speak Spanish as their primary, home language. More than half of these individuals live in Florida, Texas, or California. Moreover, 25% of preschoolers in the United States are of Latino origin; 75% speak Spanish as their first language (National Task Force on Early Childhood Education for Hispanics, 2007). In the United States, it is often the case that a child’s first formal exposure to English is upon school entry. The onset of second language acquisition generally classifies a child as a simultaneous or sequential bilingual. Simultaneous bilinguals begin learning their languages at the same time from birth. For example, the father speaks English and the mother speaks Spanish (Barron-Hauwaert, 2004). In contrast, sequential bilinguals learn their languages in tandem. For example, the child learns his first or home language (L1) and then adds a second language (L2) upon entry into school (Thompson, 2000). The majority of bilingual children in the United States are sequential bilinguals, whose L1 is a minority, non-English, language (Bedore & Leonard, 2001; Gutierrez-Clellen, 1996; Restrepo & Gutierrez-Clellen, 2001; Restrepo et al., 2010) with L2 beginning at school.

Early identification of language-learning difficulties has been shown to help young bilinguals succeed in their language proficiencies in the United States. Language disorder versus language delay (or difference) is not widely understood, particularly in early sequential bilinguals under age 5 (Crutchley, Conti-Ramsden, & Botting, 1997; Gabini et al., 2009), for multiple reasons. First, there are, limited normative data regarding the trajectory of typical language development in this population (Bedore & Peña, 2008). Second, the quantity and quality of assessment measures, especially for young bilingual children, is limited and further complicated by the limited numbers of professionals competent to administer measures with sensitivity to a child learning two languages. Further, young bilinguals fluctuate in their language abilities due to differences in use and exposure to each language (Anderson, 1999). These within- and between-subject differences present a challenge in finding the best ways to measure...
early sequential bilinguals’ language abilities, to map typical language acquisition trajectories across languages, and to define characteristics of language impairment in this population.

**Limitations of the Research on Typical Bilingual Language Developmental**

Longitudinal studies of typical language development of L1 and L2 in sequential bilinguals of any age are sparse (Genesee, 2008), particularly in preschool-age children who acquire their L1 and L2 at different ages in different settings (Genesee; Kohnert, Yim, Nett, Kan, & Duran, 2005). The general understanding of how preschoolers acquire L2 is extremely underdeveloped. Studies have aggregated data regarding preschool sequential bilinguals with data concerning simultaneous bilinguals (e.g., Gutierrez-Clellen, Wagner, & Simón-Cereijido, 2008) or with data on school-aged children. For example, in one of the earliest studies of bilingual children that included simultaneous and sequential bilinguals, Padilla and Lindholm (1976) observed 19 Spanish-English bilinguals’ development of interrogatives, adverbs, and adjectives through spontaneous language samples of each child. Participants ranged in age from 2; 10 to 6; 2. The investigators determined the children were acquiring each language separately without transferring grammatical structures between languages or cross-linguistic interference. Although these results advanced knowledge of young children acquiring a second language, they did not discriminate between early sequential and simultaneous acquisition of two languages.

Unsworth (2005) highlighted this discrepancy in her comprehensive review of literature since 1995 regarding second language acquisition. The 40 studies she reviewed from 1995 to 2005 did not observe the children’s L2 development until after age 5, albeit their exposure to L2 may have occurred before age 5. She concluded that researchers still do not know if L2 acquisition in children younger than 5 years parallels L1 acquisition, or how it might differ (Unsworth).

Genesee, Paradis, and Crago (2004), Goldstein (2004) and Oller and Eilers (2002) have contributed summaries of typical language developmental trends in both sequential and simultaneous bilinguals. These works concern patterns of growth in semantics, morphosyntax, narratives, and literacy skills in these populations. More longitudinal studies are needed to understand the development and interplay of young sequential bilinguals’ two languages, particularly studies examining language use of L1 and L2 in the natural environment (Bedore & Peña, 2008). Only after this is better understood, can clear clinical markers of atypical development begin to be identified.
**L1 and L2 Fluctuation**

The stability of L1 is a concern in younger children, especially preschool age, who are acquiring L2 sequentially (Genesee, 2008; Kohnert et al., 2005). Sequential bilingual preschoolers still are developing proficiency in their native language while beginning to acquire a second language. Research on sequential bilinguals attending English-only programs in the United States demonstrates that gradually these children’s dominant language shifts from their home language to English, leading to loss of their home language as their English strengthens (Anderson, 2004; Kohnert & Bates, 2002). Researchers have presented several variables to explain this shifting, such as exposure to English at a young age and amount of community support for L1 (Winsler, Díaz, Espinosa, & Rodríguez, 1999). Thus, young bilinguals under 5 years of age entering English schools are at-risk for language loss in their L1 (Kan & Kohnert, 2005; Lambert, 1975; Leseman, 2000; Montrul, 2002; Schaerlaekens, Zink, & Verheyden, 1995; Páez, Tabors, & López, 2007; Tabors, Páez, & López, 2003). “When a child loses the home language, a parent can no longer offer this language education to the child in that language. Important cognitive scaffolding is dismantled” (Baker, 2006, p. 131).

**Theoretical Perspectives of Bilingualism**

*Role/importance of L1 in L2 acquisition.* The Developmental Interdependence Hypothesis states a child’s L2 competence partly depends upon his L1 competence. The more developed the L1 is, the easier it is to acquire L2 (Cummins, 1978, 2000a, 2000b; Huguet et al., 2000; Kohnert & Derr, 2004; Oller & Eilers, 2002; Proctor, 2003). One predictor of L2 proficiency in the United States is the amount of formal education in L1. Longitudinal studies of U.S. schools revealed that sequential bilinguals exclusively educated in English (L2) without any L1 accommodations took 7-10 years longer to attain the language proficiency of their native English speaking peers (Collier, 1995). Castilla, Restrepo, and Perez-Leroux (2009) discovered a relationship between L1 and L2 development in 49 sequential bilinguals attending a monolingual English preschool. The children’s L1 grammatical and semantic skills significantly predicted their L2 grammatical and semantic skills 9 months later.

*The age factor: L1-L2 years of exposure.* The relationship between the age of acquisition of a second language and acquiring proficiency in that language is a debated topic. One argument states the younger the child begins learning the second language, the more proficient he will be in that language in the long-term (often referred to as the “critical period hypothesis”). “For
young children, a new language is caught rather than taught; acquired rather than learned” (Baker, 2006, p. 128). Other scholars counter that young adults and older children can learn a second language much more efficiently and quickly than young children, because they possess metacognitive abilities to think about and process the two languages at much higher cognitive (metalinguistic) level than a young child (Kohnert et al., 2005). Several works support these findings, such as Cobo-Lewis, Eilers, Pearson, and Umbel, 2002; Genesee and colleagues, 2004; and Gutierrez-Clellen, 1999.

Marinova-Todd and colleagues (2000) identified age as a mediator variable that influenced second language learning because of its association with social, psychological, and educational factors that can affect a child’s L2 proficiency.

The evidence for a critical period for second language acquisition is scanty, especially when analyzed in terms of its key assumptions. There is no empirically definable end point, there are no qualitative differences between child and adult learners, and there are large environmental effects on the outcomes...The view of a biologically constrained and specialized language acquisition device that is turned off at puberty is not correct. (Hakuta, 2001, p. 11-12)

Consequently, rather than supporting a critical period of L2 acquisition, researchers now talk about “optimal periods” for L2 acquisition (i.e., early childhood and elementary/secondary education), with the focus changing to language usage (Marinova-Todd et al.).

Assessing Language Development in Bilingual Children

Expanding the knowledge base for sequential language learners necessitates accurate and appropriate measures of language development. A brief review of the current tools and challenges with measurement follows.

Norm-referenced assessments. Standardized assessments are important tools that clinicians and researchers utilize in the identification of typical language development and language impairments. They allow for comparison of participant scores by employing uniform implementation and scoring procedures. Standardized assessments can include norm-referenced or criterion-referenced tests (Bond, 1996). Norm-referenced tests are designed to indicate how a child is functioning relative to norms. In the United States, early sequential bilinguals typically begin learning their second language (L2), English, when they enter a formal education program, around 3-6 years of age. Children are often assessed upon entry to determine if they have a
language disorder or qualify for additional services (e.g., bilingual education). In the past, educators assessed bilinguals only in L2, English, without accounting for L1, which created the possibility for under- and over-diagnosis of a language disorder (Espinosa, 2005). Even assessing a child in both languages has the potential to result in an improper diagnosis because of limitations of current assessment tools (Espinosa). Early sequential bilinguals are at a particular risk for being misdiagnosed with a language disorder by assessment tools that do not contain appropriate clinical markers for language impairment in a bilingual population.

As noted, a major challenge to assessment of bilingual children’s language ability is the availability of reliable and valid assessments in L1. To address this need, two common recommendations for the assessment of bilingual children have been translating tests for adaptation in the child’s L1 and developing local norms (Stow & Dodd, 2003; Taylor & Payne, 1983). Test translations assume that language development in L1 follows the same developmental path as L2 and that L1 and L2 share the same clinical markers of language impairment (Bedore & Peña, 2008). However, results have not supported this assumption. For example, the first version of the *Preschool Language Scale-3, Spanish Edition* (SPLS-3; Zimmerman et al., 1993) was normed on an English-speaking population and translated into Spanish. Restrepo and Silverman’s (2001) analysis revealed the translated items had disparate difficulty levels. Auditory Comprehension No. 36’s vocabulary was too high-level for children of Hispanic origin who may not have had experience with words such as parachute or wheelbarrow. English prepositions, which are bound morphemes (‘s), develop earlier than Spanish prepositions, which are free morphemes (de + noun). Additionally, the scoring does not include articles or clitic markers shown to be challenging for children with language impairment learning Spanish and other romance languages (Bedore, 2001; Bedore & Leonard, 2005), resulting in compromised accuracy of diagnosing language impairment. Experts in the field have cautioned that translated measures inappropriately compare a bilingual to a monolingual norm by presuming that a bilingual’s languages develop in the same order as a monolingual’s (Bedore & Peña; Espinosa, 2005). For further evidence, the reader is referred to Bedore & Peña, Caesar & Kohler (2007), Saenz & Huer (2003), and Stubbe & Peña (2002).

Many assessments normed on U.S. demographics contain bias toward bilinguals with different demographic and socioeconomic backgrounds from the normative sample (Campbell, Dollaghan, Needleman, & Janosky, 1997; Dollaghan & Campbell, 1998). The assessments’
parameters (i.e., standard scores, standard deviations, and ranges of normality) are based upon the normative sample. Thus, children whose demographics, such as language background, SES, and years of education, differ from the normative sample are misrepresented. This distortion can result in an improper diagnosis based upon assessment tools (Bedore & Peña; Crutchley et al., 1997; Gabini et al., 2009) that are sensitive and specific to markers of clinical impairment in the normative sample, not the target population.

This bias is particularly noteworthy for bilingual children from families of lower SES whose parents completed 11-years and fewer of schooling. Traditional bilingual assessments are normed on middle SES families speaking a majority language and who are geographically stable. They do not account for transient families who migrate to different cities and states with the seasons or the effect this translocation has on their child’s two languages and language development. Children who are unaccustomed to the mainstream culture and testing protocol also may perform poorly on assessments due to sheer lack of experience with test-taking procedures (Paradis, Crago, Genesee, & Rice, 2003). New measures, such as the Primary Test of Nonverbal Intelligence (PTONI; Ehrler & McGhee, 2008) the Clinical Evaluation of Language Fundamentals Preschool – Spanish Edition (CELF Preschool-2 Spanish; Wiig, Secord, & Semel, 2009) have shown more resiliency in this area. The majority of their normative sample represented parent education of 11 years or fewer.

Currently, researchers are working to define clinical markers of language disorder in this population (Conti-Ramsden, 2003; Plante, 2004; Rice & Wexler, 2001) through observational studies of young bilinguals’ language use in various environments. These studies hold great promise of developing better standardized measures for bilingual children.

Nonverbal assessments. In an effort to accommodate a bilingual’s language differences, researchers are more commonly using nonverbal assessments to measure a bilingual’s processing abilities without specific language content. Cognitive processing measures such as non-word repetitions and rapid automatic naming tasks are more commonly used as tools to differentiate children with language delays and disorders (Campbell, Dollaghan, Needleman, & Janosky, 1997; Vaughn et al., 2006). Cummins (1984a) and Baker (2006) posited that a bilingual’s core cognitive abilities are as, if not more, important than his language abilities. For example, bilingual children frequently score higher on the Performance subtest of the Wechsler Intelligence Scale for Children: Revised (WISC-R, Wechsler, 1974) or the PTONI (Ehrler &
McGhee, 2008) than on the verbal subtest. They possess the cognitive skills to understand and process language, they just may not have adequate grasp of English (L2) to portray it verbally (Baker, 2006).

**Parent/Caregiver reports.** Gathering information from parents and teachers can be an important complement to standardized assessments. These measures, including caregiver checklists, interviews, and questionnaires, are useful to gather information about a family’s culture, language background, and perspectives on their child’s language development. Clinicians and researchers utilize parent report. While limited at this time, data are emerging on the potential of caregiver report information for assessing bilingual children. In one example, Guiterrez-Clellen and Kreiter (2003) sampled 57 children in second grade who were of Mexican descent. Analysis of children’s spontaneous narratives revealed the amount of Spanish input children received significantly predicted 35% of the variance in Spanish grammatical performance $F (7,45) = 5.62, p = .001$, although not in English. Moreover, the child’s grammatical performance in Spanish correlated with parent ($r = .75, z = 6.45, p < .001$) and teacher reports ($r = .35, z = 2.41, p < .05$) of the child’s Spanish grammatical skills. English ratings demonstrated similar results. Parent reports of their child’s English grammatical performance were $r = .32, z = 2.18, p < .05$ and teacher reports were $r = .61, z = 4.68, p < .001$. Teachers’ ratings of the children’s English proficiency were correlated at $r = .44, z = 3.12, p < .005$, suggesting parent and teacher reports of estimates of each language might help determine bilingual status.

**Language samples.** A further option for assessing language is obtaining a language sample of the child. Observational language sampling is a common research and clinical tool, but one that is resource intensive requiring transcription and analysis of the child’s sample by trained personnel. Strategies to reduce the costs of language sampling have been developed. The *Early Communication Indicator* (ECI; Luze et al., 2001) is an example of a standardized measure that gathers a brief 6 min spontaneous language sample of a child during play. The purpose of the measure is not for identification of a language delay or disorder. This measure compares a child’s performance on a particular skill (e.g., number of gestures, single or multiple words) to developmental data to monitor a child’s language growth across time. Studies are currently evaluating the utility of the ECI for the expansion of information on typical bilingual trajectories.
To date, language sampling at home and in classrooms has been restricted in length, location, and form (Warren et al., 2010). One technology option for increasing language sampling is the use of the Language Environment Analysis (LENA) system that permits day-long language samples of a child in the natural environment with a small digital recording device. The portability of the device, which fits into a small pocket of clothing the child wears, permits little to no disruptions in the child’s daily activities while data are collected. Moreover, the LENA computer software automatically analyzes the recordings regarding the verbal input the key child receives (i.e., the child wearing the device), the child’s vocal counts, and the turn-taking exchanges between the child and adults (Xu et al., 2008a). The automatic generation of the count estimates is based upon each segment’s acoustic features. This software has the capability of revealing numeric differences in frequency of adult-child interactions, thereby offering window into natural family life, culture, and interactional styles. However, transcription is required for more detailed analysis of the forms and functions of the language collected. The Infoture Natural Language Study (Gilkerson & Richards, 2008) collected data on 329 children with typical development from monolingual, English-speaking families in the Denver, Colorado area. The longitudinal study occurred in two phases. Phase I recruited families of children 2-36 months and ages 37-48 months. Sixty-five of these children and families continued participation into Phase II, which collected normative data on children up to age 48 months. Approximately eight children per each month of age, 2-36 months, and 15 children, 37-48 months, were included in this study. Infoture matched its normative sample on the U.S. population’s demographics for mother’s level of education: Some high school, 22%, high school diploma without college, 26%, some college, 29%, bachelor’s degree or higher, 23%. In addition, a certified speech-language pathologist evaluated all but 16 participants with the following measures within a 2-week window of their recording: Receptive Expressive Emergent Language Test-3, Preschool Language Scale-4, Cognitive Adaptive Test/Clinical Linguistic and Auditory Milestone Scale, Peabody Picture Vocabulary Test, Goldman-Fristoe Test of Articulation, and Bayley Scales of Infant and Toddler Development. Due to time constraints or the age of a child, not all tests were administered (Gilkerson & Richards). Each month, participants created a consecutive, 12-hour recording within a single day for up to 7 months. Results demonstrated that adult word counts did not significantly correlate with age $r(327) = .04, p = .47$. Therefore, LENA did not make any adjustments to norms for adult word counts. Contrastingly, conversational
turns significantly increased with age per month, $r(327) = .51, p < .01$. The frequency of child vocalization counts also increased with age per month, $r(327) = .61, p < .01$. The increase in child vocalization counts and conversational turn counts is assuring for the construct validity of LENA. Infoture’s current study made one of the first attempts to compile and analyze day-long, language samples of young children. Replication studies using LENA need to be conducted in order to identify any atypical findings in the results.

