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Quasi-experimental design and outcomes of a graduate clinician and caregiver-infant coaching intervention in a university speech-language pathology program

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Quasi-Experimental Design and Outcomes of a Graduate Clinician and Caregiver-Infant Coaching Intervention in a University Speech-Language Pathology Program

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Dedication

Dedicated to my family: You have each encouraged me, in your own unique way, to pursue this work which has been a child of my heart for many years. I could not have taken this path or completed this work without your belief in me and the many roles I am meant to play in life.

To my parents, William and Diann Conlin: For instilling in me a love of learning from our earliest interactions and gifting me with an ideal language learning environment. This achievement is as much yours as mine.

To my sister, Shaena Conlin Rogers: For being my first student, a very responsive baby to teach, and perhaps my greatest champion throughout all of life. Your pride in me is only matched by my pride in you.

To my sons, Aiden, Riley, and Brody Harbick: You are so much more important to me than any job or title ever could be. I could write dissertations on each of you. It is because of you that I am so effective in my role as a speech-language pathologist, educator, and supporter of other caregivers.

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Abstract

Infants are born ready to learn language as one of their most critical developmental tasks, yet infants subject to environmental risk factors related to poverty and low maternal education have been shown to lag behind their peers in language development as early as 8 months of age. Research also indicates the quality of an infant's language environment can significantly diminish the effects of these risk factors. This quasi-experimental clinical research study explored the effects of a preventive caregiver-infant coaching intervention delivered by graduate student clinicians in a university speech-language pathology program.

Developed based on a systematic review of preventive programs for caregivers-infants, the Facilitating Infant Responsiveness to Stimulate Talking (FIRST) Program provided 36 caregiver-infant dyads with education and experience in evidence-based practices known to support prelinguistic development and provided clinical experience for 70 graduate clinicians in preventive education, infant interaction, and caregiver coaching. Offered to parents of any socioeconomic status with infants ages 6- to 12-months-old, the intervention was hypothesized to be of particular benefit to the 14 participating caregiver-infant dyads from low-socioeconomic (low-SES) backgrounds. The intervention, which combined the individual attention of home visit coaching with peer-group instructive modeling, was offered as an 8-session program (2019), a 1-session program (2020), and a 4-session program (2021). A control group participated in all outcome measurements timepoints (pre-test, post-test, and a 3-month follow-up) prior to receiving a delayed session of intervention.

Scores on measures of caregiver knowledge and beliefs about early language development significantly increased for the 8- and 4-session participants. Time spent in responsive, turn-taking communication patterns significantly increased for 8-session caregivers and infants. Infant standardized expressive communication scores increased significantly in all intervention conditions. Low-SES participant scores on multiple measures of language learning showed boosts not observed in mid-high SES scores. Graduate clinician confidence in both caregiver coaching and infant assessment showed higher gains for higher numbers of intervention sessions. Overall outcomes reveal a promising preventive model for clinical education in speech-language pathology that benefits caregivers, infants, and students and should be replicable in other university settings and communities.

Chapter I: Introduction

Language acquisition is one of the most critical developmental tasks of infancy, yet infants exposed to environmental risk factors such as poverty and low maternal education have been shown to lag behind their peers in cognitive and communicative development as early as 8 months, with significant differences documented by school entry (Cates et al., 2012; DePaolis, et al., 2016; Landry et al., 2008; Suskind et al., 2015). An increasing body of research indicates that the quality of language exposure infants experience can significantly mitigate the effects of these risk factors (Masek et al., 2021; Zauche et al., 2016). In response to these findings, a variety of caregiver-focused early communication programs have emerged to encourage and equip caregivers to provide high quality language experiences to their infants. These programs fall almost exclusively outside speech-language pathology, yet speech-language pathologists are educated in, licensed to practice in, and often specialize in early intervention.

Early intervention (EI) to prevent language delay in environmentally at-risk infants has not gained the same momentum in speech-language pathology as EI for infants diagnosed with primary developmental disorders. With robust evidence (Guralnick, 2011; Roberts & Kaiser, 2011) that EI reduces disability and advances language development in infants with primary developmental disorders, speech-language pathologists (SLPs) have an integral role as interprofessional service providers under Part C of the Individuals with Disabilities Educational Improvement Act (IDEA, 2011). In comparison, despite substantial evidence that EI also reduces disability and advances language development in infants with environmental risk factors, SLPs have historically not provided services to infants from low socioeconomic (SES) backgrounds unless or

until they are diagnosed with developmental language disorders. Pediatricians, nurses, social workers, and other health-care professionals who monitor infant development address communication milestones, but their scopes of practice do not include assessing caregiver-infant communication and it is not common practice to refer infants at risk of developmental language disorders for EI (Silverstein et al., 2006). Additionally, SLPs do not typically participate in preventive early intervention (Caesar, 2020) or culturally responsive experiences as part of their clinical training (Caesar, 2013), despite required coursework in typical infant language development.

Prelinguistic and Early Linguistic Infant Development

Infant vocalizations progress throughout the first year of life beginning with the **phonation stage** (birth to 2 months) characterized by reflexive and vegetative sounds usually tied to physical states such as crying, burping, and sucking. These early phonation acts transform during the 2- to 4-month **coo and goo stage** (Bleile, 2015) with emerging nasal-like sounds and velar sounds. Laughter and imitation of caregiver intonation contours begin in this stage as infants become more comfortable in face-to-face interactions (Gratier & Devouche, 2011). These early phonatory milestones may interest caregivers and thus encourage more frequent communication exchanges with their infants, increasing opportunities for a wider range of language experiences with eye gaze and gestures as infant motor development progresses (Iverson, 2010).

By 5 months, infants typically are alert for extended periods and better at regulating their emotional states (Bornstein et al., 2020). They initiate interactions with a caregiver through eye gaze, and vocal turn-taking emerges (Bornstein et al., 2015) during this phonatory development stage termed **vocal play** in 4- to 6-month-olds. This stage is

characterized by sustained vowels, pitch and loudness variation, and the beginning of consonant-vowel productions. This vocal play stage, an early babble stage, is referred to as marginal babble because the infant productions, while approaching the characteristics of adult models, are not yet similar enough to adult "speech-like" sounds to be interpreted as such. No matter how rudimentary, marginal babble garners caregiver attention and excitement. By 5 months of age, as infants' motor and visual development enables exploration of their environment, they also use babble to elicit caregiver attention and response (Goldstein et al., 2009).

Motor and phonatory development continue to coincide with reciprocal gains observed in each domain. The peak period for mouthing objects (6 to 9 months) occurs with transition to the **canonical babbling** stage, characterized by the production of "adult -like" consonant sounds and consonant-vowel combinations with adult-like timing (Bleile, 2015; Fagan & Iverson, 2007). Rhythmically timed sequences of arm movements and hand banging precede reduplicated babble, a rhythmically timed sequenced production of the same consonant-vowel string (e.g., [dadada]), by 2 to 3 weeks (Eilers et al., 1993). Around 8 months, pointing gestures emerge at the same time infants follow a caregiver's pointing gesture with eye gaze shift and a head turn (Iverson, 2010; Reilly et al., 2006). Variegated babble, vocalizations with a relatively small set of consonants and vowels that change during string production (e.g., [magada]), also emerge as strings during the canonical babbling period (Pena-Brooks & Hegde, 2015).

Canonical babbling, while bearing resemblance to the speech sounds within the infant's language community, is not yet considered speech, but co-occurs with the transition to true words, termed by some as the **integrative stage** (Oller, 2000). During

this stage, nonmeaningful babble begins to include meaningful words (described frequently as jargon) recognizable as adult word forms and serve as a communicative function for the infant. Caregivers begin to infer meaning from these babbled productions and other forms of communication, and incorporate activities (such as peek-a-boo games) that highlight turn-taking. By 9 to 10 months infants also initiate sound-gesture games with their caregivers (Bleile, 2015) and the social context in which an infant learns to communicate becomes a critical factor to an infant's developmental progress. Interactions between an infant and a caregiver contribute more to speech learning, over and above simple exposure to environmental speech (Donnelly & Kidd, 2021; Goldstein & Schwade, 2008).

The Importance of Caregivers in Infant Language Development

As infants become capable of initiating interactions and more aware of the impact of their communication attempts, input from engaged caregivers becomes even more critical for language development. Many examples in the research literature support the reciprocal social shaping influence (Goldstein & Schwade, 2008) infants and caregivers have on each other's language. Infants produce more speech-like vocalizations when caregivers respond contingently to their babble (Goldstein et al., 2003). Caregivers simplify their language structure in response to infant babble (Elmlinger et al., 2019; Gros-Louis et al., 2006; Gros-Louis & Miller, 2018). Caregivers also modify other aspects of their speech input when engaging in infant directed speech (IDS). IDS, also referred to as "parentese" or "motherese," is characterized by a higher and more variable pitch, vowel alterations, reduced lexical diversity, shorter and redundant utterances (Fernald, 1989).

Caregiver use of IDS appears to promote infant attention to language. As early as 7 weeks of age infants demonstrate a preference for IDS over adult-directed speech (Pegg et al., 1992); and throughout the first year of life, IDS not only fosters social interaction but highlights key features of the spoken language that infants are learning (Golinkoff et al., 2015; Kalashnikova et al., 2018). Kalashnikova (2018) showed caregiver use of vowel hyperarticulation with 9- and 11-month-olds predicted expressive vocabulary at 15 and 19 months of age. Other aspects of caregiver responsivity (usually studied as maternal sensitivity and responsiveness) are predictive of later child language outcomes. Bornstein et al. (2020) showed that maternal sensitivity and language in a sample of white Americans with 5-month-old infants predicted child language at 49 months of age. Maternal responsiveness in their study was defined as prompt, accurate, contingent responses that included expressions of positive feelings and emotions toward the infant. Short et al. (2019) found that reduced child language outcomes were frequently associated with reduced caregiver responsivity in combination with other identified risk factors in the child's environment.

Measurable Predictors in Infancy of Developmental Trajectories

As illustrated in previous studies, considerable research interest addresses measurable factors associated with differences in language development trajectories. One area of inquiry is infant vocabulary knowledge. A study by Short et al. (2019) confirmed findings of others (Ghassabian et al., 2014; Henrichs et al., 2011; Reilly et al., 2010) that infant vocabulary knowledge measured before 2 years of age using formal measures (e.g., the Ages and Stages Questionnaire and the Peabody Picture Vocabulary Test) is not a sensitive predictor *in isolation* of later language delay or of need for early intervention

services. Other factors measurable in early infancy serve as stronger predictors of later language outcomes. For example, Mundy et al. (2007) found that the frequency of infant responses to communication partner eye gaze and gesture at 12 months predicts language outcomes at 24 months. Some researchers (e.g., Christensen et al., 2017) posit that individual factors, like vocabulary knowledge, can account for small amounts of variability in language development, but when compounded with other risk factors, a pattern of delayed or disordered language development can emerge. Similarly, some factors, such as strong familial support networks (Baydar et al., 2013), being read to regularly (Collisson et al., 2016; Conti-Ramsden & Durkin, 2015), and participation in high quality early childhood education can be facilitative of developmental trajectories. Protective factors like these can be measured within an infant's language environment.

Much research attention has been devoted to caregiver and familial factors that impact infant language development both negatively and positively, including maternal responsivity (Bornstein et al., 2020; Madigan et al., 2019; Pace et al., 2017), maternal education (Harding et al., 2015; Huttenlocher et al., 2010), maternal mental health (Baydar et al., 2013), number of other children in the home (Choudhury & Benasich, 2003; Harrison & McLeod, 2010), family history of language delay or disorder (Reilly et al., 2007), and SES (Nelson et al., 2011; Rice & Hoffman, 2015). Many of these factors are presumed significant to language development because they directly influence the language environment an infant experiences. For example, infants of mothers with graduate degrees are more likely to have robust language development. Huttenlocher et al. (2010) reported that the complexity and diversity of IDS increases as caregiver educational level increases from high school to a graduate degree.