Warren and colleagues (2010) employed LENA to contrast the automated measures (i.e., child vocalization counts, adult word counts, and conversational turn counts) in 78 children with typical development with 26 children with autism spectrum disorders (22 male, 4 female; ages 16-48 months; $M = 30.2$, $SD = 8.5$). The data of the children with typical development came from LENA’s Natural Language Study, previously described (Gilkerson & Richards, 2008), and were matched to the sample of the children with autism on demographic characteristics, length of the recording period, and chronological age (Warren et al.). Because LENA is not sensitive to linguistic complexity (see method section), children with autism exhibiting echolalia were excluded from this study. In addition, children with high language abilities, who might later be diagnosed with Asperger’s, were excluded from the study. Families created 8 day-long (16-hour) recordings over 7 weeks. Home was the primary context of the recordings, although for 14 participants with autism, recordings did occur on therapy and non-therapy days. Results did not reveal differences in therapy and non-therapy days for all measures, although child vocalization counts, $F(1,13) = 6.39, p = .03$, adult word counts, $F(1,13) = 9.35, p < .01$, and conversational turn counts, $F(1,13) = 8.84, p = .01$, significantly increased during therapy sessions. The authors then compared the daily estimates of child vocalization, adult word, and conversational turn counts of the children with autism to the daily estimates of the children with typical development. The groups did not significantly differ on adult word counts, $t(102) = 0.61, p = .54$. But, the children with autism engaged in significantly fewer conversational turns, $t(102) = 2.85, p < .01$ and demonstrated significantly fewer child vocalization counts, $t(102) = 3.56, p < .01$. The current study’s findings show significant increases in adult word counts, conversational turn counts, and child vocalization counts of the children with autism during intervention sessions. The significant group differences between the children with autism and typical development could be due to the way the samples were matched. Only a subset of children with autism was matched on chronological age to the children with typical development. Other
limitations include the present state of LENA’s automated vocal analysis, namely, its inability to code nonverbal behaviors (e.g., eye contact, gaze-point-follow, joint attention) that are central measures of social-communication skills, a core diagnostic feature of autism (American Psychiatric Association, 2000).

The application of LENA to bilingual assessment is limited at this time. The LENA Foundation (2008) conducted a study of 20 children (2-36 months) from monolingual Spanish-speaking families residing in the United States. Once a month for 6 months, a natural language sample was taken of the children using the LENA software (LENA Foundation, 2008). Estimated adult word counts ($M = 1336, SD = 920$) across a 12-hour day did not significantly differ from the hand transcribed adult word counts ($M = 1511, SD = 959$), $t(11) = 0.82, p = .43$. The two methods’ counts were correlated at $r(10) = .69, p = .01$ for estimation of adult word counts.

Infoture’s technology has been proposed to contribute to the limited normative data regarding the developmental trajectories of early sequential bilinguals, particularly in both languages, by examining a child’s natural language use across a single day or across months or years; however, published studies are not available. LENA characterizes language development according to its automated measures. In turn, researchers can compare these measures to established measures to determine their relationship. Studies of this nature using LENA are warranted. Further explanation of the LENA system and software is included in the method section.

Cultural Differences in the Importance of Talk

Cultures differ in the significance they place on children’s verbal abilities, specifically the amount of child talk they value, the language strategies adults use to teach their children various skills, and the way children use language to express their knowledge and understanding (van Kleeck, 1994). The past two decades have demonstrated the influence of adult talk on child language development (Chapman, 2000; Hart & Risley, 1995; Huttenlocher, Haight, Bryk, Selzer, & Lyons, 1991; Rowe, 2008) and have increased the interest of assessment within the natural environment with the child’s typical communication partners. American mainstream culture places great value on child talk. Parents are the primary caregivers who employ a variety of teaching strategies to promote their child’s language growth (Chapman, 2000). For example, they converse with their newborns, respond to their young child’s initiations and gestures,
initiate talk, and encourage imitation (Chapman; van Kleeck). The rates of adult talk to children, child vocalizations, and parent responsivity to their child’s vocalizations predict more speedy acquisition of vocabulary (Huttenlocher et al.; Tamis-LeMonda, Bornstein, & Baumwell, 2001).

Little recent research exists on mother-child interactions in first-generation, Hispanic children, particularly families of low SES, living in the United States despite the growing population. Eisenberg (2002) investigated the effects of mother-child interactions in 20 women of low SES and 20 women of middle SES and their 4-year-old children. The mothers were of Mexican descent, born in the United States and living in San Antonio, Texas. The sessions were tape recorded during home activities of building blocks and making biscuits. Mothers’ mean education in years was 15.0 (SD = 1.9) and 11.4 (SD = 1.1) for middle and low SES, respectively, $p = .000$. Coded behaviors included complexity of utterances. Low complexity referred to labeling, describing, or demonstrating an act. Intermediate complexity included sequences, recall or comparisons. High complexity utterances involved evaluation, planning, and inferences. Results revealed mothers of low SES used less positive feedback, $F(1, 38) = 8.21, p < .05$, less intermediate talk, $F(1, 38) = 8.91, p < .05$, and less high-complexity talk, $F(1, 38) = 9.79, p < .05$, than mothers of middle SES. Additionally children of low SES were more directive, $F(1,38) = 8.60, p < .05$, and asked more questions, $F(1,38) = 8.85, p < .05$, than did children of middle SES families. This study offers insights into differences in quality of parent-child interactions among families of low and of moderate SES. In addition to measuring maternal behaviors, Eisenberg recommended that future studies of this population measure adult speech, child speech and the effect of each on parent-child interactions. The past decade has evidenced increased interest to investigate bilinguals’ language use to contribute to descriptions of their developmental trajectories yet a dearth of developmental patterns of typical home and community language growth exists. This is particularly evident concerning preschoolers “who begin learning two languages at different ages and in different contexts” (Kohnert et al., 2005, p. 251). While progress has been made, sample sizes are small and homogeneous occurring primarily in the classroom or clinic. Group studies analyzing sequential bilinguals language samples are needed to inform knowledge of bilingual language development in both languages across time as “the appropriate reference group for a bilingual child is other children learning language in the same or similar type of bilingual language context” (Bedore & Peña, p. 19).
Statement of the Problem and Research Objectives

Information on language development of early sequential bilinguals (within and across children) is lacking (Kohnert & Danahy, 2007). Most studies about childhood bilingualism have focused on middle SES families speaking a majority language, the sample on which most normative measures are based. Children with different demographic backgrounds from this normative sample are at risk of being misrepresented, which could lead to incorrect diagnosis based upon assessments (Bedore & Peña; Crutchley et al., 1997; Gabini et al., 2009) that detect clinical impairment in the normative sample rather than the target sample. Very limited data are available on children at risk for language delay due to the environmental conditions of low SES, parental education level under grade 11, and migrant worker status. Therefore, it is important to study language use in children of families of low SES to identify milestones of both typical language development and markers of clinical impairment. The benefit of language sampling in the natural environment is that it decreases concerns about the results’ external validity, whether the findings generalize to daily life (Kazdin, 2003). In turn, these observations will offer insight into participants’ performances on current monolingual and bilingual measures. The use of LENA technology was explored as a potential tool to help researchers obtain extended language samples in natural environments including education programs and homes.

The purpose of this study was to examine language use of 3-and 4-year-old sequential bilinguals of families of low SES, in the natural environment across a single day via LENA technology and to compare these samples to standardized measures of language.

Specific research questions include:

1. Are there differences in LENA child vocalization counts, adult word counts, and conversational turn counts observed in relation to 3- and 4-year-old sequential bilinguals across home and school contexts? Based upon previous research and theories, children were hypothesized to vocalize more and to engage in more conversational turns at home than at school. Adult word counts were hypothesized to be greater at home than at school.
   a. Are there differences in child vocalization counts by gender?
   b. What are the descriptive statistics of child vocalization counts across contexts?
   c. Are there differences in adult word counts across contexts?
   d. Are there differences in conversational turn counts across contexts?
   e. What are the differences in recording durations across participants?
2. Do home and school contexts, adult word counts, conversational turns, and age significantly relate to LENA child vocalization counts per 15 min across a single day? The researcher hypothesized that these parameters would relate to child vocalization counts at home.

3. What is the correlation between each of the following assessments and child vocalization counts over and above the conditional model specified in Question 2? The researcher hypothesized that the CELF-P2 Spanish and the PTONI would significantly correlate to child vocalization counts.
      i. Core Language Score
      ii. Expressive Language Index
      iii. Receptive Language Index
   b. *Test of Vocabulario Imagenes* (TVIP; Dunn, Lugo, Padilla, & Dunn, 1986)
   d. *Primary Test of Nonverbal Intelligence* (PTONI; Ehrler & McGhee, 2008)
      i. Core Language Score
      ii. Expressive Language Index
      iii. Receptive Language Index

4. What is the contribution of each aforementioned assessment over and above the conditional model specified in Question 2? The researcher hypothesized that the CELF-P2 Spanish and the PTONI would significantly relate to child vocalization counts.

5. How do the child-vocalization-count, adult-word-count, and conversational-turn-count patterns vary across the day in 15 min intervals?
6. Do child vocalizations differ across 15-min and 1-hour intervals throughout the day at home and school?
CHAPTER 2

METHOD

The methods described in this chapter were developed to study child language use in the natural environment.

Participants

Participants included 35 children (ages 37 to 59 months) attending a preschool or Head Start program in Gadsden County, Florida, that served economically disadvantaged children. All participants qualified for free and reduced lunches. The participants were identified from preschools and Head Start programs serving bilingual children in the Panhandle region. All contacted schools agreed to participate and provided verbal or written permission to the researcher. The researcher then met face-to-face with ten teachers from three schools to describe the study. Two of the ten teachers were bilingual. However, English served as the language of instruction in all classrooms. The bilingual teachers stated, and classroom observations affirmed, that they primarily spoke in English to their students.

Teachers identified children who met the following selection criteria: (1) L1 was Spanish and L2 was English; (2) children were 3- or 4-years-old; (3) children presented with limited receptive and expressive language in English; (4) teachers and parents expressed no concern about the child’s development in L1 according to the Parent-Teacher Questionnaire and the Ages and Stages Questionnaire Spanish version (ASQ Spanish; Bricker & Squires, 1999); (5) children were within normal limits for their developmental age on the ASQ Spanish and the MacArthur-Bates Communicative Development Inventory, Spanish Version (CDI Spanish; Jackson-Maldonado et al., 2003); (6) children passed a pure-tone hearing screening at 25dB HL within the school year (ANSI, 1989); (7) children lived within a 40-mile radius; and (8) children did not have additional medical diagnoses involving neurological impairments (e.g., syndromes).

One parent declined participation, and one child did not complete the study prior to moving. Table 1 includes descriptive demographics of the participants.
Procedures

The researcher contacted the parents of the identified children to explain the study. Both oral and written contacts by the researcher were conducted in the family’s primary language, Spanish. After granting consent, (see Appendices A, B, and C) families then completed the Parent-Teacher Questionnaire (see Appendix D) and the ASQ Spanish (Bricker & Squires, 1999) with the researcher to gather a history of the child’s language background, use, and global development. The researcher sent the CDI Spanish (Jackson-Maldonado et al., 2003) home for the caregiver(s) to complete during the assessment period for each child. The researcher met in person or phoned caregivers who did not read to complete the forms together. Parents reported they perceived their children’s Spanish receptive and expressive language skills to be typical, reflecting no parent concern. Accordingly, all children scored within normal limits on the ASQ Spanish and CDI Spanish.

Children were given a battery of standardized measures to assess their expressive and receptive language and nonverbal understanding (see Table 2). Spanish assessments of vocabulary and global language development were not direct translations of the English assessments; they were normed on a Spanish or bilingual Spanish-English population. Still, the order of administration of Spanish and English assessments was counterbalanced to control for possible language effects. Each child underwent a maximum of 60 min of testing per day to prevent fatigue. Total assessment time ranged from 3-4 hours per child. Each child’s assessments were completed within a 2.5 week timeframe.
Table 1

Summary of Participant Demographics (n=35)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents’ education in years completed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother ($M, SD$)</td>
<td></td>
<td>8.03</td>
<td>2.88</td>
</tr>
<tr>
<td>Father ($M, SD$)</td>
<td></td>
<td>7.73</td>
<td>3.11</td>
</tr>
<tr>
<td>Parents who reported being able to read in Spanish (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td></td>
<td>91.4</td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td></td>
<td>88.6</td>
<td></td>
</tr>
<tr>
<td>Child age in months ($M, SD$)</td>
<td></td>
<td>49.90</td>
<td>6.79</td>
</tr>
<tr>
<td>Females (%)</td>
<td></td>
<td>69.7</td>
<td></td>
</tr>
<tr>
<td>Older siblings&lt;sup&gt;a&lt;/sup&gt; (%)</td>
<td></td>
<td>54.3</td>
<td></td>
</tr>
<tr>
<td>Child’s exposure to English in months&lt;sup&gt;b&lt;/sup&gt; ($M, SD$)</td>
<td></td>
<td>6.65</td>
<td>7.17</td>
</tr>
<tr>
<td>Teachers’ education in years completed</td>
<td></td>
<td>16.18</td>
<td>1.97</td>
</tr>
<tr>
<td>Bilingual teacher&lt;sup&gt;c&lt;/sup&gt; (%)</td>
<td></td>
<td>52.2</td>
<td></td>
</tr>
<tr>
<td>Birth Place (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA (%)</td>
<td></td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Mexico (%)</td>
<td></td>
<td>80.0</td>
<td>74.3</td>
</tr>
<tr>
<td>El Salvador (%)</td>
<td></td>
<td>20.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Honduras (%)</td>
<td></td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Guatemala (%)</td>
<td></td>
<td>0.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*Note*: <sup>a</sup>Percentage of children who were not first-born  
<sup>b</sup>Measured from when child first entered school.  
<sup>c</sup>Percentage of students with a teacher fluent in Spanish and English.
Table 2

Summary of Developmental Characteristics (n=35)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Language</th>
<th>M =100</th>
<th>SD =15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in months (M, SD)</td>
<td></td>
<td>49.90</td>
<td>6.79</td>
</tr>
<tr>
<td>PTONI&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Nonverbal</td>
<td>97.88</td>
<td>12.98</td>
</tr>
<tr>
<td>TVIP&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Spanish</td>
<td>81.72</td>
<td>13.27</td>
</tr>
<tr>
<td>PPVT-4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>English</td>
<td>60.36</td>
<td>22.12</td>
</tr>
<tr>
<td>CELF-P2 Spanish&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Spanish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core Language Score</td>
<td></td>
<td>91.91</td>
<td>10.62</td>
</tr>
<tr>
<td>Receptive Language Index</td>
<td></td>
<td>95.22</td>
<td>11.82</td>
</tr>
<tr>
<td>Expressive Language Index</td>
<td></td>
<td>91.95</td>
<td>10.99</td>
</tr>
<tr>
<td>CELF-P2&lt;sup&gt;e&lt;/sup&gt;</td>
<td>English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core Language Score (n =21)</td>
<td></td>
<td>61.62</td>
<td>14.19</td>
</tr>
<tr>
<td>Receptive Language Index (n =30)</td>
<td></td>
<td>57.76</td>
<td>21.86</td>
</tr>
<tr>
<td>Expressive Language Index (n =18)</td>
<td></td>
<td>65.16</td>
<td>13.68</td>
</tr>
</tbody>
</table>

Note: Language - Language of administration. All assessments report standard scores based on a M of 100 and a SD of 15. <sup>a</sup>Primary Test of Nonverbal Intelligence ;<sup>b</sup>Test of Vocabulario Imagenes ;<sup>c</sup>Peabody Picture Vocabulary Test, Fourth Edition ;<sup>d</sup>Clinical Evaluation of Language Fundamentals Preschool, Spanish Edition ;<sup>e</sup>Clinical Evaluation of Language Fundamentals Preschool, Second Edition .
Language Environment Analysis. Families and classroom teachers created a 10-16 hour audio recording using a data collection instrument called the LENA system within 2.5 weeks of the assessment battery. LENA is a commercial tool that caregivers, doctors, teachers, speech-language pathologists, and researchers can employ to gather information regarding a child’s language(s) in his natural environments and his language development. The system contains a digital language processor (DLP) and language analysis software. Children wear this lightweight (2.5 ounce) DLP in a front pocket of custom-designed clothing. The DLP records a continuous 16-hour, natural language sample of the child’s vocalizations and language environment within a 4-6 foot radius. A USB connection transfers the completed audio recordings from the DLP to a computer for acoustical analyses by the LENA software (Ford et al., 2008). The software uses a Gaussian mixture model approach. Speech recognition algorithms differentiate speech (e.g., words and vocalizations) from non-speech (e.g., background noise) and calculate the number of child vocalizations, adult word counts and conversational turns. Xu and colleagues (2008a) offers a more detailed explanation of this Gaussian mixture model approach.

While processing, LENA segments the audio stream into variable length sound sections. It classifies each section segment as one of nine “segment” types given its statistical similarity to analogous pre-defined sound source models: Key Child, Other Child, Adult Female, Adult Male, Overlap, Noise, Electronic Media (e.g., TV/radio), Silence, and Unclear. Key Child segments are further analyzed into speech related utterances (e.g., real speech and babbling) from non-speech, vegetative sounds (e.g., cries, breathing, etc.). Further processed Adult Male and Female segments estimate the number of adult words by gender in each segment. These frequency estimates are not derived from the identification of individual words but from acoustic-signal properties, including algorithm-identified vowel count, consonant count, and utterance duration. Finally, LENA estimates conversational turn count through analysis of consecutive sequences of identified key child and adult segments (Xu et al., 2008b).

Results generate five core reports: child vocalization counts, adult word counts, conversational turn counts, audio environment counts, and TV and electronic sound counts. These are accessed and in 15-min, half-hour, hourly, daily or monthly views. The current study used the frequency of child vocalizations, adult word counts, and conversational turns in 15 min intervals.
Estimates of child vocalizations. This measure estimates the frequency and duration of each key-child vocalization. Child vocalizations are meaningful speech (e.g., vocalization or words) of varying length divided by 300 ms of a different sound type (e.g., another person’s vocalizations, TV or radio, noise, or silence; Oller, 2000). These do not include fixed-signal sounds, such as cries, screams, or vegetative sounds (e.g., breathing, burping). It is important to note that the frequency of child vocalizations can vary greatly at times. For example, if a child says, “ma,” the utterance is counted as a single vocalization. Likewise, if the child says “mamamama” or “Mommy, I want a ball” without marked between-word pauses, LENA also counts these as one vocalization. Consequently, this estimate of child vocalization does not yield a direct measure of utterance complexity.

Estimates of adult word counts. Once LENA identifies segments of adult speech, it further analyzes the acoustic features of the speech signal to derive an estimate of the number of adult words in each segment. As previously discussed, the processed algorithms do not identify specific words, rather estimate a statistically modeled word frequency. Reliability analyses indicated LENA’s estimated adult word counts closely match human transcribers’ estimates (see below).

Estimates of conversational turns. Conversational turns are defined as a chain of speech-related sound segments between adult (male or female) and the key child. Within these utterances, a conversational turn includes no more than 5 s of intervening non speech-related segments (e.g., silence, noise, media sounds) and no superseding vocalizations from a different child or adult. Therefore the conversational turn count is a measure of adult-child interactions.

The LENA Foundation’s reliability and validity. Xu and colleagues (2008a, b, c) and Christakis et al. (2009) reported on the reliability and validity of the LENA’s automated measures included in the present study, specifically child vocalization counts, adult word counts, and conversational turns. In order to evaluate LENA’s segmentation accuracy, a team of professional transcribers reviewed and transcribed seventy, 12-hour, adult-child audio recordings. Specifically, six nonadjacent 10-min segments containing high adult-child activity of each child were automatically pre-selected for transcription. Transcribed samples included two children per age group (2-36 months), totaling seventy audio recordings. Transcribers were trained to identify the nine aforementioned segment types, as well as differentiation of the infant and child sounds (Oller 1980; van der Stelt, 1993).
To determine inter-rater reliability, each professional transcribed the same three, 10-min segments from each of two different recordings. Agreement rating for the identification of speaker (i.e., adult versus non-adult; key child versus non-key child) using the coefficient kappa (Cohen, 1960) were .64 to .90 (Xu et al., 2008a). LENA’s automated system correctly identified 82% of the utterances transcribers labeled Adult Speech and 76% of the utterances labeled Child Vocalizations.

Additionally, the LENA Foundation (2008) tested their system’s reliability in Spanish on 20 children (2-36 months) from monolingual Spanish-speaking families residing in the United States. Estimated adult words counts in day-long recordings did not significantly differ from the hand transcribed adult word counts $t (11) = 0.82, \ p = .43$. The two methods’ counts were correlated at $r (10) = .69, \ p = .01$. The LENA addressed Research Questions 1-4. For more information please visit: www.lenafoundation.org.

*Peabody Picture Vocabulary, Fourth Edition.* The PPVT (Dunn & Dunn, 2007) is a norm-referenced measure of a child’s receptive vocabulary in English for ages 2;6-90 years. The normative samples consists of data from 3,540 people from the United States matching the current U.S. population parameters of sex, race/ethnicity, geographic region, SES, and clinical diagnosis or placement in special education. This measure takes approximately 10-15 min to administer. Split half reliability by age for Form A and Form B, respectively was $M = .94 (SD = 3.6); M = .94 (SD = 3.6)$. This measure addressed Research Questions 3 and 4. For more information please visit: http://www.pearsonassessments.com/pdf/pubsum/ppvt4.pdf.

*Test of Vocabulario Imagenes.* The TVIP (Dunn, Lugo, Padilla, & Dunn, 1986) is a norm-referenced measure of a child’s receptive vocabulary in Spanish for ages 2;6-17;11 years. Founded on the PPVT, the TVIP selected and translated 125 words that were universal and appropriate to Spanish-speaking people. The normative sample consisted of 2,707 monolingual, Spanish-speaking students from Mexico and Puerto Rico. This measure takes approximately 10-15 min to administer. Weighted scores were used to correct the uneven SES distribution according to the U.S. census. Median reliability was .93. Reliability for ages 3-3;11 was .91 and for ages 4-4;11 was .94. This measure addressed Research Questions 3 and 4. For more information please visit: http://www.pearsonassessments.com/technical/tvip.htm.

*Clinical Evaluation of Language Fundamentals Preschool, Second Edition.* The CELF Preschool-2 (Wiig, Secord, & Semel, 2004) is a normed-referenced, global measure of a child’s
Clinical Evaluation of Language Fundamentals Preschool – Spanish Edition. The CELF Preschool-2 Spanish (Wiig, Secord, & Semel, 2009) is a normed-referenced, global measure of a child’s receptive, expressive and global language abilities in Spanish for ages 3-6;11 years. It is an adaptation of the CELF Preschool-2, not a translation. This normed-referenced measure was standardized on a population of 464 monolingual Spanish and bilingual (Spanish-English) preschoolers residing in 20 U.S. states, the District of Columbia, and Puerto Rico. The demographics match the population of Hispanic children in the United States on age, sex, race/ethnicity, geographic region, and the educational level of the primary caregiver (U.S. Bureau of Census, 2005). Administration time takes approximately 30-45 min. Test-retest reliability for children age 3-4;11 was .91 for core language, .85 for receptive language, and .95 for receptive language. Cronbach’s alpha for internal consistency was: .93 for core language, .87 for receptive language, and .93 for expressive language. This measure addressed Research Questions 3 and 4. For more information please visit: http://pearsonassess.com/haiweb/cultures/en-us/productdetail.htm?pid=015-8036-727.

Primary Test of Nonverbal Intelligence. The PTONI (Ehrler & McGhee, 2008) is a language-free, nonverbal, norm-referenced assessment of cognitive processing for ages 3 to 9;11. This measure was standardized on 1,010 children in 38 states matching the current U.S. demographics reported in the Statistical Abstract of the United States (U.S. Bureau of the Census, 2007). This measure takes approximately 5-15 min to administer. Internal consistency reliability was measured with Cronbach’s coefficient alpha and was .92 ($SD = 4$) for age 3 and .95 ($SD = 3$) for age 4. Test–retest reliability ranged from .96 to .97. It addressed Research Questions 3 and 4. For more information please visit: http://www.proedinc.com/customer/productView.aspx?ID=4213.
Scoring of Assessments and Data Entry

Bilingual graduate students in speech-language pathology, who were blind to the study’s purpose, assisted the researcher in administering and scoring the assessments listed in Table 1. Prior to administering the measures, students trained to 80% reliability with the researcher in their administration and scoring of the assessments on children similar in age and language background who were not participating in this study. It is essential to state that only the researcher and one 2nd-year graduate student administered the CELF-P2 Spanish and CELF-P2, because they possessed sufficient competency in reading, writing, and speaking Spanish to administer these assessments. The other graduate students either did not have enough grammatical background in Spanish or experience in assessing to competently administer these assessments. The researcher was present during all assessment sessions and ensured that all student researchers followed the procedural fidelity of administration outlined in Appendix E for each assessment.

All assessments were double scored for accuracy by the researcher and graduate students. An undergraduate student then entered these scores twice into a database for statistical analysis. Any discrepancies between the two scores were resolved by referring back to the original protocols/score sheets. Necessary changes were then made to the raw score, hard code, and transactional files. Similarly, the LENA software was used to analyze the audio recordings. Data from the LENA DLPs were transferred to the LENA computer 3 times per week. Once a recording was transferred, the DLP was automatically cleared and ready to use with the next child. The researcher backed up the LENA computer weekly on a 500 GB hard drive.

Parent Instructions for LENA Recordings

The researcher phoned parents the day before their child was scheduled to wear the DLP to explain device and the procedures included in Appendix F. The teacher completed Steps 1 through 3 and the caregiver, Step 4. As soon as the child arrived at school (around 8:30 or 9 a.m.), the teacher placed the vest with the DLP recording on the child (see Appendix G). At the end of the school day, she sent the child home with the device still recording. A small brown bag with instructions in Spanish (Appendix F) was placed in the child’s backpack. When the child arrived home, parents removed the brown bag and read the instructions. If parents could not read, the researcher called them that afternoon to explain the device and procedures anew. Picture supports were included in the handouts to support literacy.
Caregivers were instructed to turn off the device and remove the vest when the child went to sleep, otherwise to leave it recording. During nap or bath times, parents and teachers were instructed to remove the clothing holding the DLP from the child and to place it on a counter near the child while the child napped or bathed, the device still recording. They redressed the child in the clothing with the DLP once the time ended.

Caregivers placed the clothing and DLP in the brown bag inside the child’s backpack, and the child returned all materials to school the next day. The researcher collected the materials from the teachers and downloaded the full DLP onto the computer for the LENA software to process. The researcher called families one last time to complete the LENA Session Questions form in Appendix H. If a family reported that their child’s recording did not occur on a typical day, the recording was deleted and a new recording was created following the aforesaid method on another day that the families considered typical as per the LENA Session Questions. Once families completed their participation in this study, parents were sent a thank you letter and a $10 token of appreciation along with a summary of their results.
CHAPTER 3

RESULTS

Preliminary Data Analysis and Descriptive Statistics

Data analysis occurred through modeling and visual inspection. Hierarchical linear modeling (HLM; Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2004; Raudenbush & Bryk, 2002) with PASW Statistics 18 (SPSS, 2010) was used to answer Questions 1 through 4 because of the nested nature of the data (e.g., individual time points within children). A two-level, random intercepts model was constructed with 15 min time points across a single day (adult word counts, conversational turns, and contexts—home versus school; level 1) and child variables (age and assessment scores; level 2). The dependent variable was the frequency of child language use in the natural environment per 15 min (i.e., child vocalization counts per 15 min). For all models, continuous variables were grand mean centered and categorical variables, such as context, were dummy coded with 1 being the variable of interest (i.e., home). First, the researcher fit the unconditional model, which did not employ any predictor variables in the estimation of child vocalization counts. The intraclass correlation coefficient (ICC) was calculated from the unconditional model. Next the researcher fit conditional models by employing independent variables (i.e., context, adult word counts, conversational turns, age, and child assessment scores) as predictors of repeated child vocalizations across a single day. The researcher systematically built each model until a best-fitting model was realized.

To permit model comparison in PASW Statistics 18 (SPSS, 2010), models were run with full maximum likelihood (ML). The researcher examined the data for skewness and found that the adult word count and conversational turn count data had a slight positive skew (2.499 and 2.459, respectively), which is representative of count data (Raudenbush & Bryk, 2002). Values of skewness above +2 or below -2 are considered outliers. The data, however, were not log adjusted for skewness because HLM is robust to this violation of normality (Raudenbush & Bryk).
**Question 1**

Are there differences in LENA child vocalization counts, adult word counts, and conversational turn counts observed in relation to 3- and 4-year-old sequential bilinguals across home and school contexts?

**Child Vocalization Counts: Differences by Gender**

The researcher employed inferential statistics and visual inspection to analyze the data. On average, males vocalized 36.80 (SD = 4.51) times per 15 min, in comparison to females who vocalized 38.19 (SD = 2.57) times per 15 min. A two-tailed $t$-test did not reveal statistically significant differences between the frequency of male and female child vocalization counts, $t(36.19) = -0.309$, $p = .759$, even though females comprised 69.7% of the sample. Figure 1 graphically displays this difference.

![Figure 1. Child vocalization count differences per 15 min by gender.](image)
### Child Vocalization Counts: Descriptive Statistics across Contexts

Table 3

Child vocalization count descriptive statistics across contexts per child

<table>
<thead>
<tr>
<th>ID</th>
<th>School No. 15 min Blocks</th>
<th>M</th>
<th>SD</th>
<th>Home No. 15 min Blocks</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>15.96</td>
<td>15.13</td>
<td>17</td>
<td>19.00</td>
<td>21.88</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>18.36</td>
<td>16.47</td>
<td>23</td>
<td>15.17</td>
<td>22.09</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>43.24</td>
<td>35.07</td>
<td>35</td>
<td>52.31</td>
<td>27.88</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>46.67</td>
<td>24.23</td>
<td>24</td>
<td>52.54</td>
<td>41.87</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>15.44</td>
<td>15.71</td>
<td>27</td>
<td>28.52</td>
<td>22.55</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>16.28</td>
<td>15.82</td>
<td>30</td>
<td>29.87</td>
<td>26.79</td>
</tr>
<tr>
<td>7</td>
<td>25</td>
<td>20.24</td>
<td>18.80</td>
<td>16</td>
<td>48.69</td>
<td>53.40</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>12.36</td>
<td>11.64</td>
<td>27</td>
<td>23.59</td>
<td>30.81</td>
</tr>
<tr>
<td>9</td>
<td>25</td>
<td>11.48</td>
<td>8.88</td>
<td>32</td>
<td>53.63</td>
<td>53.09</td>
</tr>
<tr>
<td>10</td>
<td>29</td>
<td>44.59</td>
<td>42.12</td>
<td>16</td>
<td>33.94</td>
<td>31.62</td>
</tr>
<tr>
<td>11</td>
<td>27</td>
<td>16.41</td>
<td>21.21</td>
<td>15</td>
<td>71.33</td>
<td>30.99</td>
</tr>
<tr>
<td>12</td>
<td>26</td>
<td>30.38</td>
<td>37.70</td>
<td>23</td>
<td>57.26</td>
<td>47.69</td>
</tr>
<tr>
<td>13</td>
<td>27</td>
<td>30.26</td>
<td>34.44</td>
<td>15</td>
<td>40.47</td>
<td>45.27</td>
</tr>
<tr>
<td>14</td>
<td>28</td>
<td>21.32</td>
<td>15.50</td>
<td>26</td>
<td>95.38</td>
<td>47.65</td>
</tr>
<tr>
<td>15</td>
<td>27</td>
<td>29.15</td>
<td>18.38</td>
<td>21</td>
<td>93.48</td>
<td>81.84</td>
</tr>
<tr>
<td>16</td>
<td>27</td>
<td>19.93</td>
<td>18.05</td>
<td>19</td>
<td>63.21</td>
<td>68.80</td>
</tr>
<tr>
<td>17</td>
<td>26</td>
<td>7.73</td>
<td>7.63</td>
<td>29</td>
<td>34.90</td>
<td>43.01</td>
</tr>
<tr>
<td>18</td>
<td>28</td>
<td>30.64</td>
<td>32.31</td>
<td>27</td>
<td>32.07</td>
<td>23.92</td>
</tr>
<tr>
<td>19</td>
<td>27</td>
<td>24.56</td>
<td>23.14</td>
<td>19</td>
<td>77.32</td>
<td>90.90</td>
</tr>
<tr>
<td>20</td>
<td>22</td>
<td>5.32</td>
<td>7.34</td>
<td>24</td>
<td>49.75</td>
<td>33.87</td>
</tr>
</tbody>
</table>
Table 3

Child vocalization count descriptive statistics across contexts per child

<table>
<thead>
<tr>
<th>ID</th>
<th>School</th>
<th></th>
<th></th>
<th></th>
<th>Home</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. 15 min Blocks</td>
<td>M</td>
<td>SD</td>
<td>No. 15 min Blocks</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>27</td>
<td>22.67</td>
<td>20.63</td>
<td>20</td>
<td>48.65</td>
<td>28.71</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>21</td>
<td>35.14</td>
<td>29.54</td>
<td>22</td>
<td>36.86</td>
<td>28.45</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>25</td>
<td>31.20</td>
<td>29.69</td>
<td>28</td>
<td>55.25</td>
<td>47.19</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>29</td>
<td>51.14</td>
<td>44.09</td>
<td>19</td>
<td>82.47</td>
<td>51.48</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>28</td>
<td>39.93</td>
<td>26.41</td>
<td>37</td>
<td>42.46</td>
<td>33.69</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>4</td>
<td>42.75</td>
<td>28.84</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>27</td>
<td>39.33</td>
<td>31.21</td>
<td>26</td>
<td>82.04</td>
<td>49.56</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>28</td>
<td>33.32</td>
<td>31.06</td>
<td>21</td>
<td>67.52</td>
<td>41.22</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>28</td>
<td>17.07</td>
<td>18.18</td>
<td>17</td>
<td>59.47</td>
<td>43.39</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>27</td>
<td>13.81</td>
<td>16.45</td>
<td>29</td>
<td>68.31</td>
<td>66.76</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>27</td>
<td>31.44</td>
<td>38.18</td>
<td>10</td>
<td>69.30</td>
<td>43.64</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>28</td>
<td>17.36</td>
<td>27.15</td>
<td>7</td>
<td>69.14</td>
<td>35.93</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>27</td>
<td>7.96</td>
<td>18.18</td>
<td>19</td>
<td>54.00</td>
<td>32.60</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>25</td>
<td>17.84</td>
<td>21.33</td>
<td>30</td>
<td>40.63</td>
<td>28.07</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>21</td>
<td>17.24</td>
<td>17.86</td>
<td>25</td>
<td>86.12</td>
<td>47.10</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 contains descriptive statistics regarding each child’s average vocalization count at home and at school and their standard deviation in each context, as well as the number of 15 min blocks of recording time. Of note, the majority of children had longer recording times—more 15 min blocks of time—at school than at home. The majority of children had greater child vocalization count means at home than at school.
Adult Word Counts: Differences across Contexts

Visual inspection of the data and inferential statistics showed significant differences between the frequency of adult word counts per 15 min at school and at home, \( t (1642.039) = 2.002, p = .045 \) (two-tailed). Adult word counts averaged 219.74 (\( SD = 13.86 \)) at school and 192.00 (\( SD = 17.37 \)) at home per 15 min. Figure 2 illustrates these differences.