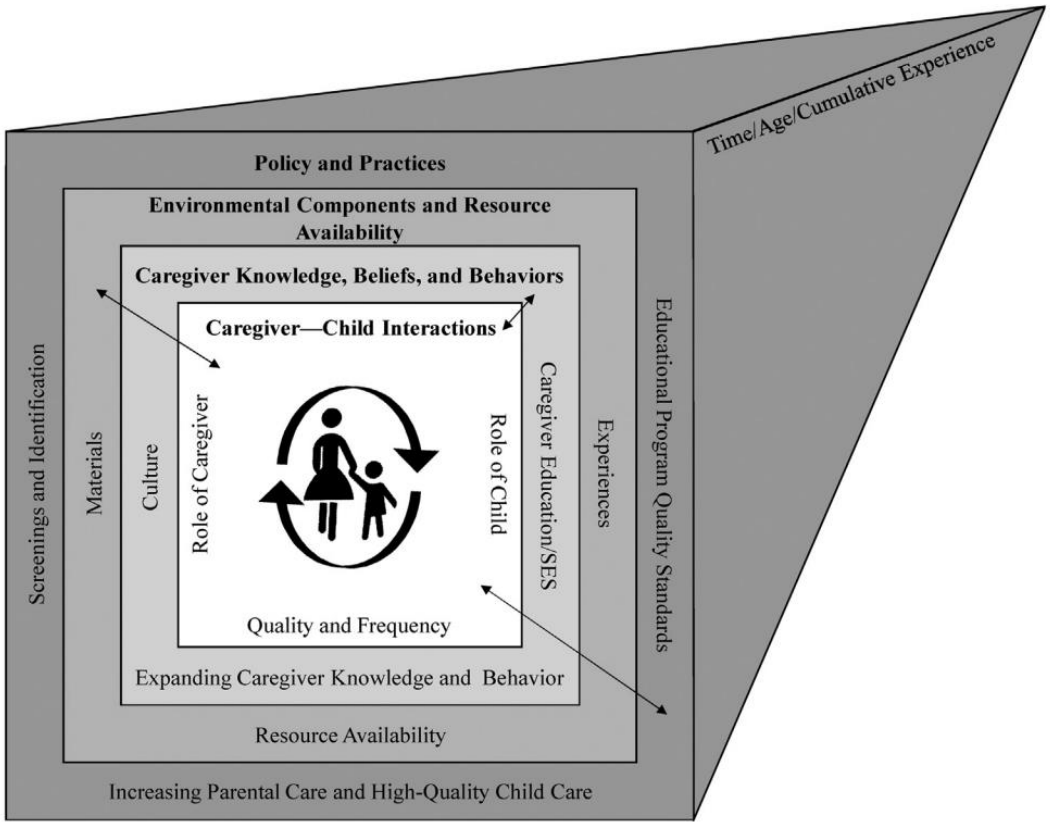
In addition to measurable predictors of language development discernible from caregiver behaviors or circumstances, other factors can be measured in the communicative interactions between infant and caregiver. Turn-taking exchanges can be measured either from video analysis and audio recording technology such as the Linguistic Environmental Analysis (LENA) system. Donnelly and Kidd (2021) identified a significant relationship between infant vocabulary growth and caregiver-infant conversational turn-taking, when the quantity of words in the language environment was controlled for. Similarly, Zimmerman et al. (2009) found that conversational turn-taking predicted language scores on the Preschool Language Scales - 4th Edition.

Ecobehavioral Models of Early Language Development

Caregiver-infant interaction findings are consistent with theories and models of early language development that center on the importance of social interaction (Sameroff, 2009). Ford et al. (2020) offered an ecobehavioral model of early language development that centers the developing child within the context of interaction with the caregiver. This model (Figure 1) posits that language is learned through interaction with caregivers which is influenced by micro-context variables (e.g., caregiver knowledge/beliefs/behavior, environmental components, family access to resources) and macro-context variables (e.g., policies and practices, community resources). While ecological models of development (Bronfenbrenner, 1977) are mainly descriptive, ecobehavioral models have the advantage of being used to understand aspects of language development most readily influenced by causal and functional variables that are malleable and measurable. The relationships between the model variables can provide guidance for intervention design and policy development.

Figure 1

Ecobehavioral Model of Language Development



Note. From Ford, A. L. B., Elmquist, M., Merbler, A. M., Kriese, A., Will, K. K., & McConnell, S. R. (2020). Toward an ecobehavioral model of early language development. *Early Childhood Research Quarterly, 50,* 246–258 (https://doi.org/10.1016/j.ecresq.2018.11.004). Copyright 2021 by Elsevier. Reprinted with permission.

Impact of Socioeconomic Status on Development

Low socioeconomic status is a risk variable that has motivated intervention and policy development for several decades. Economic hardship, especially chronic hardship, is associated with reduced cognitive and academic outcomes (Brooks-Gunn & Duncan, 1997) and patterns of early developmental delay in children from low-resourced families

contribute to later academic gaps that continue to widen over time (Halle et al., 2009). The “30 Million Word Gap” is a term derived from Hart and Risley's (1995) findings that low SES children in their small sample heard 30 million fewer words by age 4 than upper SES children. The “30 Million Word Gap” has received a lot of attention, both in terms of actionable policies and programs and, in more recent years, as the subject of skepticism (Purpura, 2019; Sperry et al., 2019).

SES by itself as a factor is a strong predictor for childhood language delays, developmental language disorders (DLDs), and learning disabilities (Fernald et al., 2013; Ginsborg, 2006; Nelson et al., 2011). However, poverty is not a uniform experience and multiple investigators have reported variability across SES groups and within parent samples of the same SES status (DePaolis, et al., 2016; Fernald et al., 2013; Gilkerson et al., 2018). SES can be a broad and easily misused construct for understanding differences in language development. As previously noted, a child’s linguistic environment is complex and subject to many factors; the quantity of parental input is only one of these factors.

Rowe and Weisleder (2020) provided a current and comprehensive literature review of the micro and macro contexts in which children develop language. The macro context includes social, political, and economic systems, culture, values, and belief systems. A child’s language environment occurs within a micro context embedded in the broader macro context. SES is a factor of both macro and micro contexts and influences outcomes in complex interactions with a host of other macro and micro contextual factors.

The Case for Prevention

A language-impoverished infancy, regardless of contributing risk factors, has implications for later life, including academic performance and educational outcomes (Sirin, 2005). Ample research evidence illustrates the cascading effects of delayed or reduced early language developmental markers. For example, the number of infant gestures used at 18 months predicts infant vocabulary at 42 months (Rowe et al., 2012). Smaller vocabularies at 24 months (Hoff, 2003) and at 40 months (Horton-Ikard & Weismer, 2007) predict reduced kindergarten-ready language. Low kindergarten vocabularies predict low reading skills at 3rd grade (Sénéchal et al., 2006) and reduced reading levels follow a child throughout education, ultimately limiting high school graduation and lifetime economic status. The impact of early language disparities on so many future life outcomes has led multiple thinkers to cast this issue as a critical public health dilemma (Greenwood et al., 2017; Mahoney et al., 2020). Indeed, Law et al. (2013) argued, from a preventive perspective and a public health framework, for increased speech-language services to be made widely available at the population level.

Historical Background of Prevention Efforts in Child Development in the United States.

The United States has historically acknowledged early childhood developmental disparities as a public health problem and funded population-level solutions. Early childhood researchers in psychology and education in the 1950s and 1960s reported findings about the impact of poverty on children's academic potential and argued for early intervention for affected children. In his 1964 State of the Union address, President Lyndon B. Johnson declared a "War on Poverty." Congress followed with a comprehensive child development program called *Head Start* to help communities meet

the needs of disadvantaged preschool children and better prepare them for elementary school success. Bronfenbrenner (1974) reviewed the first 10 years of preschool programs for low-income children and concluded a need to increase family involvement for improved and sustained outcomes for children. Congress reauthorized the Improving Head Start for School Readiness Act in 2007. The Head Start Impact Study Final Report (Puma et al., 2010) revealed that participating Head Start children performed significantly better than non-participating peers on many measures of school readiness, but advantages did not persist through the end of first grade.

In their report for the Council of Chief State School Officers, Halle et al. (2009) addressed the need to understand disparities in early development at the very youngest ages by analyzing nationally representative data from the Early Childhood Longitudinal Study-Birth Cohort. Of approximately 11,000 children born in 2001, significant disparities in cognitive and social-emotional development, and in general health, were revealed as early as 9 months in homes with low-income and low maternal education. Halle and colleagues concluded a need to address demographic developmental disparities well before age 3 and recommended preventive programming as early as possible.

Neurological Basis for Prevention in Infancy

Evidence for supporting preventive services to families during the first year of life is convincing. Language development in the first year is arguably the infant's most critical developmental task; indeed, strong evidence exists that infant language acquisition begins in utero (Kisilevsky et al., 2009). The infant brain recruits the entirety of its environment in the service of language acquisition and caregivers define this environment, acting as the primary curators of the world in which babies learn to

communicate. Environments with sufficient language exposure include positive caregiver language input, positive social interactions, and shared reading experiences (Zauche et al., 2016). A substantial body of evidence supports the influence of quality early language environments through caregiver language input or infant-directed speech (IDS) on early neural development. Zangl and Mills (2007) revealed increased neural activity (measured through cortical evoked potentials) when 6- and 13-month-olds heard familiar words presented in IDS, but not in adult-directed speech. Snell-Rood and Snell-Rood (2020) offered evidence supporting the nurturing influence of positive social support, including maternal touch and facial affect that increases growth hormones like oxytocin in the infant brain. Given that language trajectories begin at or before birth, multiple developmentalists call for preventive interventions to begin well before a child's first words (Adamson et al., 2020).

Caregiver-Focused Prevention Efforts

Given the essential role of caregivers during the most critical periods of brain development, it is not surprising that prevention efforts frequently focus on caregivers. Interventions that support caregivers as they provide engaging language environments appear to mitigate the long-term effects of multiple risk variables to some greater or lesser degree. Roberts and Kaiser (2011) concluded from their systematic review of 18 studies that parent-implemented language interventions were effective in improving language of toddlers and preschoolers with language impairment. Similarly, Heidlage et al. (2020) reviewed 25 randomized controlled trials of parent-implemented language intervention with young children and found that these interventions may lead to positive child language outcomes. Zauche et al. (2016) demonstrated from their integrative

analysis of 103 studies that caregivers “have the potential and the power to mitigate the influences of various circumstances that threaten to limit their child’s success simply by making their child their conversational partner early and often” (p. 329).

Purpose of the Study

Analysis of the literature, detailed in Chapter II, revealed an absence of speech-language pathologists—experts in infant language development, licensed and certified to offer preventive early intervention services—as professionals who work with caregivers and infants at risk of language delay because of low SES and other environmental factors. As a consequence of this absence, I developed and implemented a clinical training program to Facilitate Infant Responsiveness to Stimulate Talking (FIRST) (Harbick et al., 2021). The FIRST Program is a short-term preventive intervention that combines the individual attention of home visits with peer-group instructive coaching and modeling. The FIRST Program was offered in the Summer of 2019, the Spring of 2020, and the Summer of 2021 as a community outreach of the James Madison University Speech-Language Clinic to empower economically-disadvantaged caregivers to support the language development of their infants. The outcomes of the current study are relevant to children who are at-risk for language disorders associated with economic and other environmental risk factors, caregivers who may feel unable to influence their child's future, and speech-language pathology graduate students who typically lack experiences in EI with disadvantaged communities prior to entering the workforce (Caesar, 2020). The long-term goal of this quasi-experimental applied clinical research is to determine whether a preventive intervention using the resources of university speech-language clinics is effective for supporting language development trajectories that equip

economically-disadvantaged children with language skills necessary for success at school entry.

The purpose of this study was to explore the effects of the FIRST Program, delivered at varying levels of intensity (8-, 4-, 1-session groups, and a control group) to low SES and to mid-high SES families (who served as controls), on caregiver knowledge of infant language development, caregiver interaction practices, infant language development, and SLP graduate clinician confidence in caregiver coaching and infant language assessment.

Research Questions

Research Question 1. Does the FIRST Program make a difference or effect a change in caregiver (a) knowledge and (b) behaviors immediately after the program and three months after the program? Are there differences in outcomes based on family SES status or program intensity?