Figure 2. Adult word count differences per 15 min across contexts.
Conversational Turn Counts: Differences across Contexts

Visual inspection of the data and descriptive statistics showed significant differences between the frequency of conversational turn counts per 15 min at school and at home, \( t(1640.697) = -13.965, p = .000 \) (two-tailed). Mean conversational turn counts at school were 3.54 (SD = 0.37) and at home were 8.72 (SD = 0.49) per 15 min. Figure 3 depicts these differences.

![Figure 3. Conversational turn count differences per 15 min across contexts.](image)

Recording Duration

Day-long recordings averaged 11.78 hours long (SD = 2.99). They ranged from 0.77 hours to 16 hours. One child’s recording only lasted 0.77 hours. The researcher included the child in these HLM analyses because HLM permits differences in the number of individual time points, so long as the time points are of equal length (Raudenbush & Bryk, 2002). Each child’s time points included in the model were 15 min in length. When investigated in 5-min intervals, the correlation among the variance components increased, causing high collinearity among the
variables. Raudenbush and Bryk note this can occur when the time metric is very fine grained and suggest increasing the time metric’s units. Thus, in this case, the researcher increased the time metric from 5 min to 15 min. In addition, 15 min time points best represent the length of typical routines in a child’s day and conversations regarding these routines.

**Question 2**

Do home and school contexts, adult word counts, conversational turns, and age significantly relate to LENA child vocalization counts per 15 min across a single day?

**Unconditional Model**

The researcher built HLM models starting with the fully unconditional model, from which the ICC was calculated. This coefficient, sometimes referred to as the cluster effect, quantifies the amount of variance in the outcome (child vocalization counts) attributable to between-group differences (i.e., level 2, between-child differences). The computed ICC was .072, signifying that 7.2% of the variance in participants’ child vocalization counts is attributable to child-level differences. Significance testing of this model involved one parameter, the intercept, which indicated whether the child vocalization counts differed from zero per 15 min intervals. Results indicated that child vocalization counts per 15 min differed significantly from zero. The conditional model was then built accordingly.

**Conditional Model**

The two-level model included child vocalization counts per 15 min as the outcome variable. Context (school versus home), adult word counts (AWC), and conversational turns counts (CT) were entered as level-1 predictors. Conversational turn counts were allowed to vary randomly. The child-level variable age was added afterward. Table 4 provides the descriptive statistics for the unconditional model.
The two-level model equation follows (see Equation 1):

Level 1 Model

\[ CVC_{ij} = \beta_{0j} + \beta_{1j}(age\_cent) + r_{ij} \]  

(1)

Level 2 Model

\[ \beta_{0j} = \gamma_{00} + \gamma_{01}(age\_cent)_j + u_{0j} \]

\[ \beta_{1j} = \gamma_{10} \]

Table 4

HLM Descriptive statistics for modeling CVC

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (individual time points)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context (proportion at home)</td>
<td>0.47</td>
<td>0.50</td>
</tr>
<tr>
<td>Adult word counts (AWC)</td>
<td>206.34</td>
<td>290.69</td>
</tr>
<tr>
<td>Conversational Turn counts (CT)</td>
<td>5.95</td>
<td>8.22</td>
</tr>
<tr>
<td>Level 2 (child)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in months</td>
<td>49.90</td>
<td>6.79</td>
</tr>
</tbody>
</table>

*Note: Child vocalization counts (CVC) per 15 min across a single day.*

Results of the two-level HLM (see Table 5) revealed that child vocalization counts at home were statistically different from zero. That is, on average children said 42.14 ($\gamma_{00}$) vocalizations per 15 min at home. In the test of the difference between home and school, a significant negative slope resulted, signifying there is an average difference in child vocalization counts at home and at school (-7.93, $\gamma_{10}$). On average, children produced fewer vocalizations at school than at home (i.e., 42.14 – 7.93 = 34.21 vocalizations per 15 min at school). The results demonstrated a significant interaction between context and adult word counts ($\gamma_{20}$); markedly, the relationship between adult word counts and child vocalization counts was weaker at home than at school. Adult word counts’ negative relationship ($\gamma_{20}$) indicated that on average, for every adult word, children vocalized 0.07 times less at home per 15 min and 0.03 times less at school.
per 15 min (i.e., -0.07 +0.03 = -0.04). Figure 4 demonstrates the relationship between child vocalizations and high and low levels of adult word counts (i.e., at 1 SD above and below the mean for adult word counts in each context). Conversational turns illustrated a significant positive relationship with child vocalization counts at home ($\gamma_{40}$). For every conversational exchange, children increased their vocalizations at home by 4.19 times per 15 min. The test of the relationship between conversational turns and context was not significant ($\gamma_{50}$). On average, conversational exchanges at home and at school are not significantly different from zero, still fewer conversational turns occurred at school than at home (i.e., $4.19 - 0.54 = 3.65$ turns per 15 min at school). Finally the level-2 parameter age revealed a significant, positive relationship with child vocalization counts ($\gamma_{01}$). The relationship between mean age (49.9 months) and child vocalizations counts was 0.54.
Table 5

Two level conditional model showing estimation of fixed effects. Child vocalization counts is the outcome variable.

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Approx. df</th>
<th>t-value</th>
<th>p-value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>42.14</td>
<td>1.63</td>
<td>68.70</td>
<td>25.88***</td>
<td>.000</td>
<td>38.89 - 45.39</td>
</tr>
<tr>
<td>School, $\gamma_{10}$</td>
<td>-7.93</td>
<td>1.65</td>
<td>1645.76</td>
<td>-4.81***</td>
<td>.000</td>
<td>-11.16 - -4.69</td>
</tr>
<tr>
<td>AWC, $\gamma_{20}$ (at home)</td>
<td>-0.07</td>
<td>0.01</td>
<td>1604.35</td>
<td>-11.27***</td>
<td>.000</td>
<td>-0.08 - -0.06</td>
</tr>
<tr>
<td>AWC X Context, $\gamma_{30}$ (at school)</td>
<td>0.03</td>
<td>0.01</td>
<td>1623.09</td>
<td>4.61***</td>
<td>.000</td>
<td>0.02 - 0.05</td>
</tr>
<tr>
<td>CT, $\gamma_{40}$ (at home)</td>
<td>4.19</td>
<td>0.22</td>
<td>54.63</td>
<td>19.30***</td>
<td>.000</td>
<td>3.75 - 4.62</td>
</tr>
<tr>
<td>CT X Context, $\gamma_{50}$ (at school)</td>
<td>-0.54</td>
<td>0.29</td>
<td>1532.10</td>
<td>-1.91</td>
<td>.057</td>
<td>-1.10 - 0.02</td>
</tr>
<tr>
<td>Age, $\gamma_{01}$</td>
<td>0.54</td>
<td>0.19</td>
<td>35.134</td>
<td>2.86**</td>
<td>.007</td>
<td>0.16 - 0.93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Random Effects</th>
<th>Wald Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_{ij}$ (Time points)</td>
<td>827.55</td>
</tr>
<tr>
<td>$\mu_{0j}$ (Child, Intercept + CT)</td>
<td>42.86</td>
</tr>
<tr>
<td>$\mu_{1j}$ Covariance (Intercept &amp; Slope)</td>
<td>1.66</td>
</tr>
<tr>
<td>$\mu_{2j}$ Slope</td>
<td>0.69</td>
</tr>
</tbody>
</table>

*Note: df = degrees of freedom

* $p < .05$, ** $p < .01$, *** $p < .001$
Figure 4. The relationship between adult word counts and child vocalizations across contexts.

**Question 3**

What is the correlation between each of the following assessments and child vocalization counts over and above the conditional model specified in Question 2?

1. CELF-P2 Spanish core language score (CLS)
2. CELF-P2 Spanish expressive language index (ELI)
3. CELF-P2 Spanish receptive language index (RLI)
4. TVIP
5. PPVT
6. PTONI
7. CELF-P2 core language score (CLS)
8. CELF-P2 expressive language index (ELI)
9. CELF-P2 receptive language index (RLI)
Bayesian correlations were computed by z-scoring each assessment and all parameters in the nine conditional models in Question 4 to compute the weight each assessment added to the model predicting child vocalization counts. Bayesian correlations of .1 are considered small, .3 medium, and .5 large. The results mirrored the results of the nine subsequent assessment models. Only the CELF-P Spanish’s core language score and expressive language index significantly correlated with child vocalizations counts (see Table 6).

Table 6
Bayesian adjusted correlations among assessments and child vocalization counts

<table>
<thead>
<tr>
<th>Assessments</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Approx df</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CELFsp_CLS</td>
<td>0.08*</td>
<td>0.03</td>
<td>34.20</td>
<td>2.46</td>
<td>.019</td>
</tr>
<tr>
<td>2 CELFsp_RLI</td>
<td>0.06</td>
<td>0.03</td>
<td>34.32</td>
<td>1.84</td>
<td>.075</td>
</tr>
<tr>
<td>3 CELFsp_ELI</td>
<td>0.07*</td>
<td>0.03</td>
<td>32.88</td>
<td>2.34</td>
<td>.025</td>
</tr>
<tr>
<td>4 TVIP</td>
<td>0.06</td>
<td>0.03</td>
<td>33.02</td>
<td>1.68</td>
<td>.11</td>
</tr>
<tr>
<td>5 PPVT</td>
<td>0.01</td>
<td>0.03</td>
<td>33.99</td>
<td>0.34</td>
<td>.73</td>
</tr>
<tr>
<td>6 PTONI</td>
<td>0.04</td>
<td>0.03</td>
<td>34.21</td>
<td>1.42</td>
<td>.17</td>
</tr>
<tr>
<td>7 CELF_CLS</td>
<td>-0.03</td>
<td>0.05</td>
<td>21.27</td>
<td>-0.60</td>
<td>.56</td>
</tr>
<tr>
<td>8 CELF_RLI</td>
<td>-0.03</td>
<td>0.04</td>
<td>28.77</td>
<td>-0.77</td>
<td>.45</td>
</tr>
<tr>
<td>9 CELF_ELI</td>
<td>-0.06</td>
<td>0.05</td>
<td>18.47</td>
<td>-1.15</td>
<td>.27</td>
</tr>
</tbody>
</table>

Note: The coefficient is the Bayesian adjusted correlation.
* p < .05, ** p < .01, *** p < .001

Question 4
What is the contribution of each aforementioned assessment over and above the conditional model specified in Question 2?
Unconditional Model

The unconditional model was the same as the unconditional model in Question 2. The computed ICC attributed \(0.072\) or \(7.2\%\) of the variance in child vocalization counts to child-level differences.

Conditional Models

Nine different two-level models were constructed. All models included child vocalization counts per 15 min as the outcome variable. The same conditional model in Question 2 was used with a single assessment added; therefore, each model included a different assessment. School versus home contexts, adult word counts (AWC), and conversational turns counts (CT) were entered as level-1 predictors. Conversational turn counts were allowed to vary randomly. Next the child-level variables age and assessment were entered into the model for the following measures CELF-P2 Spanish CLS, ELI, RLI; TVIP; PPVT; PTONI; and CELF-P2 CLS, ELI, RLI. The purpose of these nine models was to measure the relationship of each assessment to child vocalization counts controlling for all other variables in the model. Table 7 provides the descriptive statistics for the unconditional model for each assessment.

The two-level HLM model equation follows (see Equation 2):

\[
\text{Level 1 Model} \quad (2) \\
C_{ij} = \beta_{0j} + \beta_{1j}(age\_cent) + \beta_{2j}(assessment) + r_{ij}
\]

\[
\text{Level 2 Model} \\
\beta_{0j} = \gamma_{00} + \gamma_{01}(age\_cent)_j + \gamma_{02}(assessment)_j + u_{0j} \\
\beta_{1j} = \gamma_{10} \\
\beta_{2j} = \gamma_{20}
\]
Table 7
HLM Descriptive statistics for modeling CVC

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1 (individual time points)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context (proportion at home)</td>
<td>0.47</td>
<td>0.50</td>
</tr>
<tr>
<td>Adult word counts (AWC)</td>
<td>206.34</td>
<td>290.69</td>
</tr>
<tr>
<td>Conversational Turn counts (CT)</td>
<td>5.95</td>
<td>8.22</td>
</tr>
<tr>
<td><strong>Level 2 (child)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in months</td>
<td>49.90</td>
<td>6.79</td>
</tr>
<tr>
<td><strong>Spanish Assessments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CELF-P2 Spanish CLS</td>
<td>91.91</td>
<td>10.62</td>
</tr>
<tr>
<td>CELF-P2 Spanish RLI</td>
<td>95.22</td>
<td>11.82</td>
</tr>
<tr>
<td>CELF-P2 Spanish ELI</td>
<td>91.95</td>
<td>10.99</td>
</tr>
<tr>
<td>TVIP</td>
<td>81.72</td>
<td>13.27</td>
</tr>
<tr>
<td><strong>Nonverbal Assessment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTONI</td>
<td>97.88</td>
<td>12.98</td>
</tr>
<tr>
<td><strong>English Assessments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT-4</td>
<td>60.36</td>
<td>22.17</td>
</tr>
<tr>
<td>CELF-P2 CLS</td>
<td>61.62</td>
<td>14.19</td>
</tr>
<tr>
<td>CELF-P2 RLI</td>
<td>57.76</td>
<td>21.86</td>
</tr>
<tr>
<td>CELF-P2 ELI</td>
<td>65.16</td>
<td>13.68</td>
</tr>
</tbody>
</table>

*Note:* Child vocalization counts (CVC) per 15 min across a single day.
**CELF-P2 Spanish**

*Core Language Score.* The CELF-P2 Spanish core language score ($\gamma_{02} = 0.29$, $p = .019$) showed a significant positive relationship with child vocalization counts controlling for everything else in the model (see Table 8). All other parameters entered into the model revealed similar relationships and significance levels with child vocalization counts as described in the two-level conditional model in Question 2.

*Receptive Language Index.* Table 8 presents the results of this two-level HLM. The CELF-P2 Spanish receptive language index ($\gamma_{02}$) did not significantly decrease this model’s level-2, intercept variance. However, it did reveal a positive relationship with child vocalization counts ($\gamma_{02} = 0.20$, $p = .075$). The relationships among the other predictors in the model and child vocalization counts were similar to those explained in Question 2’s conditional model.

*Expressive Language Index.* The relationship between the CELF-P2 Spanish expressive Language Index ($\gamma_{02}$) and child vocalization counts was significant and positive ($\gamma_{02} = 0.27$, $p = .025$). This model revealed similar relationships among its predictor variables and child vocalization counts as the conditional model in Question 2 (see Table 8).

**TVIP**

Results of this two-level model demonstrated a non-significant, positive relationship between the TVIP and child vocalization counts ($\gamma_{02} = 0.18$, $p = .103$). Additionally the relationship among child vocalization counts and the other parameters in this model was similar to those in Question 2’s conditional model (see Table 8).

**PPVT**

The PPVT demonstrated a positive, though non-significant, relationship with child vocalization counts in the two-level HLM ($\gamma_{02} = 0.02$, $p = .733$). The other parameters in the model revealed similar relationships with child vocalization counts as described in Question 2’s conditional model (see Table 8).

**PTONI**

A positive, though non-significant, relationship between the PTONI and child vocalization counts was demonstrated ($\gamma_{02} = 0.14$, $p = .166$). The relationship among child vocalizations and the other predictor variables in the model is similar to those in the conditional model in Question 2 (see Table 8).
**CELF-P2 English**

The CELF-P2’s core language score, receptive language index, and expressive language index, were less sensitive in capturing the children’s developing English abilities. Many of the children did not attain a basal score, therefore, were not included in these three analyses (CLS \( n = 21 \); RLI \( n = 30 \); and ELI \( n = 18 \)). In all the previous models, the level-1 analyses’ \( n = 1659 \). In the CELF-P2’s three analyses, the level 1 \( n \) ranged from 927 to 1416. This decrease is due to a decrease in the level 2 (child) \( n \), resulting in standard errors that are negatively biased (Raudenbush & Bryk, 2002). By adding this assessment as a predictor in the model, the Pseudo R2 variances that account for a decrease in level 1 and level 2 variances both have become negative. Negative Pseudo R2 values indicate that the intercept value (i.e., the number of child vocalizations at home) has changed to a place with greater variance than in the previous model that did not include this variable (i.e., the conditional model in Question 2; see Table 8).
Table 8

Two level conditional model showing estimation of fixed effects. The outcome variable is CVC.

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>CELF-P2 Spanish CLS</th>
<th>CELF-P2 Spanish RLI</th>
<th>CELF-P2 Spanish ELI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>$42.18^{***}$ 1.57</td>
<td>$42.18^{***}$ 1.57</td>
<td>$42.18^{***}$ 1.57</td>
</tr>
<tr>
<td>School, $\gamma_{10}$</td>
<td>$-8.03^{***}$ 1.65</td>
<td>$-8.03^{***}$ 1.65</td>
<td>$-8.01^{***}$ 1.65</td>
</tr>
<tr>
<td>AWC, $\gamma_{20}$ (at home)</td>
<td>$-0.07^{***}$ 0.01</td>
<td>$-0.07^{***}$ 0.01</td>
<td>$-0.07^{***}$ 0.01</td>
</tr>
<tr>
<td>AWC X Context, $\gamma_{30}$ (at school)</td>
<td>$0.03^{***}$ 0.01</td>
<td>$0.03^{***}$ 0.01</td>
<td>$0.03^{***}$ 0.01</td>
</tr>
<tr>
<td>CT, $\gamma_{40}$ (at home)</td>
<td>$4.18^{***}$ 0.22</td>
<td>$4.18^{***}$ 0.22</td>
<td>$4.19^{***}$ 0.22</td>
</tr>
<tr>
<td>CT X Context, $\gamma_{50}$ (at school)</td>
<td>$-0.55$ 0.29</td>
<td>$-0.54$ 0.28</td>
<td>$-0.55$ 0.29</td>
</tr>
<tr>
<td>Age, $\gamma_{01}$</td>
<td>$0.68^{**}$ 0.18</td>
<td>$0.51^{**}$ 0.18</td>
<td>$0.65^{**}$ 0.18</td>
</tr>
<tr>
<td>Assessment, $\gamma_{02}$</td>
<td>$0.29^*$ 0.12</td>
<td>$0.20$ 0.11</td>
<td>$0.27^*$ 0.11</td>
</tr>
</tbody>
</table>

Random Effects

<table>
<thead>
<tr>
<th></th>
<th>CELF-P2 Spanish CLS</th>
<th>CELF-P2 Spanish RLI</th>
<th>CELF-P2 Spanish ELI</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_{ij}$ (Time points)</td>
<td>827.49*** 29.38</td>
<td>827.61*** 29.39</td>
<td>827.30*** 29.37</td>
</tr>
<tr>
<td>$\mu_{0j}$ (Child, Intercept + CT)</td>
<td>36.77** 13.94</td>
<td>36.95** 13.90</td>
<td>36.56** 13.95</td>
</tr>
<tr>
<td>$\mu_{ij}$ Covariance (Intercept &amp; Slope)</td>
<td>2.09 1.58</td>
<td>1.38 1.54</td>
<td>2.02 1.56</td>
</tr>
<tr>
<td>$\mu_{2j}$ Slope</td>
<td>0.69* 0.28</td>
<td>0.69* 0.28</td>
<td>0.71* 0.28</td>
</tr>
</tbody>
</table>

Note: Assessment in each model indicated at the top of the table. Child vocalization counts (CVC).

* $p < .05$, ** $p < .01$, *** $p < .001$

$n = 1659$ for CELF-P2 Spanish assessments, TVIP, PPVT, and PTONI.

$n = 927$ for CELF-P2 CLS; $n = 1416$ for CELF-P2 RLI; $n = 789$ for CELF-P2 ELI.
Table 8 (continued)

Two level conditional model showing estimation of fixed effects. The outcome variable is CVC.

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>TVIP</th>
<th></th>
<th>PPVT</th>
<th></th>
<th>PTONI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>SE</td>
<td>Coefficient</td>
<td>SE</td>
<td>Coefficient</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>42.12***</td>
<td>1.57</td>
<td>42.15***</td>
<td>1.63</td>
<td>42.16***</td>
<td>1.53</td>
</tr>
<tr>
<td>School, $\gamma_{10}$</td>
<td>-7.91***</td>
<td>1.65</td>
<td>-7.95***</td>
<td>1.65</td>
<td>-7.94***</td>
<td>1.65</td>
</tr>
<tr>
<td>AWC, $\gamma_{20}$ (at home)</td>
<td>-0.07***</td>
<td>0.01</td>
<td>-0.07***</td>
<td>0.01</td>
<td>-0.07***</td>
<td>0.01</td>
</tr>
<tr>
<td>AWC X Context, $\gamma_{30}$ (at school)</td>
<td>0.03***</td>
<td>0.01</td>
<td>0.03***</td>
<td>0.01</td>
<td>0.03***</td>
<td>0.01</td>
</tr>
<tr>
<td>CT, $\gamma_{40}$ (at home)</td>
<td>4.19***</td>
<td>0.22</td>
<td>4.19***</td>
<td>0.22</td>
<td>4.18***</td>
<td>0.22</td>
</tr>
<tr>
<td>CT X Context, $\gamma_{50}$ (at school)</td>
<td>-0.54</td>
<td>0.28</td>
<td>-0.55</td>
<td>0.28</td>
<td>-0.54</td>
<td>0.28</td>
</tr>
<tr>
<td>Age, $\gamma_{01}$</td>
<td>0.65**</td>
<td>0.20</td>
<td>0.55**</td>
<td>0.19</td>
<td>0.50**</td>
<td>0.19</td>
</tr>
<tr>
<td>Assessment, $\gamma_{02}$</td>
<td>0.18</td>
<td>0.11</td>
<td>0.02</td>
<td>0.06</td>
<td>0.14</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Random Effects

<table>
<thead>
<tr>
<th></th>
<th>TVIP</th>
<th></th>
<th>PPVT</th>
<th></th>
<th>PTONI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_{ij}$ (Time points)</td>
<td>827.81***</td>
<td>29.40</td>
<td>827.57***</td>
<td>29.39</td>
<td>827.81***</td>
<td>29.40</td>
</tr>
<tr>
<td>$\mu_{0j}$ (Child, Intercept + CT)</td>
<td>36.62**</td>
<td>13.79</td>
<td>42.79**</td>
<td>15.34</td>
<td>38.17**</td>
<td>14.15</td>
</tr>
<tr>
<td>$\mu_{ij}$ Covariance (Intercept &amp; Slope)</td>
<td>0.99</td>
<td>1.56</td>
<td>1.70</td>
<td>1.61</td>
<td>1.02</td>
<td>1.60</td>
</tr>
<tr>
<td>$\mu_{zj}$ Slope</td>
<td>0.68*</td>
<td>0.27</td>
<td>0.69*</td>
<td>0.28</td>
<td>0.67*</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Note: Assessment in each model indicated at the top of the table. Child vocalization counts (CVC).

* $p < .05$, ** $p < .01$, *** $p < .001$

$n = 1659$ for CELF-P2 Spanish assessments, TVIP, PPVT, and PTONI.

$n = 927$ for CELF-P2 CLS; $n = 1416$ for CELF-P2 RLI; $n = 789$ for CELF-P2 ELI.
Table 8 (continued)

Two level conditional model showing estimation of fixed effects. The outcome variable is CVC.

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>CELF-P2</th>
<th>Coefficient</th>
<th>SE</th>
<th>CELF-P2</th>
<th>Coefficient</th>
<th>SE</th>
<th>CELF-P2</th>
<th>Coefficient</th>
<th>SE</th>
<th>CELF-P2</th>
<th>Coefficient</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td></td>
<td>43.59***</td>
<td>2.55</td>
<td></td>
<td>41.68***</td>
<td>1.85</td>
<td></td>
<td>44.90***</td>
<td>2.88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School, $\gamma_{10}$</td>
<td></td>
<td>-9.90***</td>
<td>2.42</td>
<td></td>
<td>-6.94***</td>
<td>1.84</td>
<td></td>
<td>-10.74***</td>
<td>2.72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AWC, $\gamma_{20}$ (at home)</td>
<td></td>
<td>-0.09***</td>
<td>0.01</td>
<td></td>
<td>-0.09***</td>
<td>0.01</td>
<td></td>
<td>-0.09***</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AWC X Context, $\gamma_{30}$ (at school)</td>
<td></td>
<td>0.06***</td>
<td>0.01</td>
<td></td>
<td>0.05***</td>
<td>0.01</td>
<td></td>
<td>0.06***</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT, $\gamma_{40}$ (at home)</td>
<td></td>
<td>4.52***</td>
<td>0.31</td>
<td></td>
<td>4.45***</td>
<td>0.25</td>
<td></td>
<td>4.36***</td>
<td>0.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT X Context, $\gamma_{50}$ (at school)</td>
<td></td>
<td>-1.09**</td>
<td>0.38</td>
<td></td>
<td>-0.81**</td>
<td>0.31</td>
<td></td>
<td>-1.00*</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, $\gamma_{01}$</td>
<td></td>
<td>0.42</td>
<td>0.29</td>
<td></td>
<td>0.47*</td>
<td>0.22</td>
<td></td>
<td>0.39</td>
<td>0.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment, $\gamma_{02}$</td>
<td></td>
<td>-0.08</td>
<td>0.14</td>
<td></td>
<td>-0.05</td>
<td>0.07</td>
<td></td>
<td>-0.18</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Random Effects

<p>| | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_{ij}$ (Time points)</td>
<td></td>
<td>964.34***</td>
<td>45.85</td>
<td></td>
<td>871.35***</td>
<td>33.51</td>
<td></td>
<td>1072.02***</td>
<td>55.29</td>
</tr>
<tr>
<td>$\mu_{0j}$ (Child, Intercept + CT)</td>
<td></td>
<td>55.31*</td>
<td>24.73</td>
<td></td>
<td>45.41**</td>
<td>17.46</td>
<td></td>
<td>52.01*</td>
<td>26.28</td>
</tr>
<tr>
<td>$\mu_{ij}$ Covariance (Intercept &amp; Slope)</td>
<td></td>
<td>0.27</td>
<td>2.42</td>
<td></td>
<td>1.30</td>
<td>1.89</td>
<td></td>
<td>0.16</td>
<td>2.44</td>
</tr>
<tr>
<td>$\mu_{2j}$ Slope</td>
<td></td>
<td>0.81*</td>
<td>0.41</td>
<td></td>
<td>0.82*</td>
<td>0.35</td>
<td></td>
<td>0.66</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Note: Assessment in each model indicated at the top of the table. Child vocalization counts (CVC).

* $p < .05$, ** $p < .01$, *** $p < .001$

$n = 1659$ for CELF-P2 Spanish assessments, TVIP, PPVT, and PTONI.

$n = 927$ for CELF-P2 CLS; $n = 1416$ for CELF-P2 RLI; $n = 789$ for CELF-P2 ELI.
Ruling Out a Potential Confounding Variable

The following procedure was conducted to investigate whether differences in participants’ sample durations, or total number of 15 min time blocks, influenced child vocalization counts as a possible confounding variable.

First the researcher examined the correlations between each child’s total number of 15 min time blocks and each predictor variable in Question 4 (see Table 7) to determine if differences in the number of time blocks might affect child vocalization counts. There was a significant correlation between time blocks and the home-school variable ($r = .88, p = .000$). Because one child only had four time blocks (less than 1 hour recording time), the researcher dropped him from the analyses. Next, time block was entered as a Level 2 variable in Question 2’s HLM to control for differences in children’s number of time blocks. The two-level HLM model equation follows (see Equation 3):

Level 1 Model

$$CVC_{ij} = \beta_{0j} + \beta_{1j}(timeblock\_cent) + \beta_{2j}(age\_cent) + r_{ij}$$

Level 2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(timeblock\_cent)_j + \gamma_{02}(age\_cent)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

Time block did not significantly change the results of Question 2’s HLM and it was not a significant parameter in the model ($p = 0.944$). The same parameters were significant and revealed the same patterns as in Question 2’s results (see Table 9).
Table 9

Two level conditional model showing estimation of fixed effects. Child vocalization counts is the outcome variable.

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Approx. df</th>
<th>t-value</th>
<th>p-value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>42.08</td>
<td>1.63</td>
<td>67.31</td>
<td>25.84***</td>
<td>.000</td>
<td>38.83 - 45.33</td>
</tr>
<tr>
<td>School, $\gamma_{10}$</td>
<td>-7.97</td>
<td>1.65</td>
<td>1636.65</td>
<td>-4.83***</td>
<td>.000</td>
<td>-11.21 - -4.73</td>
</tr>
<tr>
<td>AWC, $\gamma_{20}$ (at home)</td>
<td>-0.07</td>
<td>0.01</td>
<td>1599.68</td>
<td>-11.27***</td>
<td>.000</td>
<td>-0.08 - -0.06</td>
</tr>
<tr>
<td>AWC X Context, $\gamma_{30}$ (at school)</td>
<td>0.03</td>
<td>0.01</td>
<td>1619.73</td>
<td>4.62***</td>
<td>.000</td>
<td>0.02 - 0.05</td>
</tr>
<tr>
<td>CT, $\gamma_{40}$ (at home)</td>
<td>4.19</td>
<td>0.22</td>
<td>54.63</td>
<td>19.30***</td>
<td>.000</td>
<td>3.76 - 4.63</td>
</tr>
<tr>
<td>CT X Context, $\gamma_{50}$ (at school)</td>
<td>-0.54</td>
<td>0.29</td>
<td>1526.07</td>
<td>-1.91</td>
<td>.057</td>
<td>-1.11 - 0.02</td>
</tr>
<tr>
<td>Timeblock, $\gamma_{60}$</td>
<td>0.01</td>
<td>0.21</td>
<td>34.13</td>
<td>0.07</td>
<td>.944</td>
<td>-0.40 - 0.43</td>
</tr>
<tr>
<td>Age, $\gamma_{02}$</td>
<td>0.53</td>
<td>0.19</td>
<td>34.73</td>
<td>2.75**</td>
<td>.009</td>
<td>0.14 - 0.93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Random Effects</th>
<th>Wald Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_{ij}$ (Time points)</td>
<td>827.61</td>
</tr>
<tr>
<td>$\mu_{0j}$ (Child, Intercept + CT)</td>
<td>42.62</td>
</tr>
<tr>
<td>$\mu_{1j}$ Covariance (Intercept &amp; Slope)</td>
<td>1.61</td>
</tr>
<tr>
<td>$\mu_{2j}$ Slope</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Note: df = degrees of freedom
* $p < .05$, ** $p < .01$, *** $p < .001$
The researcher then reran Question 4’s nine assessment HLMs with time block in the model. The two-level HLM model equation follows (see Equation 4):

Level 1 Model

\[ C_{ij} = \beta_{0j} + \beta_{1j}(\text{timeblock\_cent}) + \beta_{2j}(\text{age\_cent}) + \beta_{3j}(\text{assessment}) + r_{ij} \]  

Level 2 Model

\[ \begin{align*}
\beta_{0j} &= \gamma_{00} + \gamma_{01}(\text{timeblock\_cent})_j + \gamma_{02}(\text{age\_cent})_j + \gamma_{03}(\text{assessment})_j + u_{0j} \\
\beta_{1j} &= \gamma_{10} \\
\beta_{2j} &= \gamma_{20} \\
\beta_{3j} &= \gamma_{30}
\end{align*} \]

Correspondingly, time block did not change the results of the nine HLMs. The same parameters were significant and revealed the same patterns. The CELF Spanish CLS and ELI still were the only significant assessment parameters, \((\gamma_{02} = 0.29, p = .021\) and \(\gamma_{02} = 0.27, p = .028,\) respectively). Thus, time block did not affect the relationship among the variables to be considered a confounding variable that influenced child vocalization counts.

**Question 5**

How do the child-vocalization-count, adult-word-count, and conversational-turn-count patterns vary across the day in 15 min intervals?

Figures 5, 6, and 7 present scatter plots of the 35 children’s vocalization counts, adult word counts, and conversational turn counts in 15 min intervals through a single day. The dark blue line in each figure represents a spline interpolation line, a type of regression line that weights the closer points more heavily than the points that are farther away. The x-axis represents time of day in military time (e.g., 5 a.m. to 1 a.m.). Children were at school between the hours of 8 a.m. and 4 p.m.; otherwise, they were at home.
Figure 5. Scatter plot of child vocalization counts (n = 35) across a single day.
Figure 6. Scatter plot of adult word counts (for n = 35 children) across a single day.
Figure 7. Scatter plot of conversational turn counts (for n = 35 children) across a single day.
Question 6

Do child vocalizations differ across 15-min and 1-hour intervals throughout the day at home and school?