Hypotheses for RQ 1.

(a). Low SES caregivers will improve their scores on a measure of parent knowledge and beliefs about child language development and mid-high SES dyads will not experience these increases. Caregivers enrolled in greater numbers of sessions will experience a greater degree of improvement in their scores on a measure of parent knowledge and beliefs about child language development.

(b). Socioeconomic status and intervention intensity will both influence the amount of responsive, symmetrical communication used by caregivers with their infants during coded 5-minute interaction videos.

Research Question 2. Does the FIRST Program make a difference or effect a change in infant language outcomes immediately after the program and three months after the program? Are there differences in outcomes based on an infant's SES status or program intensity?

Hypotheses for RQ2.

Socioeconomic status and intervention intensity will both influence infant language scores on (a) standardized and (b) non-standardized measures of language development.

Research Question 3. Does the FIRST Program make a difference or effect a change in graduate clinician confidence in infant assessment and caregiver coaching immediately after the program? Are there differences in outcomes based on program intensity?

Hypothesis for RQ3.

Intervention intensity will influence clinician scores on measures of self-reported confidence in early intervention.

Chapter II: Systematic Literature Review

The FIRST Program was designed after analysis of a systematic literature review that emphasized the importance of preventive efforts for child language, particularly within low SES populations, as well as speech-language pathology graduate clinician need for preprofessional experience in caregiver coaching and opportunities for diverse cultural exposure.

A Survey of Early Caregiver-Focused Preventive Programming

In preparation for the development of a preventive intervention, a systematic review of other caregiver-focused prevention program models was completed (Harbick et al., 2019) from a large literature of authors from pediatric medicine, nursing, and psychology. The review was designed to identify effective preventive models that resulted in improvements in later child language outcomes and that could lend themselves to implementation within an existing framework of speech-language pathology service delivery or SLPs' training programs. Included studies were limited to those that employed a randomized-controlled trial design with typically developing infants, studied a preventive intervention that aimed to facilitate caregiver-infant interaction, and included at least one outcome measure for spoken language development. A summary of 5 preventive program models follows.

Home Visiting Interventions

Home visiting programs offer naturalistic context and convenience for parents who do not have transportation, childcare, or work leave. Sweet and Appelbaum's (2004) analysis of 60 publications on the effectiveness of home visiting programs in the United States revealed small effect sizes for both parent and child outcomes. They warned that

firm conclusions were difficult to draw with wide variability in program goals, components, target populations, and professional training of home visitors.

In contrast, Olds et al. (1997) and Olds (2006) reported on longitudinal outcomes of home visiting programs with long-term positive results in child health, academic, and social outcomes. They described positive outcomes of the *Nurse-Family Partnership* for first-time teenage mothers and public health nurses' home visits from pregnancy until the child is 24 months of age. Caldera et al. (2007) described similar approaches and outcomes from *Healthy Families America*, as did Guttentag et al. (2014) from *My Baby and Me*.

Two studies using a home visiting model met the systematic review inclusion criteria, a language-motor curriculum delivered to adolescent mothers (Hoffman et al., 2020) and a contingent talk intervention (McGillion et al., 2017), both delivered in a single in-person session. While both studies reported short-term gains in infant language development, neither were sustained over time.

Information Session and Coaching Program Models

An adaptation to the home visiting model are programs that use a similar type of guided curriculum but choose to educate participants in some combination of large and small groups with the potential for individual coaching in a location outside of the home. An example of this type of programming is *LENA® Start*, a 10-week small group program that aims to help parents increase the quantity and quality of their talk at home with young children. The LENA® (Language ENvironment Analysis) Digital Language Processor is described as a "talk pedometer" for measuring early language environments. A number of programs exist that incorporate these devices which provide parents and

professionals with quantitative data about an infant's language experience, including number of words spoken to an infant, quantity of infant vocalizations, and turns taken between an infant and a communication partner (Ganek & Eriks-Brophy, 2018). Beecher and Van Pay (2020) described a quasi-experimental investigation of the influence of the *LENA® Start* program conducted at a public library on the home language environments of children from 0 to 30 months. They found significant improvements in child vocalizations, conversational turns, and adult language input in the intervention families.

Four studies using an information session and coaching model met the systematic review inclusion criteria, one conducted in the US (Ferjan Ramírez et al., 2019) and three conducted internationally in Bangladesh (Aboud & Akhter, 2011), Vietnam (Rempel et al., 2017), and South Africa (Vally et al., 2015). These studies emphasized caregiver-infant interaction within the contexts of feeding, book-sharing, and fathering. Ferjan Ramírez et al. (2019) used LENA feedback in coaching sessions with caregivers. The number of coaching and group educational sessions in these studies ranged from 2 to 8 sessions. All of these preventive interventions resulted in improved child language outcomes.

Center-Based Interventions

Center-based approaches to early child development offer benefits like a consistent curriculum delivered by trained staff to participating children, and longer child-care hours than home-visiting programs. López (2007) described the *Carolina Abecedarian Project* (Ramey et al., 1976) as a center-based approach that provided intervention to children of single mothers with less than a high school education. Participating children received continuous childcare for 6 to 8 hours a day, 5 days a

week, starting at 3 months of age. Experimental findings included positive and lasting effects on IQ, reading and math scores, with differences in IQ detectable as early as 18 months of age. The *Infant Health and Development Program* (Ramey et al., 1992), another center-based program, provided home visits to enrolled babies born prematurely, from birth to age 3, in addition to day care. Hill et al. (2003) reported that 350 days of center-based care was a critical threshold for at-risk families in providing positive and sustained cognitive and motor outcomes.

Two studies of center-based models for preventive intervention met the systematic review criteria. Love et al. (2005) investigated the impact of Early Head Start (a program available to families with infants and toddlers prior to Head Start preschool programming) on child outcomes at age 3. Yazejian et al. (2017) evaluated the effect of the Educare program (a birth to age 5 program for low-income families) on multiple measures of child development. Both models offered hundreds of hours of child development enrichment and included elements that emphasized caregiver-infant interaction practices. Children in these studies outperformed control group children in measures of expressive language.

Pediatric Health Care Interventions

Some pediatric primary health care settings also offer intervention guidance to promote caregiver-infant interactions during well-child check-ups. Pediatricians and/or nurses address developmental milestones, book sharing activities, and other preventive practices to caregivers with young children (High et al., 2000; Klass et al., 2009; Mendelsohn et al., 2001; Needlman et al., 2005). Other pediatricians go beyond anticipatory guidance with video-recorded interactions, coaching, and group discussions,

and some offer home visits as part of their practices (Mendelsohn et al., 2011; Minkovitz et al., 2007; Paradis et al., 2013). In a 2017 systematic review of 24 primary care interventions, Peacock-Chambers et al. (2017) identified six (Chang et al., 2015; Farber, 2009; High et al., 2000; Jin et al., 2007; Mendelsohn et al., 2007; Niederman et al., 2007) that resulted in developmental improvement, but only three (Farber, 2009; High et al., 2000; Jin et al., 2007) of those specifically addressed child language outcomes.

Three studies of low intensity (completed during one well-child visit) language and literacy prevention initiatives were included in the systematic review. Goldfeld et al. (2012), Golova et al. (1999), and High et al. (2000) did not find an impact on child spoken language outcomes from these interventions.

Two other categories of preventive models for addressing infant language environments were also not represented in the systematic review because there were no outcome studies published as of June 2021 that met the established inclusion criteria. These two categories, macro-context population level campaigns, and SLP-led preventive program models are covered here.

Public Campaign Interventions

Guided by evidence that investment in early intervention yields a marked economic return (Heckman, 2006; Irwin & Siddiqi, 2010), several cities have implemented public awareness campaigns, some in addition to their home visiting programs for direct caregiver coaching. Wong et al. (2020) described *Providence Talks'* design to improve early language environments by working with caregivers on how they speak to their children. The *Boston Basics Campaign* (Boston Basics, 2020), initiated in Boston but replicated in other US cities, promotes community-wide education and

evidence-based parenting practices with focus on optimizing critical moments in parent-child interactions. The *3Ts (Tune In, Talk More, Take Turns)* developed by the Chicago-based Thirty Million Word Initiative™ , provides parent coaching curricula for newborn nurseries, home-visiting programs, and pediatrician offices (Graf et al., 2017; Leffel & Suskind, 2013; Suskind et al., 2016, 2018). *Playful Learning Landscapes* encourages parent-child engagement during everyday activities in public spaces (e.g., grocery stores, urban parks, city streets of New York City, Philadelphia, Baltimore, Toronto, and others) to build "the 6Cs - collaboration, communication, content, critical thinking, creative innovation, and confidence" (Fisher, 2011; Hassinger-Das et al., 2018).

SLP-Led Interventions

While some of the programs previously covered may involve interdisciplinary teams that include or collaborate with SLPs, none of them specifically originated from the field of speech-language pathology. The closest SLP-led correlate is The Hanen Centre's *It Takes Two to Talk Program*, a private program specifically for children birth through 5 who have language delays. SLPs trained and certified in the Canadian-based program meet parents in small groups to encourage caregiver responsive skills for communication development in naturalistic settings (Hanen Centre, 2020). Three outcome studies (Girolametto et al., 1995, 1996; Girolametto, 1988) have documented positive outcomes, including increased parental responsiveness, increased child turn-taking, and overall accelerated vocabulary and language development in participants. In their seminar on parent-directed approaches to enriching the early language environments of children living in poverty, Leffel and Suskind (2013) acknowledged that private programs like those of the Hanen Centre have much to offer children who are at risk of

DLDs related to environmental factors. They also cited lack of research evidence for generalizing program outcomes (e.g., *It Takes Two to Talk)* to culturally and economically diverse populations.

Research Questions for the Systematic Review of the Literature

SR RQ1. Do prevention programs designed to facilitate caregiver-infant interactions promote positive spoken language outcomes in young children from environmentally at-risk samples?

I also determined that if analysis of the experimental literature supported early preventive programming for this population, several follow-up questions were needed to inform the development of prevention program models suitable for settings which capitalize upon SLP expertise:

SR RQ2. What caregiver practices and behaviors are targeted in successful programs?

SR RQ3. How are these caregiver practices introduced and reinforced?

SR RQ4. How intensive should a prevention program be to produce significant outcomes in child spoken language?

SR RQ5. Are the children's spoken language outcomes long-term?

SR RQ6. How do researchers measure spoken language outcomes in prevention programs provided during infancy?

SR RQ7. How might analysis of experimental caregiver-infant prevention program practices encourage development of new prevention programs and guide next steps in Communication Sciences and Disorders (CSD)?

Systematic Review Method

After formalizing the research questions, specific inclusion and exclusion criteria for study participants, interventions, study designs, and reported outcomes were developed using the Person, Intervention, Comparison, Outcomes (PICO) framework (Richardson, 1995). The intent of this review was to isolate experimental research designs that focused on only typically developing infants or studies that had very large population-level representative samples. The search was limited to programs for which the mean age of program enrollment was 18 months or younger since evidence overwhelmingly points to the importance of this early period for language and cognitive development (Adamson et. al., 2020). Since the focus of this review was prevention programs designed to serve families that may have environmental risk factors but otherwise typically developing infants, studies with infants with medical diagnoses (such as very low birth weight) or any early behavioral indication of developmental concerns were excluded. Programs specifically for mothers with depression or prenatal drug and alcohol use were also excluded due to the additional variables that these factors may introduce into later child language outcomes. Included environmental risk variables were factors such as low SES, low caregiver education attainment, caregiver criminal history, inhabitant of an underserved area, and minority or immigrant status. To be included, studies had to have a program element that focused on caregiver's communication interactions with their infant and outcome measures of the child's spoken language

development. The minimum design criteria were randomized controlled trials (RCTs) as defined by the Integrated quality Criteria for the Review of Multiple Study designs (ICROMS, Zingg et al., 2016). Each included study was required to satisfy the minimum recommended ICROMS score which is 21 for RCTs. A summary of the inclusion and exclusion criteria is listed in Table 1.

Table 1

Systematic Review Inclusion and Exclusion Criteria

Variable	Inclusion Criteria	Exclusion Criteria
Participants		
Infants	Mean age at intervention start 0-18 months Mean gestation of 36 weeks or greater with mean birthweight of 2500 g or greater Typically developing, no medical or behavioral diagnosis that may suggest developmental concerns Consistent, primary caregiver from time of infant's birth Risk factors including but not limited to low-income, low education, rural or underserved area inhabitant, minority, or criminal history.	Mean age older than 18 months Developmental delay, hearing impairment, cerebral palsy, trisomy 21, very low birthweight, failure to thrive
Caregivers		Adoptive or foster parent without custody since birth Factors that would indicate concerns with the prenatal period including maternal

		depression, maternal drug or alcohol use
Interventions	At least one component of the intervention must be designed to facilitate caregiver-infant communicative interaction	
Study Comparison/Design	Randomized controlled trials Satisfy minimum recommended ICROMS score for design type (RCT > 21)	Case studies, pre- and post-testing with no control, non-random quasi experimental, single-subject designs
Outcomes	At least one measure of spoken language development Standardized, researcher-created, or parent report	

Search Strategy for Identification of Relevant Studies

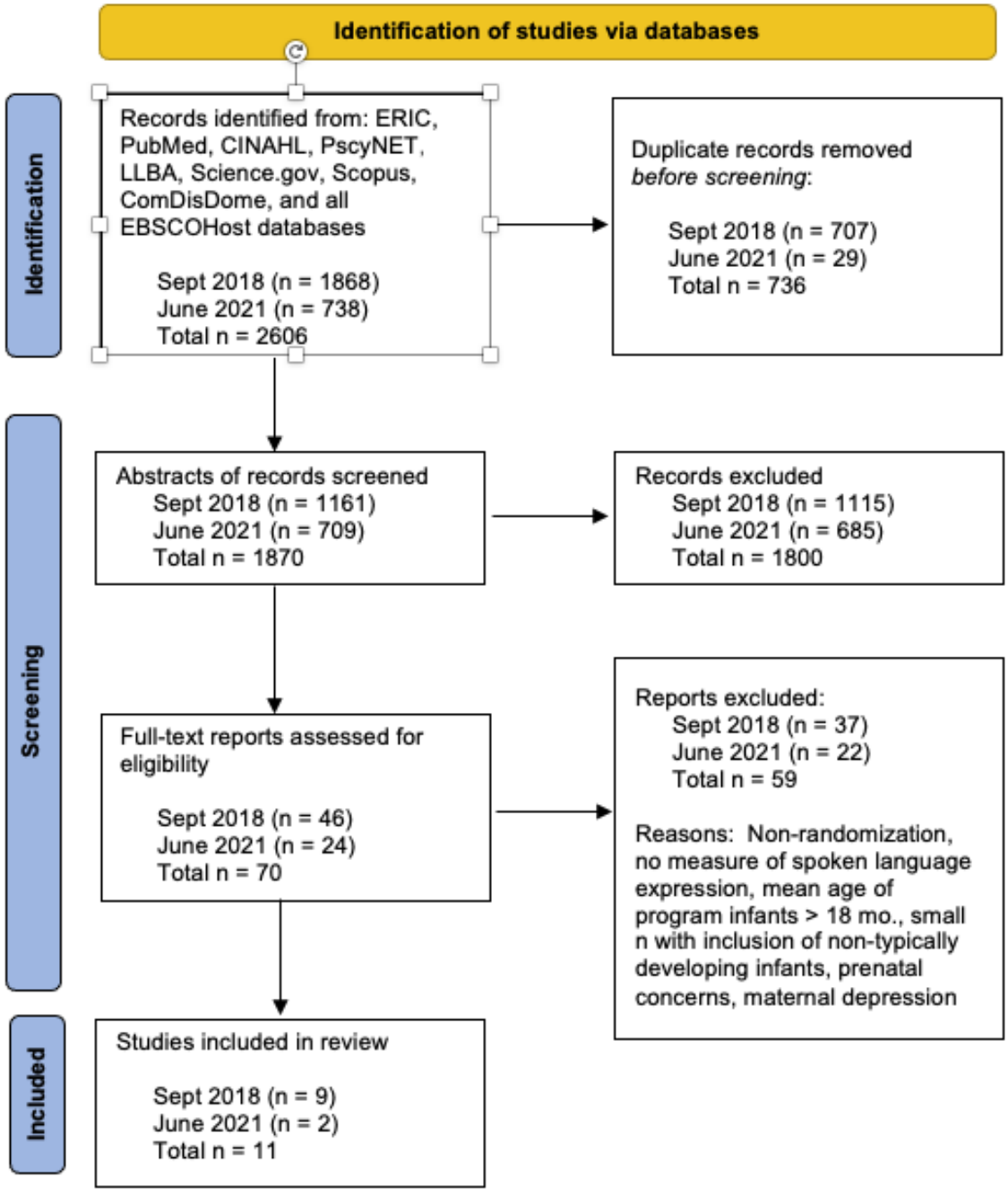
The search strategy allowed for identification and inclusion of studies from published journals, unpublished data, dissertations or theses, technical articles, and professional presentations. All studies had to be written in or translated into English. Databases were initially searched September 6-10, 2018 and queried again on June 12, 2021; span of years was unspecified in the search inclusion criteria.

A search strategy used by Zauche et al. (2016) in their comprehensive systematic integrated review on the influence of caregiver language-based interactions on early cognitive development was adapted for use in this systematic review to enable the identification of a similarly large and up-to-date literature, but for only experimental or randomized controlled trials: (infant OR baby OR newborn OR toddler) AND (infant-directed speech OR child-directed speech OR talk OR read OR engagement OR interact) AND (parent OR caregiver) AND (literacy OR language acquisition OR vocabulary OR

cognition OR language development OR neurodevelopmental outcomes) AND (allocat* OR experiment* OR random*). The search terms were used to search these databases: ERIC, PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsycNET, Linguistics and Language Behavior Abstracts (LLBA), Science.gov, Scopus, ComDisDome, and all EBSCOHost Databases with a total of 2606 potential studies identified. Three members of the review team removed all duplicate citations (736) and continued independently to screen the remaining 1870 article titles and abstracts for inclusion criteria. Articles that did not meet inclusion criteria based upon independent review of the titles and abstracts were excluded; any discrepancies between reviewers were discussed and resolved. Seventy full-text studies met the inclusion criteria. Finally, two members of the review team independently used the inclusion and exclusion criteria with each of the 70 studies, reaching 93% agreement and resolving the few disagreements through discussion with a third member of the review team. Ultimately, only 11 studies met all inclusion criteria. Figure 2 provides reasons for exclusion of 59 studies for which full texts were obtained, as well as the stages of study identification and screening according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Diagram (Page et al., 2021).

Figure 2

Flow Diagram for Selection of Articles



Adapted from: Page M.J., McKenzie J.E., Bossuyt P.M., Boutron I., Hoffmann T.C., Mulrow C.D., et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

To answer the research questions, a coding form utilizing Google Forms (Appendix A) was completed for each study by two review team members after which coding results were compared and reconciled by mutual agreement. Section 1 of the coding form included items related to the study authors, year of publication, type of publication, study objective, and how the authors answered the primary research question. Section 2 of the form involved coding characteristics of the study sample including sample size, mean infant age at study onset, and demographics of the caregivers and infants in the study. Section 3 of the form required coding characteristics of the prevention program including setting, personnel involved in implementation, caregiver behaviors targeted, methods of program delivery, materials used in program delivery, descriptions of how the program was developed, program duration and intensity, and child language outcome measures used. Section 4 of the form required coding of the RCT design characteristics including methods of randomization, blinding to participant status, attrition, and ICROMS design criteria specific to RCTs.

Systematic Review Results

The 11 peer-reviewed publications, all written in English, represented six different countries and five continents. Selected study characteristics are summarized in Table 2. All 11 studies met minimum design criteria (numerical ratings 22 and above) for RCTs and averaged 28 on the ICROMS scale for quality criteria (range from 22-32). Common reasons for ICROMS scores lower than the average of 28 related to management of bias in follow-up of subjects (protection against exclusion bias) which resulted in studies obtaining outcome measures for less than 80% of subjects. Four types of prevention program models were represented in the included publications: 3 pediatric

well-child visits (WCV), 2 home visiting programs (HV), 4 information session and coaching models (ISC), and 2 comprehensive models (COMP) that included childcare. Well-child visits took place during healthcare check-up visits and focused on literacy promotion and book sharing. Home visiting models involved home visits by trained personnel to deliver the program content. Four large- and small-group information and individual coaching sessions occurred in Bangladesh, South Africa, the United States and Vietnam. The 2 comprehensive early intervention programs included group and individual coaching sessions and home visits to emphasize caregiver-infant interaction and daily childcare. Each of the programs included low SES families. In total, 5,703 families, most with identified environmental risk factors, participated in these prevention efforts conducted across 5 different continents from 1999-2020.

Table 2

Intervention, Participant, and Outcome Summary Grouped by Intervention Model

Study Authors Intervention Sample Size Country	Brief Intervention Objective	Caregiver-Infant Risk Categories Identified	Outcome Measure(s) used to Assess Child Language Development	Did the intervention result in improved child spoken language outcomes? ICROMS Quality Score RCT > 21
Well-Child Visit Models (WCV)				
Goldfeld et al. (2012) Let's Read *n = 630* Australia	To evaluate literacy and language effects of a low intensity language intervention	Low SES	CELF - P2 Australian Edition Expressive Score	**No** ICROMS = 26

Golova et al. (1999) Literacy Promotion for Hispanic Families *n = 135* US	To evaluate the effect of a literacy promoting intervention	Low SES Single parent Low education Minority Immigrant	CDI Short form, Modified Spanish version	**No** ICROMS = 29
High et al. (2000) Literacy Promotion for Low Income Families *n = 205* US	To evaluate the effect of a literacy promoting intervention	Low SES Single parent Low education Minority Immigrant	CDI Short form, Modified	**No** for infants under 18 mo. ICROMS = 26

Home Visiting Models (HV)				
Hoffman et al. (2020) Teaching Talking & Mastering Movement *n = 108* US	To evaluate the effects of a language-motor curriculum delivered to adolescent mothers on infant language outcomes.	Low SES Low education Minority	CDI ASQ Analysis of LENA audio recorder data including adult word count, child vocalizations, and conversational turns	**Yes** though short-term gains not sustained over time ICROMS = 22
McGillion et al. (2017) Contingent talk training *n = 142* UK	To evaluate the effect of a contingent talk intervention on parent and child language outcomes	Included Low SES Included Low education	CDI Analysis of 30 minute caregiver-infant interaction videos coded for vocalizations, pointing and gaze following Analysis of LENA audio recorder data including total	**Yes** though short-term gains not sustained over time ICROMS = 32

			vocalizations and expressive vocabulary	
Information Session & Coaching Models (ISC)				
Aboud & Akhter (2011) Responsive Stimulation and Feeding Intervention *n = 302* Bangladesh	To evaluate the effect of a responsive stimulation and feeding intervention on developmental and nutritional outcomes	Low SES Low education Rural or Underserved	Modified the Bayley by extracting 11 items specific to receptive and expressive language skills	**Yes** ICROMS = 29
Ferjan Ramírez et al. (2018) Parent coaching to enhance language input *n = 79* US	To evaluate the effect of parent coaching using quantitative and qualitative linguistic feedback on parent language input and child language development	Included Low SES Included Low education	CDI Analysis of LENA audio recorder data including infant babbling and word usage	**Yes** ICROMS = 31

Rempel et al. (2017) Fathers' Involvement: Saving Brains in Vietnam *n = 771* Vietnam	To evaluate the effect of a fathering intervention on infant development	Low SES Rural or Underserved	Developmental Milestones Checklist II, 16 item Language Subscale	**Yes** ICROMS = 26
Vally et al. (2015) Dialogic book-sharing training *n = 91* South Africa	To evaluate the effect of dialogic book sharing training on child language and attention	Low SES Single parent Low education Rural or Underserved	CDI	**Yes** ICROMS = 31
Comprehensive Models (COMP)				
Love et al. (2005) Early Head Start *n = 3001* US	To evaluate the effect of Early Head Start programs on parenting practices and child development	Low SES Single parent Low education Rural or Underserved Minority	Bayley II MDI	**Yes** ICROMS = 30

Yazejian et al. (2017) Educare *n = 239* US	To evaluate the effect of Educare on the achievement gap experienced by children from low-income families	Low SES Low education Minority	PLS-4 Expressive Communication Subtest	**Yes** ICROMS = 28

Note: Low education = majority of participants had high school education or less; Immigrant = majority of participants were not born in the country in which the study was conducted; ASQ, Ages and Stages Questionnaire; Bayley II MDI; Bayley Scales of Infant Development, 2nd edition, Mental Development Index; CDI, MacArthur-Bates Communicative Development Inventories; CELF-P2, Clinical Evaluation of Language Fundamentals Preschool -2; LENA, Language ENvironment Analysis; PLS-4, Preschool Language Scale, 4th edition

SR RQ1. Do prevention programs designed to facilitate caregiver-infant interactions promote positive spoken language outcomes in young children from environmentally at-risk samples?