The researcher conducted a repeated measures ANOVA in HLM to determine differences in hourly mean child vocalization counts throughout the day. A repeated measures ANOVA in HLM is exactly the same as a regular, repeated measures ANOVA, only it uses all the children’s time points, rather than dropping a subject if they are missing a time point. The researcher used the spline interpolation line in Figure 5 to guide the decision to create hourly blocks of time for each child from 8 a.m. to 7 p.m. These were the hours in which most children had data. The main effect for hour was $F(11, 1184) = 29.06, p = .000$. Table 10 presents the predicted number of child vocalization counts per hour, or estimated marginal means. Table 11 presents follow-up, pairwise comparison tests of hourly means to one another.
Table 10

Predicted number of child vocalization counts per hour

<table>
<thead>
<tr>
<th>Hour</th>
<th>Mean</th>
<th>Standard Error</th>
<th>df</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 a.m.</td>
<td>22.76</td>
<td>4.69</td>
<td>1484</td>
<td>13.55</td>
</tr>
<tr>
<td>9 a.m.</td>
<td>23.44</td>
<td>3.11</td>
<td>1484</td>
<td>17.34</td>
</tr>
<tr>
<td>10 a.m.</td>
<td>27.90</td>
<td>3.09</td>
<td>1484</td>
<td>21.85</td>
</tr>
<tr>
<td>11 a.m.</td>
<td>37.34</td>
<td>3.09</td>
<td>1484</td>
<td>31.28</td>
</tr>
<tr>
<td>12 p.m.</td>
<td>25.79</td>
<td>3.09</td>
<td>1484</td>
<td>19.74</td>
</tr>
<tr>
<td>1 p.m.</td>
<td>19.45</td>
<td>3.13</td>
<td>1484</td>
<td>13.30</td>
</tr>
<tr>
<td>2 p.m.</td>
<td>16.25</td>
<td>3.11</td>
<td>1484</td>
<td>10.15</td>
</tr>
<tr>
<td>3 p.m.</td>
<td>36.83</td>
<td>3.09</td>
<td>1484</td>
<td>30.78</td>
</tr>
<tr>
<td>4 p.m.</td>
<td>51.07</td>
<td>3.12</td>
<td>1484</td>
<td>44.94</td>
</tr>
<tr>
<td>5 p.m.</td>
<td>56.48</td>
<td>3.18</td>
<td>1484</td>
<td>50.23</td>
</tr>
<tr>
<td>6 p.m.</td>
<td>60.71</td>
<td>3.30</td>
<td>1484</td>
<td>54.24</td>
</tr>
<tr>
<td>7 p.m.</td>
<td>69.89</td>
<td>3.58</td>
<td>1484</td>
<td>62.86</td>
</tr>
</tbody>
</table>

Note: df = degrees of freedom. CI = confidence interval.
Table 11

Pairwise group difference $p$-values in number of child vocalization counts per hour

<table>
<thead>
<tr>
<th></th>
<th>8 a.m.</th>
<th>9 a.m.</th>
<th>10 a.m.</th>
<th>11 a.m.</th>
<th>12 p.m.</th>
<th>1 p.m.</th>
<th>2 p.m.</th>
<th>3 p.m.</th>
<th>4 p.m.</th>
<th>5 p.m.</th>
<th>6 p.m.</th>
<th>7 p.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 a.m.</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 a.m.</td>
<td>1.000</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 a.m.</td>
<td>1.000</td>
<td>1.000</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 a.m.</td>
<td>.465</td>
<td>.097</td>
<td>.874</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 p.m.</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>.422</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 p.m.</td>
<td>1.000</td>
<td>1.000</td>
<td>.976</td>
<td>.003**</td>
<td>1.000</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 p.m.</td>
<td>1.000</td>
<td>.999</td>
<td>.409</td>
<td>.000***</td>
<td>.863</td>
<td>1.000</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 p.m.</td>
<td>.555</td>
<td>.140</td>
<td>.937</td>
<td>1.000</td>
<td>.536</td>
<td>.005**</td>
<td>.000***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Home</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 p.m.</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.112</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 p.m.</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.001***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.001**</td>
<td>1.000</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 p.m.</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.897</td>
<td>1.000</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>7 p.m.</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.000***</td>
<td>.005**</td>
<td>.290</td>
<td>.983</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. 
The researcher also ran a repeated measures ANOVA in HLM to determine differences in 15 min, mean child vocalization counts throughout the day. The main effect for 15 min was $F(47, 1484) = 7.861, p = .000$. The researcher conducted follow-up, pairwise comparison tests of the 15 min means to one another. The peak talk time at school occurred around 11:30 a.m., which was when most children were eating lunch (see Figure 5). Results from the 15 min pairwise comparisons did not reveal significant differences between 11:30 a.m. and any other school time. Contrastingly, results from the hourly pairwise comparisons revealed significant differences between 11 a.m. and 1 p.m., $p = .003$, and between 11 a.m. and 2 p.m., $p = .000$. Nap time occurred during 1 p.m. and 2 p.m. for most children. At home, the peak talk time occurred around 7 p.m. (again, see Figure 5). Results from the 15 min pairwise comparisons did not reveal significant differences between 7 p.m. and any other home time except 4 p.m., $p = .012$. Similarly, hourly pairwise comparison results showed significant differences between child vocalization count means at 4 p.m. and 7 p.m., $p = .005$. 


CHAPTER 4

DISCUSSION

This was one of the first observational studies conducted in the natural environment to investigate language use and assessment of 3- and 4-year-old sequential bilinguals of low SES living in rural Florida to expand the current literature base regarding typical development in this population. It is noteworthy that, unlike most studies of young bilinguals (e.g., Gutierrez-Clellen, Wagner, & Simón-Cereijido, 2008), this was not an aggregated sample of sequential and simultaneous bilinguals. The researcher gathered a single day-long recording of each child via LENA software technology and conducted standardized language assessments. The 35 children were typically developing in their L1, Spanish, and just beginning to acquire L2, English. Five main findings based on LENA analysis revealed that (1) children vocalize more at home than at school (level 1); (2) adult word counts were negatively correlated with child vocalization counts (CVC) and differed across contexts (level 1); (3) conversational turns predicted CVC, but did not differ across contexts (level 1); (4) age accurately predicted between subject differences (level 2); and (5) the CELF-P2 Spanish core language and expressive language indices each predicted CVC over and above the aforementioned predictors (level 2). None of the other standardized assessments significantly accounted for more variance in the conditional model.

Home and School Contexts

It is well established that children acquire languages in various contexts including at home and school (Kohnert et al., 2005; The National Association for the Education of Young Children [NAEYC], 1995; Office of Head Start [OHS], 2010). In turn, these contexts contain different communication partners, namely family members and siblings, teachers and peers, respectively. The participants in this study were young children below age 5 who spent the majority of their lives at home with their caregivers and siblings. They were not accustomed to school or any of the cultural differences school would present, such as unfamiliar communication partners speaking in English. As hypothesized, this study showed that participants vocalized more at home than at school. Given children’s familiarization with home and their caregiver, it is only logical that they would vocalize more in an environment in which they were familiar. Other
possible reasons for increases in child vocalization counts at home might be related to the decreased adult-child ratio from school to home. At school, teacher-child ratios were approximately 10:1; whereas at home, this ratio decreased. Another reason might involve differences in quality of adult-child interactions and adult teaching strategies – directive versus responsive (Chapman, 2000; Eisenberg, 2002; Huttenlocher et al., 1991; Tamis-LeMonda et al., 2001; van Kleeck, 1994). Current common practice assesses young children upon entry to school to detect if they qualify for bilingual or speech-language services. Assessing a young, sequential bilingual in English without accounting for Spanish can result in an incorrect diagnosis (Epinosa, 2005). The OHS and NAEYC support assessing young children in their natural environments. Findings from the current study yield important implications for assessment of young bilinguals in various contexts and suggest that assessing them in their home environment, or at the very least, with a caregiver present would be optimal.

The scatterplot of CVC every 15 min throughout the day further confirmed differences between home and school contexts. It showed that peak talk times at school and home were around mealtime or bedtime hours for children on average in the sample, 11:30 a.m. and 7 p.m. respectively. Fifteen min pairwise comparisons of school times did not show significant differences between the segments of time throughout the school day, indicating that multiple times could be useful to conduct a 15 min language sample at school for this population. In contrast, hourly pairwise comparisons of school times revealed a significant difference between the peak talk hour, 11 a.m., and nap time, 1-2 p.m. Obviously one would not sample language during nap time. Regarding home times, 15 min and hourly pairwise comparisons showed significant differences only between 4 p.m. and 7 p.m. Most children arrived home around 4 p.m. and would either eat or take a nap. At school, the 15 min pairwise comparisons seem to be more sensitive to changes in daily routines than the hourly language samples, which may reflect the variations in the activity types that occur in preschool settings.

**Cultural Differences in the Importance of Talk**

*Adult word counts.* Interestingly, increases in adult word counts at home did not account for increases in child vocalizations as the researcher predicted and other studies have shown (Hart & Risley, 1995; Huttenlocher et al., 1991; Rowe, 2008). Results revealed the opposite. Increases in adult vocalizations significantly predicted decreases in CVC. One interesting interpretation of this finding relates to the cultural differences in adult-child discourse. Most
previous natural environment studies were based upon the traditional American culture and involved mostly monolingual English-speaking families whose culture and language instruction practices may differ from Hispanic culture. Research indicates that, American, mainstream culture involves dyadic interactions (one-on-one) between mother and child (Chapman, 2000; van Kleeck, 1994). Thus parents’ vocalizations are more likely directed toward the child. However some studies have shown in Mexican culture, families are larger and engage in more multiparty interactions. Mothers turn their children outward to face and dialogue with others (Briggs, 1984; Eisenberg, 1982). In her study, Eisenberg noted that most of the mother’s vocalizations directed toward the child were instructive for re-clarification or interpretive purposes. For example, if the child said a phrase that only the mother understood, she would direct the child, “Say, ‘another cookie please,’” so that everyone else in the multiparty interaction might better understand the child’s vocalization.

Another explanation could be due to differences in language sampling procedures. Previous studies examining parent-child talk patterns involved language samples that were 60 min to a few hours in length and occurred primarily in a single environment, for example at home (Hart & Risley, 1995; Huttenlocher et al., 1991; Rowe, 2008). Moreover, the caregiver was present with the child. In comparison, using LENA technology, this study gathered day-long language samples of each child across two main environments – home and school—with multiple communication partners. This increased sample time and portability potentially increased the variability in conversational partners and environments.

An additional explanation implies an important consideration for future research using the LENA in natural environments. In this study, wherever the child roamed, the DLP recorded the talk within the ambient environment. Consequently, higher LENA adult word counts could be misleading because it includes adult utterances that were not necessarily directed to the targeted child. Instead LENA adult word counts reflect the number of adult utterances spoken around, not necessarily to, the target child. Multiparty interactions occurring at home could explain these differences; parents talking to other adults or children while near the target child, or teachers talking to another student near the target child. Results demonstrated significant differences in adult word counts across environments, notably, a weaker slope at home than at school. This finding is important because it could offer insight into the culture of schools in rural communities serving sequential bilinguals of low SES. If adult word counts were not truly
reflective of active interactions with the child, this variable would not be as important to consider in utilizing LENA data for assessment as examining the number of conversational turns between the key child and adult (Xu et al., 2008a).

**Conversational turns counts.** The key variable that elucidates the differences in increased adult word counts and decreased CVC across environments are conversational turns. When adults directed their vocalizations toward the child and the child responded (or vice-versa), they engaged in a conversational turn (Xu et al., 2008b; Warren et al., 2010). Random conversational turn counts accounted for the most decreases in variance in levels 1 and 2, 37.34% and 61.84%, respectively. For every conversational turn, children increased their vocalizations at home by 4.2 vocalizations per 15 min. There was not a significant difference between home and school environments. For every conversational turn at school, children increased their CVC by 3.6 per 15 min at school. Regardless of language (i.e., Spanish or English), previous studies have shown that conversational turns are very important to language growth. Hart and Risley (1995), Huttenlocher et al. (1991), and Rowe (2008) demonstrated the increased rate at which adults talk to their children predicted faster growth in vocabulary. More research concerning cultural differences in the importance of talk in Hispanic communities of low SES attending rural preschools in Florida needs to be conducted to better understand why adult-child conversational turns are low and how this affects language acquisition and growth across time.

LENA produces an automated vocal analysis of child and adult speech. Unfortunately it does not discriminate between type of words spoken or number of words per utterance. For example, a child who repeats the same word or phrase over and over again, as is possible with a child with autism, would accrue CVC without regard to the quality of the echolalic utterance. LENA does not differentiate between the quality of adult utterances – if their interaction style were child directed, if they expanded or recasted (Chapman, 2000). It does, however, possess the ability to collect elongated language samples and analyze the number of communication exchanges between an adult and child that can later be transcribed to address the aforementioned drawbacks.

**Between Subjects Differences**

The intraclass correlation coefficient (ICC) from the unconditional model revealed that 7.2% of the variance was attributable to child-level (level 2) differences. Studies have shown SES and maternal years of education were related to child language outcomes (Eisenberg, 1982;
Hart & Risley, 1995; Huttenlocher et al., 1991). However, all participants in the current study shared the same level of SES and their mothers’ shared similar educational backgrounds. Therefore, SES and mothers’ years of education were not expected to distinguish differences among children (level 2) in the model; thus, they were not entered into the model.

**Timeblock.** The second method entered timeblock into the model to control for a possible confounding variable, differences in each child’s number of 15 min time blocks. Timeblock did not significantly affect the results of Question 2 or 4, verifying HLM’s ability to handle differences in the number of time blocks so long as they all are of equal length (e.g., 15 min; Raudenbush & Bryk, 2002). Thus timeblock can be ruled-out as a confounding variable in this study.

**Age.** Children with typical development naturally increase their vocalizations with age, which is the pattern the results demonstrated. Age was an important variable to add because the children were between 37 and 59 months of age. This large age span accounted for differences in CVC among children. This finding substantiates the construct validity of LENA’s CVC as an indicator of child maturation. One would expect that increases in children’s chronological age would correlate with increases in the number and length of utterances. Thus, it is reassuring for construct validity to observe LENA’s CVC measure increasing with age in sequential bilinguals as well.

**Assessments.** This study sought to explore the contribution of a number of commonly used English and Spanish standardized assessments to the model and to compare their relationship with LENA’s CVC. Paradis et al. (2003) and Páez et al. (2007) expressed concern that standardized assessments do not account for the child’s proficiency in and exposure to each language, such as communication partners, dialects, length of time since L2 was first introduced, languages used in conjunction, and language acceleration and deceleration. While some of these within- and between-subject variables presented a challenge to measure because of their abstractness, others proved more measureable and were examined in the model. For that reason, months of exposure to English (measured from when children first attend school) and older siblings (a dichotomous variable) also were entered into the model after age but revealed no significant contributions to the model (i.e., significant reduction in variance). Therefore, they were removed to develop the most parsimonious model. This is not to say that these measures are not important, but that the parameters previously entered into the model already had
accounted for the construct of months of exposure to English, for example. The previously entered parameters included: home-school context, adult word counts, conversational turn counts, and age. Thus, the results indicate that months of exposure to English did not contribute to this sample over and above these parameters.

Past research on bilingual children has cautioned against using a single measure to determine if a child has a language delay or difference (Gutierrez-Clellen, 1996). Most available measures are single-language assessments—either in English or in Spanish. Because L1 and L2’s relationship varies within and across children, it becomes challenging to measure both languages with a single-language measure. Giving a sequential bilingual a monolingual assessment might over- or under-estimate her abilities (Gutierrez-Clellen), particularly if that assessment is in her L2. Bedore and Peña (2008) and Paradis and colleagues (2003) cautioned against interpreting a child’s poor performance on an assessment as representative of her lacking language abilities, rather it could simply be a reflection of her inexperience with the testing/assessment process or the target language or L1. To counteract this trend, Bedore and Peña recommend assessing a bilingual in both languages. Thus, researchers will give sequential bilinguals English and Spanish versions of an assessment in an effort to capture their abilities in both languages. The only intricacy is finding comparable, sensitive assessments available in both languages.

This study included the most widely used English and Spanish standardized assessments available for preschool children of similar language backgrounds to the participants. It is important to restate that very few standardized assessments exist to assess the language of sequential bilinguals in preschool. Each assessment was added to the conditional model, comprised of the aforementioned predictors, to determine the contribution of each to the model. The CELF-P2 Spanish expressive language index and core language score (which is comprised of the expressive language index) each contributed significantly to the conditional model and decreased the level 2 intercept variance by 14.70% and 14.21%, respectively. None of other assessments significantly contributed to the conditional model. Possible explanations for the poor correlation between CVC and some assessments relate to external validity and construct validity. Sample Characteristics of External Validity

In the current study, the amount that the findings from a monolingual assessment, such as the PPVT, TVIP, and CELF-P2, can be generalized to a bilingual population refers to sample characteristics of external validity (Kazdin, 2003). The CELF-P2 Spanish was the only bilingual
assessment which normative sample most closely fit the characteristics of the participants in this study — its normative sample was comprised of young sequential bilinguals. Nearly 40% of the CELF-P2 Spanish’s normative population completed 11 years of education or less. Mean maternal education level in the current study was 8.03 years ($SD = 2.88$). Most of the participants’ core language scores fell within 1SD of the mean on the CELF-P2 Spanish. This finding demonstrates the appropriateness of the CELF-P2 for the current sample. It also showed that when compared to a similar normative sample, participants in the current study were functioning as expected for their age. Quality assessment for sequential preschool bilinguals is lacking (Bedore & Peña, 2008; Gabani et al., 2009). The 4-year-olds evidenced difficulty with the receptive concepts and following directions. Many of the children also evidenced difficulty with the Spanish grammar, both expressively and receptively. Like Castilla et al. (2009), the children also evidenced poor grammatical skills in English.

The only other assessment that included parents with 11 years of education or less in the majority of its normative sample (79%) was the PTONI. Most participants scored within 1 SD of the mean on this assessment. The PTONI, as well as automatic naming and non-word repetition tasks, are examples of cognitive processing dependent measures that are removed from language content bias. Research is beginning to demonstrate the effectiveness of these measures in differentiating language disorder from delay in the bilingual population (Campbell et al., 1997; Vaughn et al., 2006). This test was appropriate for the current sample and indicated that children in the current sample are functioning as expected for their age, when compared to an appropriate normative sample.