Analysis revealed that 8 of the 11 (73%) research teams documented significant infant spoken language gains in the intervention groups when compared to the control groups for at least one assessment time point, suggesting caregiver-infant training provides successful outcomes *most of the time*. All of the home visiting (HV), information session and coaching (ISC), and comprehensive (COMP) programs examined resulted in improved spoken language in the intervention groups that was not observed in the control groups. The well-child visit (WCV) programs did not result in improved spoken language outcomes.

This systematic literature review and analysis began as an attempt to identify evidence-based answers to questions of caregiver-infant prevention initiatives for participants with typically developing infants who may be subject to environmental risk-factors that could influence language development. Meta-analysis of the results from included studies was originally intended. However, analysis of coded outcome information revealed a lack of homogeneity in the outcome measures and reported data across the 11 studies and made the needed statistical extractions untenable. Instead, categorization and qualitative summative analysis with a vote counting method (Bushman & Wang, 1994) was employed to determine how each of the 11 studies answered the research questions (Table 2). When the features and content of successful prevention programs were aggregated, a rich evidence-based foundation for the development of

prevention programs emerged. The follow-up research questions were answered with a detailed analysis of each of the 8 prevention programs that documented improved child spoken language outcomes.

SR RQ2. What caregiver practices and behaviors are targeted in successful programs?

Seven of the 8 programs yielding improved spoken language outcomes focused on caregiver verbal responsivity, which was explained similarly in each study as encouraging caregivers to follow the infant's lead and talk about what the child was attending to. Some programs used dialogic reading/book sharing as a means to highlight opportunities to practice this type of interaction. Three of the programs targeted caregiver use of infant-directed speech and/or parentese. Three of the programs emphasized the importance of turn-taking exchanges with infants. Each of the included studies had caregiver-infant interaction as a focus of their program, though some studies included additional aims, such as Aboud and Akhter (2011) who incorporated dietary diversity and handwashing into the aims for their study conducted in Bangladesh. Table 3 details specific caregiver practices that were targeted by each prevention program.

Table 3

Summary of Characteristics of Prevention Programs that Led to Improved Spoken Language Outcomes

Authors Program Name Infant Age at initial encounter	Program or Study Objective	Program Intensity	Program Components, Methods, & Materials for Implementation *Implementation Personnel*	Specific Caregiver Practices targeted in Prevention Program
Home Visiting Models				
Hoffman et al. (2020) Teaching Talking & Mastering Movement Within hours of birth	To evaluate the effects of a language-motor curriculum delivered to adolescent mothers on infant language outcomes.	*# Encounters:* **1 in person intervention visit, 2 mailed feedback summaries, 16 weekly text messages** Assessment visits at birth, 1 week, 4 mo., & 12 mo.	-Caregivers were coached individually in one session through 7 lessons of language enrichment and 5 lessons of early motor milestones -Caregivers were mailed linguistic feedback consisting of LENA recording summaries including reinforcement for elevated word counts and reciprocal speech opportunities	-Caregiver use of infant-directed speech, reciprocal speech, and parentese -Methods to increase overall language exposure including book sharing, song routines, and playing games

		Length of Encounters: **1-2 hour in person visit**	-Weekly text message offering reminders and sample activities related to the intervention lessons *Implemented by a researcher*	
McGillion et al. (2017) Contingent talk educational video 10-12 months	To examine the degree to which social gradients exist in infant and parent communication in the first year of life, and whether a parenting intervention to promote contingent talk would have an effect on both parent contingent talk and child language outcomes.	*# Encounters:* **1 intervention home visit followed by a phone call 2 weeks later** **4 assessment home visits** Intervention visit at 11 months Assessment visits at 11, 12, 18 & 24 months	-Caregivers shown a short video identifying ways that 11 mo.-olds indicated interest in something along with examples of contingent talk -Caregivers asked to practice contingent talk for 15 min a day, keeping a diary to record progress *Implemented by a researcher*	-Caregiver use of contingent talk, defined as caregiver talk about what is in the infant's current focus of attention

		Length of Encounters: **Not specified**		
Information Session & Coaching Models				
Aboud & Akhter (2011) Responsive Stimulation and Feeding Intervention 12-18 months	To determine if a responsive stimulation and feeding intervention improved developmental and nutritional outcomes compared with a regular information-based parenting program.	*# Encounters:* **6 weekly group sessions (5 consecutive with 1 booster after 4 months)** *Length of Encounters:* **Not specified**	-A manualized intervention for conducting responsive feeding and play sessions was provided to peer-educators -Discussion of targets between peer-educator and a group of mothers including demonstrations using one of the infants present, followed by practice within mother-infant dyads -Discussion of answers to frequently asked questions and flexible solutions to common problems -Provision of opportunities to practice and problem solve with	6 messages targeted: -Maternal verbal responsivity -Responsive stimulation during play -Infant self-feeding -Solutions to child refusals -Dietary diversity -Hand washing

			peer-support as indicated by social-cognitive learning theory -Cumulative assembly of a play bag that mothers filled with items from home *Implemented by trained peer-educators*	
Ferjan Ramírez et al. (2018) Parent coaching to enhance language input and child language development 6 months	To evaluate the effect of parent coaching using quantitative and qualitative linguistic feedback on parent language input and child language development.	*# Encounters:* **2 coaching sessions, delivered at 6 mo. and 10 mo.** Assessment data collected via LENA recorders at 6, 10, and 14 months Some parents attended an additional 1 hour group	-Coach shared feedback from LENA recordings including number of adult words, turn-taking exchanges, and use of parentese -Review of selected audio samples of targeted caregiver practices with caregiver instructed to identify target practice exemplified in clip -Clips of infant babbling and word production were reviewed	-Use of child-directed speech -Use of parentese -Use of contingent back-and-forth exchanges between caregiver and infant

		support session *Length of Encounters:* **45 minutes**	-Use of Vroom Brain Building Moments cards for providing language input and interaction during daily routines -Discussion of upcoming language milestones and strategies to support this development *Implemented by a researcher*	
Rempel et al. (2017) Fathers' Involvement: Saving Brains in Vietnam 0-3 months	To examine the extent to which fathers can be taught and encouraged to develop positive relationships with their children, especially in infancy, and the effects of this fathering intervention on	*# Encounters:* **1 prenatal group session with a follow-up individual home session with each father** **1 individual session at birth of infant** **3 home visits at 7 days, 6**	-Prenatal session promoted discussion of hopes and dreams of fathers for their infant and the role of the father -Birth session promoted infant touch, discovery of primitive reflexes including facial mimicry, diaper changing instruction and receipt of a father-infant relationship calendar with suggested interaction activities at each developmental	Targeted Principles of Quality Father Involvement. Fathers need to: - be part of a team with mothers to jointly care for their infant -spend time directly interacting with their infant -be warm and caring with their infant -pay attention and be sensitive to infant needs and respond in a way that is best for the infant -touch their infant -talk to their infant

	infant development.	**weeks and 15 weeks** **A weekly 10-minute community wide loudspeaker message** **Fathers Club met monthly for 6 months** *Length of Encounters:* **Varied**	period and a spot for observation of milestones and pictures -Home visits included discussion of activities fathers could do with infants at each stage, including turn-taking, play and reading infant cues -Loudspeaker messages focused on the value of father-infant interaction. Posters with these messages also posted at health centers -Local officials and community leaders were engaged in supporting the project -Formation of a local Father's Club that allowed for sharing on topics of mutual interest and culminated in a "Father's Contest"	-help infant explore and learn in their own way and do things for themselves -play with their infant -use gentle control and correction as the infant develops -protect their infant -ensure that basic physical needs of the infant are met

			Implemented by a trained local health care provider	
Vally et al. (2015) Dialogic book-sharing training 12-18 months	To establish the impact on child language and attention of providing training in dialogic book sharing to carers of infants in an impoverished South African community.	*# Encounters:* **8 small group intervention sessions (4-5 carers-infants per group)** **Pre and post individual assessment** *Length of Encounters:* **90 minute intervention sessions**	-Sessions included a group-delivered didactic presentation accompanied by demonstration video clips as well as time for individual coaching for each dyad as they engaged in book sharing. -Sessions ended with a 20-minute group discussion about the picture book they were to take home for the week and use for 10 min. each day. *Implemented by trained local women who were supervised weekly*	Key learning points for guidance about book sharing: -Follow infant cues to actively engage them in book sharing -Point to and name objects -Emphasize the stimuli to which the infant attends -Active questioning using "where", "what" and "who" style questions -Active linking of book content to the baby's real world
Comprehensive Models				
Love et al. (2005) Early Head Start	To determine if Early Head Start programs have significant impacts on	Early Head Start programs represent a variety of	All programs in this study were using and evaluated against Early Head Start Program Performance Standards	Although targeted caregiver practices were not within the scope of this study, parent responsiveness to infants was mentioned

4-6 months	child and parenting outcomes at age 3.	models for which encounters and durations are difficult to enumerate. This study included: 4 *center-based programs* with parent education and 2 home visits a year **1, 391 mean hrs of care** 7 *home-based programs* with weekly home visits. **2-3 visits a month per family** 6 *mixed approach*	*Implemented by home visitors and teachers with varying levels of post-secondary education*	Broad aims included improved child health, social-emotional development, cognitive and language development, and parenting behaviors

		programs with center and home-based components. **2 visits a month per family, 1,400 mean hrs of care** **Assessments completed at 14, 24, and 36 months** *Total Duration:* **Birth to age 3**		
Yazejian et al. (2017) Educare (an Early Head Start program) 7-9 months	To determine if Educare, a high-quality center based program for birth to age 5 with focus on school-family partnerships, successfully reduces the	*# Encounters:* **Children are enrolled in center-based program as early as 6 weeks and children can attend until kindergarten**	While meeting EHS program performance standards, Educare meets additional more stringent standards including smaller teacher:child ratios and higher teacher education requirements. Each Educare program must also have a partnership with a local	Family engagement goals are to encourage positive parent-child relationships, help parents nurture child learning and development, and support family well-being Each program has a Policy Council composed of parents and community members that

	achievement gap between children from low-income families and more economically advantaged peers.	**2 home visits and 2 parent conferences per year** **Families are offered a variety of group meetings, activities, classes and social events.** *Length of Encounters:* **Varied** *Total Duration:* **6 weeks until kindergarten entry**	university researcher who collects data and advises for program improvement Educare incorporates four practices to improve child outcomes: -data utilization -teacher coaching and professional development -high-quality teaching and interactions -strong school-family partnerships *Implemented by teachers who had at least a 4 year college degree and were mentored by "master teachers" in addition to ongoing professional development* *Family support specialists were also involved with home visiting*	meets monthly for program planning

SR RQ3. How are these caregiver practices introduced and reinforced?