In comparison, the remaining assessments did not include parents with 11 years or less of education in the majority of their normative sample (i.e., the TVIP, PPVT, and CELF-P2). The TVIP was normed on a monolingual Spanish-speaking population. The authors reported they did not collect information on the socioeconomic status from their normative population, which did not include children from rural areas of Mexico. “Debe notarse, sin embargo, que no se proporcionó información sobre el nivel socioeconómico de los sujetos. Aún más, en el proyecto no se incluyeron niños de las áreas rurales de México” (Dunn et al., 1986, p. 68-69). Thus the demographics of the participants in this sample are not accurately represented in the TVIP (Bedore & Peña, 2008). The children’s mean score was 81.72, which is more than 1.5 SD below the mean, and lower than would be expected for this sample.
Similarly, only 11.7% of the PPVT normative sample for 2-5 year-olds included parents with 11 years or less of education. Although these percentages matched the U.S. population’s demographics, they do not accurately represent the children and families in the current study (Bedore & Peña, 2008). Moreover, the children in this study were just beginning to acquire English. The PPVT was normed on a monolingual English-speaking population.

Finally in the CELF-P2’s normative sample, 16.5% of the participant’s parents completed 11 years of education or less. Although these percentages matched the U.S. population’s demographics, they do not accurately represent the children and families in the current study. This measure also was normed on a monolingual, English-speaking population. As a result, many of the participants were unable to achieve a basal on this assessment. Results indicate that the CELF-P2 is an inappropriate measure for this sample, especially the ELI which comprises the CLS, because so many children were unable to achieve a basal on these subtests. This has important implication for researchers and clinicians assessing bilingual children of similar backgrounds to the participants in this study.

_Narrow Stimulus Sampling of Construct Validity_

Construct validity refers to the specific aspect of the study responsible for effecting the results (Kazdin, 2003). Narrow stimulus sampling concerns the same limitations as the external validity constraints previously mentioned (Kazdin). The assessments used in this study were chosen because they demonstrated good construct validity, psychometric characteristics, and sensitivity on their respective normative samples (see method section). But these factors may change when applying each measure to a different sample (Campbell et al., 1997; Dollaghan & Campbell, 1998; Kazdin). This exploratory study sought to determine which current measures were best suited to assess the language of young sequential bilinguals of low SES. The children did not perform within 1 SD on the TVIP, PPVT, or CELF-P2 measures; however, the children scored within 1SD on the CELF-P2 Spanish and PTONI, demonstrating that these measures were appropriate for this sample because the normative samples were similar to the participants included in the current study. Similarly, the LENA significantly correlated to the CELF-P2 Spanish CLS and ECI. While the construct validity of LENA in the bilingual population still is under investigation, the current study demonstrated an increase in CVC with age and a significant relationship with the CELF-P2 Spanish, an assessment normed on a bilingual
population. These findings can help to inform future studies investigating or developing better instrumentation for assessing language competencies of young sequential bilinguals.

**Clinical and Educational Implications**

The current study offers insights into the home and school cultures of young sequential bilinguals of low SES backgrounds. It revealed differences in CVC across the environments. The finding that these participants vocalized more at home than at school is important when considering where to assess a young sequential bilingual. These results seem to suggest that assessing early bilinguals in their natural environment, in particular home, with familiar conversational partners, like their parents, would yield the most optimal assessment of their language abilities. Even better would be to assess them across their natural environments, to examine the true interplay of their languages. In contrast, this study’s findings support results from previous authors who caution against assessing an early sequential bilingual at school with measures that do not accurately capture their L1 and L2 development (Bedore & Peña, 2008; Epinosa, 2005).

This study also demonstrated that high adult word counts did not correspond with increases in CVC at home or at school. Conversational turns provided an explanation to this puzzling finding. Still there is much left to discover. It is possible that language might serve as a mediating variable to answer why turn counts were surprisingly low at school. If teachers only spoke English and children Spanish, this could explain why they did not engage in frequent turn-taking exchanges with a child. Similarly the multiparty interactional style common in Mexican families, also could explain this home dynamic. Another explanation could be due to differences in interactional styles, similar to those previously mentioned in parent-child interactions (Chapman, 2000; van Kleeck, 1994) or differences in teacher preparation/skills in working with young sequential bilinguals at school. Florida Department of Education (2009) reported a critical shortage of appropriately prepared teachers of ELLs in the state of Florida. More research needs to be conducted on differences in parent-child and teacher-child interaction styles in these cultures and environments to uncover how they affect conversational turns and bilingual language growth across time, as well as how teacher preparation/competence might also affect these interactional styles. Of note, van Kleeck (1994) cautioned against stereotyping Mexican culture, or any culture for that matter, because it differs from the mainstream. Rather, these
findings present new insights into how young bilinguals use and acquire their languages at home and at school.

Regarding assessments, the CELF-P2 Spanish and PTONI appear to be promising measures for evaluating the language abilities of young sequential bilinguals of low SES, more so than the PPVT, TVIP, or CELF-P2. Both measures included high percentages of parents with 11 years of education or less. However, only the CELF-P2 Spanish matched the demographics of Hispanic children residing in the United States (Wiig et al., 2009). In contrast, the PTONI’s demographics matched the entire U.S. population (Ehrler & McGhee, 2008). The PTONI is a language-free measure; whereas, the CELF-P2 Spanish is an assessment of language. Thus, concluding whether the findings of this study were largely based upon SES, as measured by parent education level, or culture still is left to be determined.

**Strengths and Limitations**

The LENA system afforded the opportunity to collect day-long language samples of bilingual children in their natural environments. Sampling in the natural environment reduces threats of external validity by reducing the concern of whether the findings generalize to quotidian life (Kazdin, 2003). It allowed for the investigation of children’s and adults’ language uses across a single day, across languages, and it granted a peek into differences in parent-child and teacher-child interactions and culture. This study is a first-step in exploring the language use of early sequential bilinguals with typical development when they entered U.S. English preschools with little to no knowledge of L2, English.

Rather than comparing all children’s standardized assessment scores to a single time point and running a simple regression, the researcher compiled multiple time points throughout each child’s day, nested them within each child, and compared them to each child’s standardized assessment scores in a two-level HLM. The design of this study proved to be a great strength, for it captured the naturalness of the data (i.e., the way it appears in real life). Children naturally go from school to home and dialogue with teachers and parents at different times of the day. Using HLM to model a two-level nested data structure of time points within individual children permitted the researcher to examine both within- and between-subject differences in a single model without inflating the risk of committing a Type I error (Raudenbush & Bryk, 2002).

Most of the variance from this study was attributed to level 1 (i.e., 92.8% within-subject variability) and the rest to the between-subject variability in child vocalization counts. Earlier
studies have observed that the relationship between L1 and L2 varies within and across children (Gutierrez-Clellen, 1996; Páez et al., 2007; Paradis et al., 2003). These data support these studies’ findings that children use their languages at different rates and that these rates differ across contexts and conversational partners. Furthermore, these rates increase with increases in conversational turns. To date, the great majority of bilingual research has focused on level-2 variables that distinguish children from one another, such as assessments. Yet the previous discussion about assessment and the design of this study suggest that focusing on within-subject variables first would explain more within-subject variability before moving on to level 2.

There are limitations to this study. Reliability of the LENA in Spanish is still underway in a longitudinal study, although preliminary data showed evidence that estimated adult word counts do not significantly differ from hand-transcribed adult word counts. Warren et al.’s (2010) investigation of the language use in children with autism reported 82% reliability of LENA adult word counts with hand transcribed adult word counts and 76% LENA CVC with hand transcribed CVC. While good, these percentages could be higher and suggest a little noise in the data. Still the current findings should be interpreted with caution until the reliability analysis is completed. The LENA automatic analyses provided limited data for this population, without a normative sample to which to compare the current study’s results.

The current study did not code for the languages the children were speaking across the various contexts. So, the reader must not assume that just because a child was at home, he was not speaking in English or speaking Spanish at school. Although this does not have implications for how the current data were interpreted, it could lend more insight to theoretical foundations of bilingual language development in future studies. Discovering how and when children use their L1 and L2 across environments will better portray the interplay between L1 and L2 and inform current bilingual theories, such as the Developmental Interdependence Hypothesis (Cummins, 1978, 2000a, 2000b; Huguet et al., 2000; Kohnert & Derr, 2004; Oller & Eilers, 2002; Proctor, 2003) and the Critical Period Hypothesis (Baker, 2006).

The children in this study were attending English-speaking preschools that monolingual English preschoolers also were attending. Therefore these children were hearing English from some of their classmates, as well as from their teachers. It is possible that the classroom peers’ vocalizations might have affected the targeted child’s CVC. LENA permits the researcher to investigate an “other” child’s vocalizations counts in relation to the key child’s CVC. The
current study did not investigate “other” child’s vocalization counts in relation to the targeted child’s CVC, but could in the future.

**Future Directions**

Future studies would enhance current knowledge through transcription of the recordings to explore the languages used by the children and adults in various settings and the manner in which they use each language. With these data, the researcher could explore various grammatical, semantic, morphological, features within and across languages and children. This would allow for the investigation of possible dialects, code-switching, and mixing that would be common for children of this age and language background. Like Eisenberg (2002), the recordings might also reveal cultural differences in interaction styles between the child and adults across environments. Future studies could add a third level to model differences among parents and teachers or schools and homes to try and explain these cultural differences. The researcher could further explore a child’s day through various activities, or continue a longitudinal study of this sample to track language trajectories across time via growth curve modeling. Following children over time could lead to the identification of preferred times for assessment of language competence in sequential bilinguals. Assessments upon entry to school may be too early as the child has not yet become accustomed to the culture of the classroom. All children in this study were from families of low SES, making it difficult to distinguish differences in culture and SES in the current study. Future studies could investigate sequential bilinguals of middle and high SES and compare their results on the LENA and assessments with the children in the current study to separate the effects of SES from culture.

Finally, assessments for preschool sequential bilinguals are limited. One finding this study made was noting the possible influence of parent level of education on the children’s performances on the standardized assessments. Information from this study can contribute to future studies concerning or developing assessments for sequential bilingual preschoolers. Commonly standardized assessments consolidate parents with fewer years of education into the category 11-years-or-less-of-education. The mean years of education for parents in this study were 8.03 (SD = 2.88) and 7.73 (SD = 3.11) for mothers and fathers, respectively. There is great variability between 8 and 11 years of education. Therefore, the disparity in this category might contribute to the lack of sensitivity some assessments show toward sequential bilinguals. Future
assessments should try to better control for this variability by collapsing this category further into more representative educational brackets.

LENA presents opportunities as well as limitations. Continued development of the LENA database for preschool bilingual children is essential if the process is going to make future contributions to the field. Prospective studies should examine methods of transcription that could be used by practicing educators and clinicians with a dynamic assessment intervention model.

Summary

This study investigated language use in sequential bilinguals of low SES across a single day with the LENA software. Children were first-generation born in the United States. Most of their parents were born and educated in Mexico. A two-level HLM was constructed with CVC as the dependent measure and environments (home and school), adult word counts, and conversational turns as the level-1 predictors. Age and individual assessments comprised the level 2 predictors. Separate HLM models were constructed for each assessment using the same conditional model. Results revealed differences in child vocalizations across environments, that is, children vocalized significantly more at home than at school. Adults talked more at home than at school, but these increased adult word counts were negatively associated with CVC. Conversational turns positively predicted CVC and did not differ across environments. Age was positively correlated with CVC. Finally, only the CELF-P2 Spanish’s core language score and expressive language index significantly predicted CVC over and above the previously specified conditional model. Theoretical, clinical, and educational implications were discussed. The researcher also offered several avenues future studies might explore to help further understanding of a bilingual’s language learning abilities and capabilities.
APPROVAL MEMORANDUM

Date: 5/14/2009

To: Rachel Saffo [rmw02d@fsu.edu]

Address: 107 Regional Rehabilitation Center; M/C 1200
Dept.: COMMUNICATION DISORDERS

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
Language Use in Natural Environment of Spanish-English Bilingual Preschoolers

The application that you submitted to this office in regard to the use of human subjects in the research proposal referenced above has been reviewed by the Human Subjects Committee at its meeting on 05/13/2009. Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 5/12/2010 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol
change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Juliann Woods, Chair [Juliann.Woods@comm.fsu.edu]
HSC No. 2009.2524
RE-APPROVAL MEMORANDUM

Date: 7/7/2010

To: Rachel Saffo

Address: 107 Regional Rehabilitation Center; M/C 1200
Dept.: COMMUNICATION DISORDERS

From: Thomas L. Jacobson, Chair

Re: Re-approval of Use of Human subjects in Research
Language Use in Natural Environment of Spanish-English Bilingual Preschoolers

Your request to continue the research project listed above involving human subjects has been approved by the Human Subjects Committee. If your project has not been completed by 5/11/2011, you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the committee.

If you submitted a proposed consent form with your renewal request, the approved stamped consent form is attached to this re-approval notice. Only the stamped version of the consent form may be used in recruiting of research subjects. You are reminded that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report in writing, any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor are reminded of their responsibility for being informed concerning research projects involving human subjects in their department. They are advised to review the protocols as often as necessary to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

Cc: Juliann Woods, Chair
HSC No. 2010.4383
APPENDIX B

PARENT CONSENT FORM (ENGLISH)

INFORMED CONSENT FORM

This research is being conducted by Rachel W. Saffo, M.S., CCC-SLP, under the guidance of Juliann Woods, Ph.D., CCC-SLP, who is professor and chair of the Department of Communication Disorders at Florida State University. I understand the purpose of the research project is to study language development in children who are dual language learners.

If I provide consent, I understand that my child will participate in speech-language evaluations over the next 12 months at no cost to me. If selected to participate in the study, the time commitment for participation is approximately 6-8 hours of assessment and one complete day of audio recording using the Language Environment Analysis (LENA) system. During assessment sessions, supervised graduate students will evaluate my child’s language and literacy skills using common assessments of receptive and expressive language, nonverbal IQ, early literacy skills, and play. My child also will be given a hearing screening. I understand that I will receive evaluation reports and printed information about my child’s performance upon request. I may be asked to provide the results of my child’s most recent audiological evaluation.

I understand my child’s participation is completely voluntary and at any time s/he may take a break. My child’s participation and responses will be kept confidential to the extent allowed by the law. The name of my child or family members will not appear on any of the results. Individual responses will not be reported with any identifying information.

I understand that there are potential benefits for participating in this research project. My child will receive a comprehensive battery of language assessments in both Spanish and English. We will learn about the results of these assessments, my child’s daily talk in the natural environment, and how to help my child strengthen both his/her languages. The results also will provide professionals with valuable information about the effectiveness of these assessments. Additionally, it will provide professionals with a better understanding of how dual language learners use their two languages in the natural environments of home and school.

I understand that my child will be tape recorded and or videotaped by the researcher. These tapes will be kept by the researcher in a locked filing cabinet. I understand that only the researcher will have access to these tapes and that they will be destroyed by Dec. 31, 2020.

No risk is anticipated, although my child may become fatigued and can take a break or discontinue at any time.

I understand that this consent may be withdrawn at any time without penalty. I understand that I may contact Rachel W. Saffo (850-644-2348) or Juliann Woods (850-645-4972) at Florida State University, Department of Communication Disorders, 107 Regional Rehabilitation Center, 32306-1200 for answers to questions about this research or my rights. Group results will be sent to me upon my request.

I give consent for my child __________________________ to participate in the aforementioned study, “Language Use in Natural Environment of Spanish-English Bilingual Preschoolers.”

Parent’s Signature __________________________ Date __________________________

Printed Name of Child __________________________ Date of birth of child __________________________

Phone Number __________________________ Email address __________________________

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-8633.
INFORMED CONSENT FORM

This research is being conducted by Rachel W. Saffo, M.S., CCC-SLP, under the guidance of Julianna Woods, Ph.D., CCC-SLP, who is professor and chair of the Department of Communication Disorders at Florida State University. I understand the purpose of the research project is to study language development in children who are dual language learners.

If I provide consent, I understand that my child will participate in speech-language evaluations over the next 12 months at no cost to me. If selected to participate in the study, the time commitment for participation is approximately 6-8 hours of assessment and one complete day of audio recording using the Language Environment Analysis (LENA) system. During assessment sessions, supervised graduate students will evaluate my child's language and literacy skills using common assessments of receptive and expressive language, nonverbal IQ, early literacy skills, and play. My child also will be given a hearing screening. I understand that I will receive evaluation reports and printed information about my child’s performance upon request. I may be asked to provide the results of my child’s most recent audiological evaluation.

I understand my child’s participation is completely voluntary and at any time he may take a break. My child’s participation and responses will be kept confidential to the extent allowed by the law. The name of my child or family members will not appear on any of the results. Individual responses will not be reported with any identifying information.

I understand that there are potential benefits for participating in this research project. My child will receive a comprehensive battery of language assessments in both Spanish and English. I will learn about the results of these assessments, my child’s daily talk in the natural environment, and how to help my child strengthen both his/her languages. The results also will provide professionals with valuable information about the effectiveness of these assessments. Additionally, it will provide professionals with a better understanding of how dual language learners use their two languages in the natural environments of home and school.

I understand that my child will be tape recorded and/or videotaped by the researcher. These tapes will be kept by the researcher in a locked filing cabinet. I understand that only the researcher will have access to these tapes and that they will be destroyed by Dec. 31, 2020.

No risk is anticipated, although my child may become fatigued and can take a break or discontinue at any time.

I understand that this consent may be withdrawn at any time without penalty.

I understand that I may contact Rachel W. Saffo (850-644-2234) or Julianna Woods (850-644-4972) at Florida State University, Department of Communication Disorders, 107 Regional Rehabilitation Center, 32306-1200 for answers to questions about this research or my rights. Group results will be sent to me upon my request.

I give consent for my child ___________________ to participate in the aforementioned study, “Language Use in Natural Environment of Spanish-English Bilingual Preschoolers.”

Parent’s Signature ___________________ Date ____________

Printed Name of Parent ___________________ Child’s Date of Birth ____________

Phone Number ___________________ Email address ___________________

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you may contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-8633.

FSU Human Subjects Committee approved on 7/7/10. Void after 5/11/11. HSC# 2010.4383
APPENDIX C

PARENT CONSENT FORM (SPANISH)

HOJA DE consentimiento INFORMADO

Esta investigación está siendo conducida por Rachel W. Saffo (logopeda) por la orientación de Juliann Woods, profesora y directora del departamento de comunicación desordenada en la universidad del estado de Florida. Yo entiendo que el propósito de este proyecto de investigación es examinar el desarrollo de lenguaje en niños bilingües.

Si decide ofrecer su consentimiento, entiendo que mi niño(a) recibirá evaluaciones del habla-lenguaje gratuitamente durante estos 12 meses que vienen. Si mi niño(a) es seleccionado para participar en la investigación, el tiempo total de compromiso será de 6-8 horas de evaluaciones y una día completa de grabaciones de audio del lenguaje de mi niño(a) por el sistema de Language Environment Analysis (LENA). Durante las sesiones de evaluación, estudiantes de Maestria darán pruebas de lenguaje y alfabetización usando exámenes comunes de lenguaje expresivo y receptivo, inteligencia, destrezas de alfabetización temprana, y juego. Yo entiendo que recibiré informes sobre las evaluaciones e información impresa sobre los trabajos que complete mi niño(a) y sus mejoras. También entiendo que los investigadores podrán pedirme una copia de la evaluación audiológica más reciente de mi niño(a).

Yo entiendo que la participación de mi niño(a) es completamente voluntaria y el/ella podrá tomar descansos o detener su participación en cualquier momento. Toda información sobre mi niño(a) será confidencial excepto cuando la ley lo exija. El nombre de mi niño(a) o de sus familiares no aparecerá en los resultados de la investigación.

Yo entiendo que podría haber ciertos beneficios directos al participar en esta investigación. Mi niño(a) recibirá una batería comprensiva de pruebas de lenguaje en español e inglés. Aprenderé los resultados de estas evaluaciones, del lenguaje de mi niño(a) en el ambiente natural, y como puedo ayudar a mi niño(a) a aumentar ambos idiomas. También los resultados de la investigación darán a profesionales la información vital sobre la efectividad de estas evaluaciones. Adicionalmente, les dará un mejor comprensión de cómo los niños bilingües utilizan sus dos idiomas en sus ambientes naturales del hogar y de la escuela.

Entiendo que mi niño(a) podrá ser grabado en video o audio por el investigador. Estas cantas serán guardadas bajo llave en el laboratorio del investigador. Entiendo que solamente el investigador tendrá acceso a las cantas y serán destruidas en o antes del 31 de diciembre de 2020.

Aunque no haya ningún riesgo asociado con participar en esta investigación, si mi niño(a) experiencia fatiga, podrá tomar un descanso o detener su participación en cualquier momento sin penalidad.

Entiendo que puedo contactar a Rachel W. Saffo (850-644-2238) o Juliann Woods (850-645-4972) a la siguiente dirección, Florida State University, Department of Communication Disorders, 107 Regional Rehabilitation Center, 32306-1200, si tengo alguna pregunta sobre esta investigación o mis derechos. Los resultados del grupo me serán enviados si lo solicito.

Doy consentimiento a que mi niño(a) participe en la investigación cuya descripción anteriormente, “El Uso del Lenguaje en el Ambiente Natural de los Niños Bilingües de Edad Preescolar” (“Language Use in Natural Environment of Spanish-English Bilingual Preschoolers”).

Firma del padre o encargado

Fecha

Nombre (en letra de molde)

Fecha de nacimiento

Número de Teléfono

Dirección de Correo Electrónico (si tiene)

Si tiene alguna pregunta sobre sus derechos como participante de esta investigación, o si entiende que ha sido expuesto a algún riesgo, puede comunicarse con el Director del Human Subjects Committee, Internal Review Board, a través del Vice-Presidente de la Oficina de Investigaciones al (850) 644-8633.
HOJA DE CONSENTIMIENTO INFORMADO

Esta investigación está siendo conducida por Rachel W. Saffo (logopeda) por la orientación de Julianne Woods, profesora y directora del departamento de comunicación desordenada en la universidad del estado de Florida. Yo entiendo que el propósito de este proyecto de investigación es examinar el desarrollo de lenguaje en niños bilingües.

Si decidí ofrecer mi consentimiento, entiendo que mi niño(a) recibirá evaluaciones del habla-lenguaje gratuitamente durante estos 12 meses que vienen. Si mi niño(a) es seleccionado para participar en la investigación, el tiempo total de compromiso será de 6-8 horas de evaluaciones y una día completa de grabaciones de audio del lenguaje de mi niño(a) por el sistema de Language Environment Analysis (LENA). Durante las sesiones de evaluación, estudiantes de Maestría darán pruebas de lenguaje y alfabetización usando exámenes comunes de lenguaje expresivo y receptivo, inteligencia, destrezas de alfabetización temprana, y juego. Mi niño también recibirá una prueba de audición. Yo entiendo que recibiré informes sobre las evaluaciones e información impresa sobre los trabajos que complete mi niño(a) y sus mejoras. También entiendo que los investigadores podrán pedirme una copia de la evaluación audiológica más reciente de mi niño(a).

Yo entiendo que la participación de mi niño(a) es completamente voluntaria y el/ella podrá tomar descansos o detener su participación en cualquier momento. Toda información sobre mi niño(a) será confidencial excepto cuando la ley lo exija. El nombre de mi niño(a) o de sus familiares no aparecerá en los resultados de la investigación.

Yo entiendo que podría haber ciertos beneficios directos al participar en esta investigación. Mi niño(a) recibirá una batería comprensiva de pruebas de lenguaje en español y inglés. Aprendiendo los resultados de estas evaluaciones, del lenguaje de mi niño(a) en el ambiente natural, y cómo puedo ayudar a mi niño(a) aumentar ambos idiomas. También los resultados de la investigación darán a profesionales la información vital sobre la efectividad de estas evaluaciones. Adicionalmente, les darán un mejor comprensión de cómo los niños bilingües utilizan sus dos idiomas en sus ambientes naturales del hogar y de la escuela.

Entiendo que mi niño(a) podrá ser grabado en video o audición por el investigador. Estas cintas serán guardadas bajo llave en el laboratorio del investigador. Entiendo que solamente el investigador tendrá acceso a las cintas y serán destruidas en o antes del 31 de diciembre de 2020.

Aunque no haya ningún riesgo asociado con participar en esta investigación, si mi niño(a) experimenta fatiga, podrá tomar un descanso o detener su participación en cualquier momento sin penalidad.

Entiendo que puedo contactar a Rachel W. Saffo (850-644-2238) o Julianne Woods (850-645-4972) a la siguiente dirección, Florida State University, Department of Communication Disorders, 107 Regional Rehabilitation Center, 32306-1200, si tengo alguna pregunta sobre esta investigación o mis derechos. Los resultados del grupo me serán enviados si lo solicito.

Doy consentimiento a que mi niño(a) ___________________________ participe en la investigación descrita anteriormente, “El Uso del Lenguaje en el Ambiente Natural de los Niños Bilingües de Edad Preescolar” (“Language Use in Natural Environment of Spanish-English Bilingual Preschoolers”).

Firmas del Padre o EncargadoFecha

Nombre del Padre (en letra de molde)Fecha de Nacimiento del Niño

Número de TeléfonoDirección de Correo Electrónico (si tiene)

Si tiene alguna pregunta sobre sus derechos como participante de esta investigación, o si entiende que ha sido expuesto a algún riesgo, puede comunicarse con el Director del Human Subjects Committee, Internal Review Board, a través del Vice-Presidente de la Oficina de Investigaciones al (850) 644-8633.

FSU Human Subjects Committee approved on 7/7/10. Void after 5/11/11. HSC# 2010.4383
nombre del niño (a): ____________________________  fecha de nacimiento: __________

(Child’s Name)  (Date of Birth)

persona llenando el cuestionario: __________  parentesco: __________________________

(Person filling out questionnaire)  (Relation)

fecha de hoy: ____________________________

(Today’s Date)

ayudantes en completar el cuestionario: ____________________________

(Person helping with questionnaire completion)

somos interesados en su(s) idioma(s) y uso de la(s). por favor conteste las siguientes preguntas. usted no está bajo ninguna obligación de contestar todas las preguntas. puede contestar las que usted desee.

(We would like to learn about your language(s) and language use. Please answer the following questions. You are under no obligation to answer all of the questions. You may answer whichever ones you choose).

1. ¿de qué país (o estado) es originalmente su familia?

(What country (or state) is your family originally from?)

2. ¿dónde nació su niño (a)?

(Where was your child born?)

3. ¿dónde nació la madre del (a) niño (a)?

(Where was the child’s mother born?)

4. ¿dónde nació el padre del (a) niño (a)?

(Where was the child’s father born?)
5. ¿Dónde nació la abuela materna del (a) niño (a)?
   (Where was the child’s maternal grandmother born?)

6. ¿Dónde nació la abuela paterna del (a) niño (a)?
   (Where was the child’s paternal grandmother born?)

7. ¿Cuántas personas viven en su hogar?
   (How many people currently live in your household?)

8. ¿Quienes viven en su hogar?
   (Who currently lives in your household?)

9. ¿Qué idiomas habla cada persona en su hogar?
   (What languages does each person in your house speak?)

10. ¿Qué idioma hablan usualmente en su hogar?
    (In what language do you usually speak in your household?)

11. ¿Cuáles otras idiomas hablan en su hogar? Cuando hablan cada una? Con quien?
    (What other languages do you speak in your household? When do you speak each one? With whom?)

12. ¿Qué idioma(s) habla su niño (a) en su hogar? Cuando habla cada una? Con quien?
    (In what language(s) does your child speak at home? When does he speak each one? With whom?)
13. ¿Qué idioma habla su niño (a) en la escuela?
   (In what language does your child speak at school?)

14. ¿Qué idioma(s) habla su niño (a) con otras personas?
   (In what language does your child speak to other people?)

15. ¿Para cuanto tiempo (en meses y en años) hablo su niño (a) cada idioma?
   (How long (in months and years) has your child spoken each language?)

16. ¿Hasta cuál grado de educación completó/fue la madre a la escuela?
   (Until what grade did the mother go to school/What grade did she complete?)

17. ¿ Hasta cuál grado de educación completó/fue el padre a la escuela?
   (Until what grade did the father go to school/What grade did he complete?)

APPENDIX E

PROCEDURAL FIDELITY OF ASSESSMENT ADMINISTRATION

Child Name _____________________________    ID____________________
Administrator____________________________    Date __________________

<table>
<thead>
<tr>
<th>Assessments</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk with graduate researcher to retrieve child from his/her classroom.</td>
<td></td>
</tr>
<tr>
<td>Bring child to testing room.</td>
<td></td>
</tr>
<tr>
<td>Give graduate researcher the child’s testing file and assessment protocol.</td>
<td></td>
</tr>
<tr>
<td>Answer any questions graduate researcher has before, during and after assessments.</td>
<td></td>
</tr>
<tr>
<td>Collect test protocol at end of session and properly file in child’s folder.</td>
<td></td>
</tr>
<tr>
<td>Place all file folders into a locked rolling cart for transportation.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LENA</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call parents day before to explain the LENA recording.</td>
<td></td>
</tr>
<tr>
<td>Forewarn the teacher and leave LENA DLP, vest, and directions in bag with her.</td>
<td></td>
</tr>
<tr>
<td>On morning of recording, check with teacher to make sure she remembered and LENA DLP is recording.</td>
<td></td>
</tr>
<tr>
<td>Collect LENA DLP, vest, and bag the next day.</td>
<td></td>
</tr>
<tr>
<td>Bring LENA DLP to FSU.</td>
<td></td>
</tr>
<tr>
<td>Transfer DLP information onto LENA computer for complete download.</td>
<td></td>
</tr>
<tr>
<td>Set computer to shut off after download.</td>
<td></td>
</tr>
<tr>
<td>Lock computer during download phase for confidentiality.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Date Tested</th>
<th>Date Worn</th>
<th>Date Returned</th>
<th>Administrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>MacArthur CDI Spanish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LENA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LENA Session Questions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TVIP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTONI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CELF-P2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CELF-P2 Spanish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX F

LENA DLP PARENT INSTRUCTIONS

Instrucciones para los Parientes del Procesador Digital del Lenguaje (DLP)

Por la mañana, cuando su niño se despierta, siga estas instrucciones:

1. Empiece por encender el DLP. Apriete el botón de encendido por aproximadamente 4 segundos hasta que la pantalla chica se encienda. Cuando está lista, la pantalla dirá, “Sleeping.”

2. Apriete el botón de grabar por aproximadamente 4 segundos hasta que la pantalla chica diga, “Recording.”

   • Ponga el DLP en el bolsillo de la ropa y cierre el bolsillo.
   • Vista a su niño en la ropa del DLP. Siga su día típico.

3. Inserte DLP here

4. Al final del día de grabación, saque el DLP del bolsillo y apáguelo al apretar el botón de encendido.

Por favor, refiera al otro lado de esta página
Instrucciones para los Parientes del Procesador Digital del Lenguaje (DLP)

Atención:
• No ponga más ropa sobre el bolsillo de DLP para que no desbarate/interrumpa la grabación.
• Para la seguridad de su niño, quite la ropa cuando:
  • El está en un asientos de seguridad (portabebé) o otros arnés de seguridad.
    
  $Se$ $deja$ $el$ $DLP$ $en$ $la$ $forma$ $de$ $“Recording”$ $(grabación)$. $Ponga$ $el$ $DLP$ $(en$ $la$ $ropa)$ $dentro$ $de$ $4$ $pies$ $de$ $su$ $niño$ $cuando$ $ustedes$ $están$ $viajando$.
  • El está durmiendo.
    
  $Se$ $deja$ $el$ $DLP$ $en$ $la$ $forma$ $de$ $“Recording”$ $(grabación)$. $Ponga$ $el$ $DLP$ $(en$ $la$ $ropa)$ $dentro$ $de$ $4$ $pies$ $de$ $su$ $niño$ $cuando$ $el$ $esta$ $durmiendo$.

Por la hora de acostarse:
• Quite el DLP del bolsillo.
• Apriete el botón de encendido por aproximadamente 3 segundos hasta que la pantalla chica se apague.
  (Ahora se puede vestir su niño en su ropa típica).
• Devuelva el DLP a Rachel Saffo a la escuela mañana por la mañana.

Muchísimas gracias,

Rachel Saffo
FSU Department Communication Science and Disorders
107 Regional Rehabilitation Center
Tallahassee, FL 32306-1200
850.878.4316
APPENDIX G

EXAMPLE OF CHILD WEARING LENA CLOTHING AND DLP

LENA Clothing
APPENDIX H

LENA SESSION QUESTIONS

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Is your child babbling by using sounds like “bababa” or “mabega”?</td>
<td>□ NO, □ YES</td>
<td></td>
</tr>
<tr>
<td>2) Is your child speaking words (talking)?</td>
<td>□ NO, □ YES</td>
<td></td>
</tr>
<tr>
<td>3) Did your child attend a daycare or preschool with other children present during your recording session?</td>
<td>□ NO, □ YES (total number of hours: ___)</td>
<td></td>
</tr>
<tr>
<td>What time was your child at daycare or preschool?</td>
<td>□ daycare, □ preschool</td>
<td></td>
</tr>
<tr>
<td>4) Did your child take any naps during your recording session?</td>
<td>□ NO, □ YES (total number of hours spent napping: ___)</td>
<td></td>
</tr>
<tr>
<td>What time(s) of the day did your child nap?</td>
<td>(e.g., 11 a.m. – 12 p.m. and 1:30 p.m. – 3 p.m.)</td>
<td></td>
</tr>
<tr>
<td>5) Was the TV on while your child was present during your recording session?</td>
<td>□ NO, □ YES (total number of hours: ___)</td>
<td></td>
</tr>
<tr>
<td>What time of day was the TV on while your child was present?</td>
<td>(e.g., 10 a.m. – 10:30 a.m. and 3 p.m. – 6 p.m.)</td>
<td></td>
</tr>
<tr>
<td>6) Is your child experiencing any health problems that might affect his or her speech?</td>
<td>□ NO, □ YES</td>
<td></td>
</tr>
<tr>
<td>If so, please indicate the health issue below:</td>
<td>□ Cold, □ Sore throat, □ Cough, □ Teething, □ Other</td>
<td></td>
</tr>
</tbody>
</table>

Additional Comments:
REFERENCES


Goldstein, B. (Ed.) (2004). Bilingual language development and disorders in Spanish-


La Revista Bilingüe, 3(2), 122-152.


kindergarten classes with a mixed population of monolinguals, simultaneous and successive bilinguals. *Journal of Multilingual and Multicultural Development, 16*, 477–495.


BIOGRAPHICAL SKETCH

Rachel Whittington Saffo completed her B.A. degrees in Modern Languages (Francophone Studies) and Communication Disorders at the University of Louisiana at Lafayette. She received her M.S. degree in Speech-Language Pathology and Ph.D. at The Florida State University. Her research interests include language development in bilingual children and children with autism. As of August 2010, Rachel will assume an assistant professorship in the Department of Speech Pathology and Audiology at West Virginia University.