There was considerable diversity in implementation across the 8 programs and wide variation in the level of detail provided by the study authors about their program components, materials, and methods for facilitating caregiver-infant interactions. Many of the implementation methods described were necessarily influenced by the intensity of the program. Caregiver coaching, defined here as interactions with caregivers designed to strengthen existing skills and support the acquisition of new skills (Rush & Shelden, 2019), was a primary feature of every successful program; not all researchers, however, referred to their caregiver support activities specifically as "coaching." Additionally, time spent in coaching and the personnel implementing the coaching varied based on the program model. The researchers who designed the HV programs in this review, for example, delivered 1 to 2 sessions of coaching. Trained peer educators and local health care providers delivered the coaching, either in groups or individually, for most ISC programs. Teachers offered parent coaching through home visits and group instruction in COMP programs.

Coaching practices used by successful prevention programs included activities provided individually to caregivers and those delivered in groups. Individual coaching practices included the use of anticipatory guidance and discussion about strategies for supporting child development (e.g., Ferjan Ramírez et al., 2018; Rempel et al., 2017), manualized lessons covered with the caregiver by the coach (e.g., Aboud & Akhter, 2011; Hoffman et al., 2020), and highly individualized linguistic feedback from audio recordings from the infant's home environment using LENA® technology (e.g., Ferjan Ramírez et al., 2018; Hoffman et al., 2020). Group coaching practices included the use of

video examples of targeted caregiver-infant interaction skills viewed by a group and incorporated into a group discussion (e.g., Vally et al., 2015). Group coaching also included live demonstration of target behaviors with infants, and in-person practice with real time feedback provided (e.g., Aboud & Akhter, 2011). One creative program in Vietnam (Rempel et al., 2017) incorporated many community-wide events as part of their prevention programming, including a "Father's Contest," a light-hearted event where fathers creatively presented the value of father involvement and competed in a contest of fathering knowledge.

Efforts to promote carryover of targeted caregiver behaviors into the daily life of participating families included the use of handouts (Hoffman et al., 2020), weekly text message reminders of content (Hoffman et al., 2020), use of Vroom cards that provided activity ideas (Ferjan Ramírez et al., 2018), assembly of play items to be used at home during caregiver-infant interactions (Aboud & Akhter, 2011), regular use of a relationship calendar (Rempel et al., 2017) and contingent talk diary (McGillion et al., 2017), and community wide posters and announcements (Rempel et al., 2017). See Table 3 for further details.

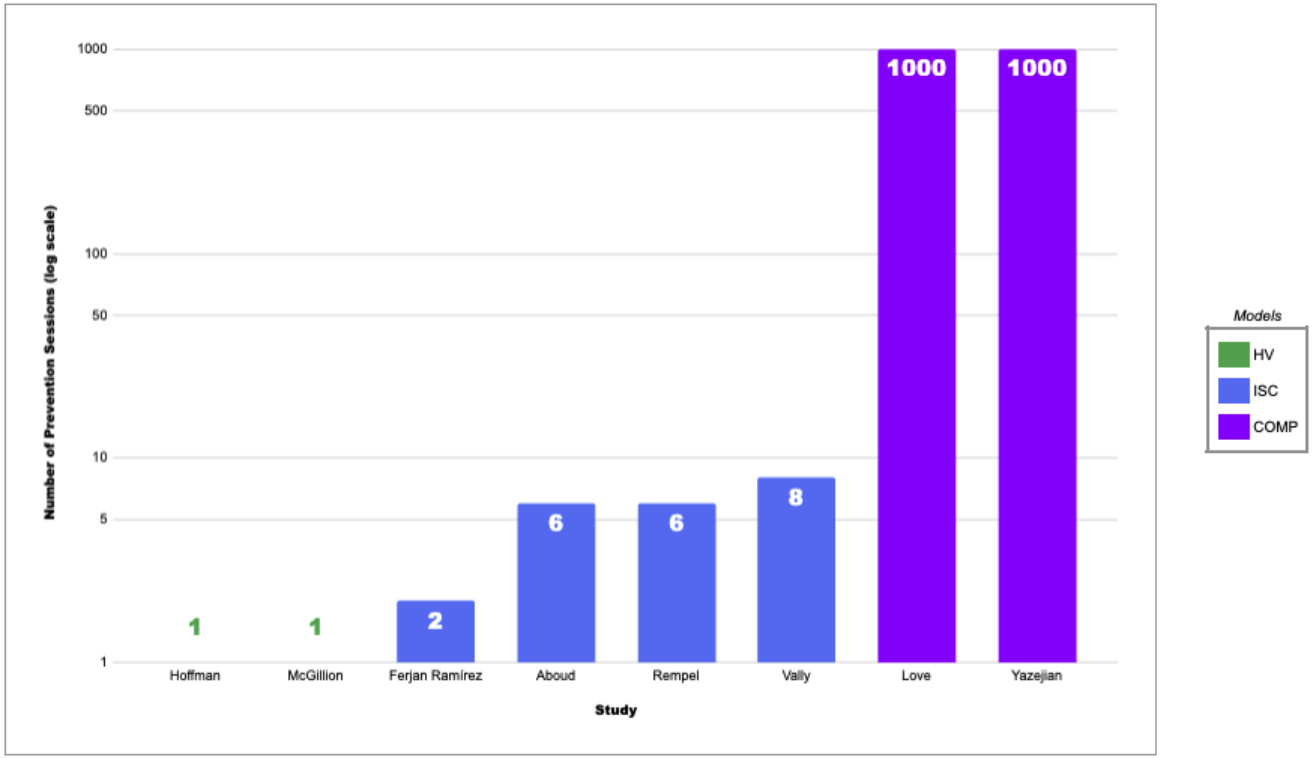
SR RQ4. How intensive should a prevention program be to produce significant outcomes in child spoken language?

Examination of the included programs yielded some potential insights but no definitive answers to this question. Figure 3 and Table 3 summarize the intensity of each program with positive outcomes for child language measured in terms of the number of sessions. The included HV programs each reported only 1 prevention session visit (Hoffman et al., 2020; McGillion et al., 2017) while the ISC programs offered a range of

intensities from a low of 2 prevention coaching session (Ferjan Ramírez et al., 2018) to 5 to 8 parent group interventions (Aboud & Akhter, 2011; Vally et al., 2015), with an additional monthly “Fathers’ Club” for 6 months (Rempel et al., 2017). The COMP programs, at the opposite end of the intensity spectrum, offered thousands of child-care hours to those infants enrolled from infancy to 3 years of age, or to kindergarten. Regular home visits usually occurred twice a month, except for more intense home visits in the first year of enrollment (Love et al., 2005; Yazejian et al., 2017).

Figure 3

Intervention Intensity by Model Type as Measured by Number of Sessions

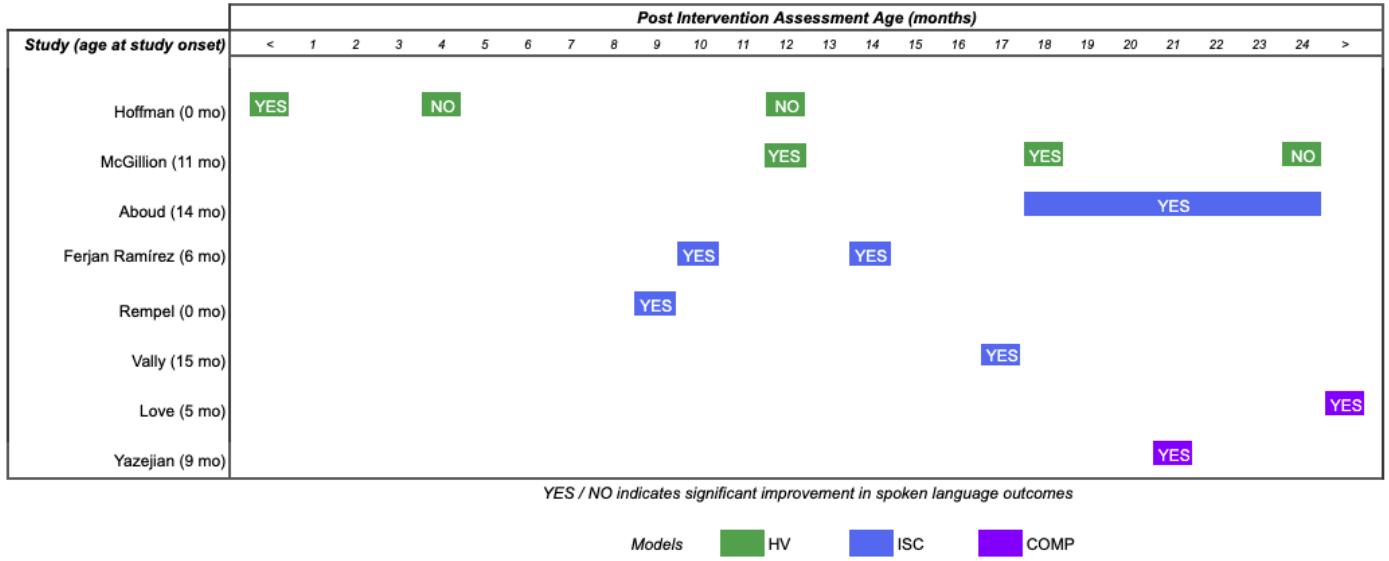


SR RQ5. Are the children's spoken language outcomes long-term?

Figure 4 summarizes the age or age range at which child spoken language outcomes were measured and reported and Table 3 offers additional detail. Not all studies reported child language outcomes for each of their identified assessment timepoints. Some investigators reported success at all assessment points, as was the case with all of the ISC and COMP studies. Investigators in both HV studies reported immediate intervention effects that were not persistent. Hoffman et al. (2020) reported an initial difference between the intervention and control groups in infant vocalization immediately following the single session of coaching but reported no differences at 4 and 12 months. McGillion et al. (2017) also employed a single session of coaching and reported meaningful gains at 15 and 18 months, but not at 24 months. Love et al. (2005) assessed child language outcomes at 36 months, the longest assessment point of this collection of studies, and reported significant language differences for children enrolled in Early Head Start in early infancy.

Figure 4

Study Assessment Points with Outcomes



SR RQ6. How do researchers measure spoken language outcomes in prevention programs provided during infancy?

Table 2 offers details about the assessment measures for "spoken" language acquisition. The review team required *spoken* language as part of the inclusion criteria, fully aware that early vocal and gestural communication and early receptive language are bound to expressive communication. Most investigators reported multiple developmental outcome measures, including receptive language and cognitive development. A few investigators also focused on outcomes (e.g., fathers' involvement, feeding outcomes) in addition to those for spoken language as part of their findings.

The most commonly used assessment (6 of the 11 studies) was the MacArthur-Bates Communicative Development Inventory (MB-CDI, Fenson et al., 2006), a parent report measure of infant and toddler receptive and expressive language development. Using a questionnaire format, the MB-CDI capitalizes on parental expertise in their child. The Words and Gestures MB-CDI measures infant language comprehension and use (vocally, verbally, and gesturally) through age 18 months. Many of the standardized assessments of child language development used in the prevention program literature allow for parent report of skills not observed or elicited by the evaluator. This option is provided because a robust literature base supports the use of parent report as a sensitive data collection tool (for background see Guiberson et al., 2011). While normative data are available for the MB-CDI starting at 8 months of age, the assessment manual, as well as other published research (Fenson et al., 2006; Fenson et al., 2000), cautions that because the normative sample was skewed toward families of higher socioeconomic status, applicability to low education/low-income families may be limited. For this reason, many

researchers used the raw data from the MB-CDIs in their analyses of infant language development and many, including Golova et al. (1999) and High et al. (2000), modified the format of the MB-CDI which can be lengthy for parents to complete.

The second most common expressive language outcome measure (3 of the 11 studies) used by included studies was the LENA® Digital Language Processor, an automated computer analysis of audio recorded caregiver-infant communication interaction (Gilkerson et al., 2017). To gather LENA® data, researchers provide participants with a small audio recorder worn by the infant in an article of clothing that records for 16 hours within the home. LENA® software then takes the audio data and estimates of the amount of speech directed to a child in their home environment, and also enables documentation and analysis of infant vocalizations/verbalizations as well as audible turns taken between adults and infants. In this review, McGillion et al. (2017) used LENA® data exclusively as an outcome measure and Hoffman et al. (2020) and Ferjan Ramírez et al. (2018) used LENA® data as *both* outcome measures and caregiver coaching tools.

Two included studies measured spoken language outcomes using the Bayley Scales of Infant Development (BSID, Bayley, 1969). Love et al. (2005) reported outcomes from the Bayley Scales of Infant Development (2nd ed.) Mental Development Index (Bayley II MDI, Bayley, 1993), which included expressive language. Aboud and Akhter (2011) extracted 11 items specific to receptive and expressive language skills from the BSID in their assessment. Other researchers measured outcomes with the Clinical Evaluation of Language Fundamentals Preschool - 2nd ed. (CELF-P2, Semel et al., 2006), the Preschool Language Scale -4th ed. (PLS-4, Zimmerman et al., 2002), the

Ages and Stages Questionnaire (Bricker et al., 1999) and the language subscale of the Developmental Milestones Checklist II (Prado et al., 2014.) McGillion et al. (2017) was the only study to include video analysis of caregiver-infant interaction as part of the outcome measurement.

SR RQ7. How might analysis of experimental caregiver-infant prevention program practices encourage development of new prevention programs and guide next steps in CSD?

Two areas of results were primarily examined for this answer: Who delivered the content of the prevention programs and how did the content and content delivery of the programming compare across program models? Coding of the primary discipline of the identified first authors was used to find that professionals from these fields were responsible for development of the prevention programs: Pediatric Medicine/Nursing (n=6), Psychology (n=4), Public Health/Policy (n=2), and Neurolinguistics (n=1). Studies varied in the amount of detail they provided about those who delivered their program content (Table 3); speech-language pathologists were not mentioned. WCV program content was delivered by pediatricians and/or nurse practitioners. HV program content was delivered by researchers though further details on the training or background of these researchers was not identified. All but one of the ISC investigators trained local peers and healthcare providers to facilitate the program content. COMP programs employed educators with 2- and 4-year degrees and educators with graduate degrees who either conducted or supervised trained family support specialists to provide services. Although some states and many federally-sponsored comprehensive programs like Early Head Start employ SLPs as part of their service provision, SLPs who work in these programs are

more likely to serve children after, not before, a diagnosis of language delay or DLD has been formalized.

As shown in Table 3, the content for improving caregiver interaction with infants was remarkably similar across all examined studies. In contrast, the method of caregiver instruction and opportunities for practice of the targeted skills varied considerably across prevention program models. HV programs were the briefest of those studied with only one coaching session each while ISC programs provided multiple sessions and highly interactive opportunities for caregivers to engage with the program content and receive individualized feedback. COMP program researchers addressed comprehensive child development, including cognitive, social-emotional, and physical development, with individual attention to caregiver-infant relationships and communication; their content is difficult to compare with the other prevention programs because of full-time developmentally-focused child care.

Systematic Review Discussion

The purpose of this systematic review and analysis was to inform the design of a university speech-language clinic-based prevention program with an emphasis on infants who may be impacted by environmental risk factors but are otherwise typically developing. The necessary precursor to the development of a prevention program is to understand if such a program is likely to meet the aims for which it is designed. The primary research question was carefully crafted to enable identification of examples of prevention programs that resulted in improved language outcomes for children who were typically developing. The results agree with other systematic reviews and meta-analyses reporting beneficial outcomes for children from parent-implemented interventions

(Heidlage et al., 2020; Roberts et al., 2019), and enabled isolation of studies that featured prevention programs for low SES families with typically developing infants at risk of language delay and DLDs.

Recommendations for Prevention Program Development in CSD

Noticeably absent from the search were studies that were directed by SLPs, highlighting an important concern that SLPs have thus far had limited involvement with the design and delivery of these programs and, arguably, could be making more contributions to the design and implementation of effective prevention programs to facilitate language in at-risk populations. Interestingly, terms such as “responsivity” (Aboud & Akhter, 2011) and “contingent talk” (McGillion et al., 2017) are familiar concepts to SLPs working in early intervention. The principles of adult learning and behavior change, present in many of these studies, also mirror EI practices used by SLPs working with parents of infants with primary disabilities (Kemp & Turnbull, 2014; Rush et al., 2003). Principles supporting the use of culturally competent peer coaches, modeling targeted behaviors, personalizing materials for relevant developmental milestones, using positive feedback, sharing goal definition between caregivers and coaches, analyzing videotaped interactions and examples, practicing with diaries to record progress, and engaging parents in group discussion and problem solving are common to speech-language pathology and those SLPs who practice in EI.

Traditionally focused on speech, language, and hearing disorders, speech-language pathologists and audiologists typically practice in the initial months of an infant’s life with screenings for disorders, particularly feeding and swallowing disorders, hearing disorders, or early signs of autism. The onset of DLDs associated with

environmental risk factors also begins in the first months of life; diagnosis and intervention are frequently delayed, however, until the developmental gap is objectively evident. It is possible that delays in services to a caregiver-child until an observable disorder has been diagnosed is in part due to the medical model in which SLP services have been traditionally delivered. The medical model favors disorder and disability over preventive services, not only in codings and other reimbursement procedures, but also in academic and clinical training. Law et al. (2013) made a compelling case for speech-language services within a public health model to highlight the value of preventive services, especially for environmental risk factors. Among their suggestions for communication science and disorders (CSD) professionals (speech-language pathologists, audiologists, speech-language-hearing scientists, SLP and audiology assistants) are models of communication competence that include "a robust understanding of the social determinants of health alongside our increasingly sophisticated understanding of the underlying biological and genetic bases of disability" (p. 492).

Successful programs in this review based their content on a well-defined body of evidence, familiar to SLPs, that emphasizes best practices in communication interactions with infants. Helping caregivers learn how to take optimal advantage of the communication opportunities present throughout the day with infants is an important ingredient to include in any prevention effort. Increasing caregiver attention to practices that enhance the quality of communication (for example, using parentese and working to facilitate turn-taking exchanges), and not just quantity, is another essential component. The content delivery models from the included programs varied in terms of intensity and methods for caregiver engagement with the material. Each of the three prevention

approaches—home visits, group coaching, and comprehensive childcare and family programs—offered some desirable features for preventive programming. Indeed, each of these approaches reported statistical evidence of improved spoken language in the intervention sample not revealed in the control sample. Short-term interventions that combine the individual attention of home visits with peer-group instructive coaching and modeling offer a reasonable approach for future prevention programs conducted by SLPs.

The systematic literature review conducted here highlights an opportunity for graduate programs in CSD, particularly those with speech-language-hearing training clinics that do not bill third-parties for services, to offer unique service-delivery (and clinical research) platforms for preventive services. Currently, only 6 of the 302 SLP masters programs in ASHA's EdFind identify EI in their "specialty tracks," and half of these address EI for deaf/hard of hearing infants, autism spectrum disorders, and bilingual specialization. Only one of the 6 programs with EI specialization emphasizes preschool language intervention and requires a "birth to preschool" language development and disorders class. Comparatively, then, EI for infants with environmental risk-factors has not been part of the SLP curriculum or prominent in clinical training.

Chapter III: Methodology

This quasi-experimental clinical investigation examined the effects of the FIRST Program on four groups of graduate students in speech-language pathology with caregiver-infant participants across four levels of intensity. Dependent variables measured caregiver, infant, and graduate clinician outcomes before the program began (pre-test assessment), immediately after the program ended (post-test assessment), and for caregivers and infants, three months after the program (follow-up assessment). Independent variables included intensity or the number of assigned sessions per group and participant socioeconomic status (SES). This chapter addresses (1) participant selection and group assignments, (2) program development including graduate clinician training and implementation of the FIRST Program, and (3) the research design of the project. All procedures were approved by the JMU Institutional Review Board across initial and revised submissions.

Participants

Thirty-four families and 70 graduate student clinicians participated in this clinical research across three programming periods. Graduate clinicians in the initial arm of the study signed up to participate as one of multiple summer practicum options. Subsequent arms of the study offered participation to all graduate students in the cohort. All students were in their second or third semester of a five-semester speech-language pathology graduate program certified by the Council of Academic Programs in Communication Sciences and Disorders; and they had completed coursework in early childhood language development and disorders, in addition to one to two semesters of clinical placements.

Sixteen graduate clinicians were assigned to 7 families in an 8-session program conducted in the Summer of 2019 on the JMU campus. The 2019 program was condensed into a single session program with 24 graduate clinicians and 12 family participants in January and February of 2020. Seven of the 2020 participants experienced the 1-session program between pre-test and post-test, while the other 5 families served as a control group and were offered the single session intervention visit virtually following the completion of data collection. All post-test assessment was finished prior to the University's March 20202 closure due to the Covid-19 pandemic. Follow-up assessments for the single session and control groups were conducted virtually. In the Summer of 2021, a 4-session version of the FIRST Program was conducted with 30 graduate clinicians and 15 families, four of whom were seen at a daycare center in New Market, VA.

Table 4 details the characteristics of the family participants by session group.

Table 4

Demographic Characteristics of Participants at Baseline Assessment 1

	8 Session (n = 7 dyads)	4 Session (n = 15 dyads)	1 Session (n = 7 dyads)	No Session (n = 5 dyads)
Infant Gender				
Female	1 (14.3%)	5 (33.3%)	2 (28.6%)	2 (40.0%)
Male	6 (85.7%)	10 (66.7%)	5 (71.4%)	3 (60.0%)
Infant Age (months)				
Mean (SD)	7.0 (2.23)	8.4 (2.59)	8.0 (2.08)	6.6 (2.07)
Median [min, max]	7.0 [3, 10]	8.0 [5, 13]	8.0 [6, 12]	6.0 [5, 10]

	8 Session (*n* = 7 dyads)	4 Session (*n* = 15 dyads)	1 Session (*n* = 7 dyads)	No Session (*n* = 5 dyads)
Infant Birth Order				
First born	4 (57.1%)	8 (53.3%)	3 (42.9%)	4 (80.0%)
Second born	2 (28.6%)	4 (26.7%)	2 (28.6%)	1 (20.0%)
Third born	1 (14.3%)	3 (20.0%)	2 (28.6%)	
Caregiver Gender				
Female	7 (100.0%)	14 (93.3%)	7 (100.0%)	5 (100.0%)
Male		1 (6.7%)		
Caregiver Age (years)				
Mean (SD)	29.9 (6.12)	33.9 (5.74)	31.7 (8.88)	35.6 (2.51)
Median [min, max]	28.0 [23, 38]	33.0 [22, 42]	31.0 [19, 46]	35.0 [34, 40]
Race/Ethnicity				
White/Caucasian	4 (57.1%)	10 (66.7%)	5 (71.4%)	5 (100.0%)
Hispanic/Latino	2 (28.6%)	3 (20.0%)	1 (14.3%)	
Black/African-American	1 (14.3%)	1 (6.7%)		
Asian/Asian-American			1 (14.3%)	
White/Kurdish		1 (6.7%)		
Degree Completion				
High School	2 (28.6%)	3 (20.0%)	3 (42.9%)	
2-year Degree	4 (57.1%)	2 (13.3%)	1 (14.3%)	
4-year Degree	-	4 (26.7%)	2 (28.6%)	4 (80.0%)
Graduate Degree	1 (14.3%)	6 (40.0%)	1 (14.3%)	1 (20.0%)
Qualification for Public Assistance	7 (100%)	6 (40.0%)	4 (57.1%)	2 (40.0%)
Socioeconomic Status[a]				
Low SES	6 (85.7%)	4 (26.7%)	3 (42.9%)	

	8 Session (n = 7 dyads)	4 Session (n = 15 dyads)	1 Session (n = 7 dyads)	No Session (n = 5 dyads)
Mid-High SES	1 (14.3%)	11 (73.3%)	4 (57.1%)	5 (100.0%)
Home Languages Spoken				
English only	4 (57.1%)	11 (73.3%)	3 (42.9%)	5 (100.0%)
English + 1	3 (42.9%)	4 (26.7%)	3 (42.9%)	
English + 2			1 (14.3%)	

[a]Socioeconomic status based on caregiver degree completion and qualification for public assistance. Low SES defined as completion of 2-year degree or less and economic qualification for Medicaid, WIC, or FAMIS.

In summary, 97% of the participating caregivers were female (one father was the caregiver) and 71% of the infants were male. Other caregivers attended the sessions along with the primary caregiver, including grandparents, partners, aunts and uncles; however, for analysis purposes only one consistent caregiver was included in the outcome measures. The mean caregiver age was 33 years old (range: 19 - 42 years) and the mean infant age was 7.5 months. While the inclusion criteria specified infants who were typically developing and between 6 and 12 months, some exceptions were made to allow younger infants needed for the participating graduate clinicians. All infants were typically developing and passed a newborn hearing screening. First-born infants made up 56% of the sample. Participants identified their race/ethnicity as White/Caucasion (71%), Hispanic/Latino (18%), Black/African American (6%), Asian/Asian-American (3%), and White/Kurdish (3%).

Socioeconomic status was determined by two factors, the need for a form of public assistance and educational attainment of the participating caregiver. Thirteen of the 34 families (38% of the total sample) that qualified for a form of public assistance based on income (e.g., Medicaid, WIC, FAMIS) and reported less than a four-year college education, were considered low SES. The distribution of low SES families throughout the sample was uneven with almost half of these families comprising almost all of the 8-session group (86%). The control group, by contrast, had no low SES families. The 1-session group had 43% and the 4-session group had 27%. (The impact of this distribution on the interpretation of the outcomes of the study will be discussed in later sections.) Similarly, the control group was the most highly educated group (100% with a four-year degree or higher) and the 8-session group was the least educated with all but one caregiver reporting a two-year degree post-high school or less. The 4-session group was also highly educated with 66% of the group reporting a four-year degree including six graduate degrees.

Functional use of spoken English was also required for enrollment. While all families spoke and understood English, there was a notable diversity in the use of home languages that were not English (32% of the total sample). The following home languages were reported: English, Spanish, Arabic, Kurdish, Twi, Mandarin, French, Italian, and American Sign Language. This language diversity was not unexpected as the sample of FIRST Program participants reflects the economic and linguistic diversity of the surrounding community. James Madison University is a public research university of 20,000 students set within a relatively rural area that historically has been a refugee resettlement community. Many of the refugees that settle in the local area are supported

and sponsored by local churches and faith communities. Harrisonburg, VA and the surrounding counties and cities (Rockingham, Augusta, Staunton, Page, and New Market) have a population of approximately 130,000 people and economic disadvantage is prevalent. According to Virginia Department of Education (VDOE) data for 2020, 69.1% of the students enrolled at Harrisonburg High School were categorized as economically-disadvantaged based on eligibility for free/reduced meals, Medicaid, Temporary Assistance for Needy Families, migrant status, or experience of homelessness (VDOE, 2020). Additionally, 33% of all students in Harrisonburg City Public Schools (HCPS) are English learners and 55 different languages are represented in their homes (HCPS, 2020).

In general, two graduate clinicians were assigned to each participating family in the FIRST Program. Following guidance from the Council for Clinical Certification in Audiology and Speech-Language Pathology, paired students simultaneously accrued clinical clock hours because they provided services and caregiver education to one child and one caregiver simultaneously. Table 5 reports the number of graduate clinicians participating in each session group. SLP clinical educators supervised up to two pairs of clinicians and each clinical educator supervised two families. Six clinical educators, all ASHA-certified and licensed by the state of Virginia, and all experienced in early childhood intervention, participated across the three years of FIRST Program arms reported here.

Recruitment

Information about the FIRST Program and opportunities for enrollment were disseminated throughout the community using flyers, informational summaries about the

program aims, content, and inclusion criteria for community partners (healthcare providers, educators, social workers), campus email listservs, social media posts, and radio ads. Community partnerships for recruitment were developed with a number of agencies, including Sentara-Rockingham Memorial Hospital, Healthy Families of the Blue Ridge, Hand in Hand Resource Mothers Program, Rockingham County Public Schools, Harrisonburg City Public Schools, Mercy House, The Gus Bus, and the Community Care & Learning Center. Interested families were instructed to call or email the FIRST Program director using a JMU email address or a dedicated google voice number for the FIRST Program. As director, I communicated with all interested parties and completed intake forms with information related to eligibility criteria, contact information, and some demographic information (Appendix F). Families were informed of the incentives attached to session attendance; these included diapers or board books after every assessment or intervention session, a meal or snack during or after each session, and an iPad or Kindle device upon completion of the entire study.

Enrollment and Attrition

In total, 34 families were enrolled in the program and attended the pre-test assessment session (Table 5). Graduate clinicians were enrolled in the study as one of several clinical practicum opportunities. Retention of the families in the program was very high. One family dropped out of the 8-session group during the intervention period. One family dropped out of the 1-session group before post-testing and another family dropped out of the same session group before follow-up testing due to pandemic related factors. The 4-session group did not experience any attrition. On a few occasions a family

missed an intervention session due to illness and these were either made up virtually or content was condensed into the next session attended.

Table 5

FIRST Participant Enrollment Groups

	8 Session	4 Session	1 Session	No Session
Infant-Caregiver Dyads	n = 7	n = 15 Tues = 7 Weds = 4 Thurs = 4	n = 7	n = 5
Graduate Clinicians	n = 16	n = 30	n = 14	n = 10
Dates:		Tuesday group dates		
Pre-test	05-17-2019	05-18-2021	01-24-2020	01-17-2020
Post-test	06-14-2019	06-22-2021	02-21-2020	02-14-2020
Follow-Up	09-16-2019	09-21-2021 Wednesday = +1 day Thursday = +2 days	05-21-2020*	05-14-2020*
Location	JMUSLC	Tuesday: JMUSLC Wednesday: CCLC Thursday: JMUSLC	JMUSLC	JMUSLC

Note. *Indicates conducted via telehealth due to COVID restrictions; JMUSLC = James Madison University Speech-Language Clinic; CCLC = Community Care & Learning Center

Intervention Program

Graduate Clinician Training

Orientation to the FIRST Program was provided in two 3-hour sessions for all groups of graduate clinicians and clinical educators. Clinician training spanned five areas: (1) intervention coaching, (2) intervention content, (3) program scheduling, (4) caregiver-infant assessment battery, and (5) session recording and data collection, all reflective of the research literature that demonstrates the rationale for a preventive caregiver-infant program (refer to Chapter II).

Intervention Coaching. The FIRST Program required SLP graduate clinicians to **coach** caregivers in communication practices with their infants, and to measure caregiver and infant outcomes. Experiences with infant populations and their caregivers are recommended but rare in the current model of clinical education (Caesar, 2020; Francois et al., 2015). *Coaching* requires sensitivity to cultural and context differences among people of differing socioeconomic status and backgrounds.

Caregiver-focused preventive interventions, especially those designed to support low SES families, must include attention to macro-context variables. Awareness of how culture can influence caregiver knowledge and beliefs about child development, and by extension, caregiving practices and behaviors (Weber et al., 2017), should be considered essential to the design and implementation of effective preventive programming. Culture may dictate the way in which a caregiver interacts with a preverbal infant, expectations

for adult-child communication, beliefs about the parental role in child development, and the value placed on education and literacy (Rowe, 2008; Schieffelin & Ochs, 1996; Woods & Brown, 2011). For example, in cultures in which it may be considered inappropriate to incorporate play routines into caregiver-infant interactions, a coach may need to consider non-play routines that occur as part of infant-care as a means to target turn-taking exchanges. Coaches should be equipped to uncover cultural values, beliefs, child rearing practices, and activities of families from a different culture than their own (Cycyk & Hammer, 2018).

The participating graduate clinicians, in many cases, were from a higher socioeconomic level than the caregiver and infant to whom they were assigned. Graduate clinicians were instructed to emphasize that caregivers are the expert in their child and to skillfully draw out parental knowledge and awareness of their infant. Clinicians were trained to do this through observations, questions, noting changes, and documenting infant skill growth throughout the program, and asking parents to watch for specific behaviors outside of the sessions. They attempted to become "expert partners" in helping a new caregiver appreciate the relational opportunities present in infancy, as well as aspects of infant development in context. Instead of telling caregivers "what to do," clinicians focused on discovering and drawing out what a caregiver desired for their child, seeking answers to questions such as: What do you want for your child? What do you think would be helpful? Learning to acknowledge and put aside one's own cultural assumptions and experience as a student, and, instead, to focus on answers to these family-centered questions, became the approach that graduate clinicians used to weave

connections between the content of the intervention and the aspects of their family's daily life in a culturally sensitive manner.

Caregiver Coaching and the Theoretical Foundations of Adult Learning. Graduate clinicians were provided with a formative experience in the clinical knowledge and skills necessary to practice in early intervention as speech language-pathologists. Part C of the Individuals with Disabilities Education Improvement Act (IDEA, 2004) mandates provider-family partnerships in EI service delivery. Caregiver involvement is expected in all service components, including development of goals, monitoring progress, and conducting intervention. In order to be effective within this model, EI SLPs need to be engaged in practices that build caregiver capacity for supporting their child's language development and build upon existing caregiver strengths. An important component of the graduate clinical training included coaching for caregiver capacity building.

Enhancing caregiver self-efficacy, or the caregiver's beliefs about their ability to influence their child's development, is a critical goal in building caregiver capacity. In a study of low SES families, Alper et al. (2021) found that children's receptive and expressive language scores were significantly associated with maternal self-efficacy and developmental knowledge. Moreover, mothers with higher self-efficacy were more responsive to children and their children had higher rates of conversational turn initiation. These outcomes are consistent with other literature reviews that link parental self-efficacy and developmental knowledge with positive child development outcomes (Albanese et al., 2019; Peacock-Chambers et al., 2017).

Adopting the role of a "coach," rather than an interventionist, requires a skill set that is focused on facilitating caregiver learning and application of strategies within daily

family settings and routines, rather than on more traditional deficit-based, child-focused services. The term “coaching” is frequently used in early intervention literature but there is currently no commonly agreed upon definition in the context of early childhood intervention. Rush and Shelden (2019) proposed the following evidence-based definition of coaching:

> An adult learning strategy in which the coach promotes the learner’s (coachee’s) ability to 1) reflect on his or her actions as a means to determine the effectiveness of an action or practice and 2) develop a plan for refinement and use of the action in immediate and future situations. (p.8)

Rush and Shelden (2019) identified five coaching practices that led to positive outcomes: joint planning, observation, action/practice, reflection, and feedback. These coaching behaviors, while implemented in programs and research in a variety of frameworks, are based on the theoretical foundations and practices of adult learning theory, or “andragogy” (Knowles et al., 1998). Adult learning theory, fundamentally different from child learning, or “pedagogy,” capitalizes on strengths that adults bring to the learning process, including skill in self-direction, diversity of prior experience to draw upon, intrinsic motivation to learn when assuming new roles, appreciation for the value of involvement in problem-solving, and interest in the immediate application of new knowledge. Graduate clinician training followed evidence-based practices from the coaching literature (Brown & Woods, 2016; Trivette et al., 2009; Wyatt Kaminski et al., 2008) emphasizing active caregiver practice within the coaching session in anticipation

of more positive learner outcomes and more positive effect sizes, for both caregivers and infants.

Friedman et al. (2012) provided a common lexicon and robust definitions of specific coaching skills, many of which incorporate opportunities for active caregiver engagement with learning. These definitions served as a framework for the study of specific coaching behaviors in a growing body of caregiver coaching literature (e.g., Brown & Woods, 2015, 2016; Kemp & Turnbull, 2014; McDuffie et al., 2013; Sone et al., 2021). The coaching curriculum of the FIRST Program situated student clinicians, caregivers, and infants within the coaching framework used in these studies, as described in Table 6.

Table 6

Caregiver Coaching Strategies Used in the FIRST Program

Coaching Strategy	Description Summary	Method of Inclusion in FIRST
Direct teaching	Coach provides print, verbal, visual, and video information on "how to" and "why" content about specific strategies, about child development, and about how to embed intervention.	Developmental and strategy information provided to caregivers via clinician developed handouts, individual and group discussion, video examples, and online content.
Demonstration	Coach narrates actions while modeling the strategy with the child, and describes what the	Clinical educators modeled and narrated use of the target strategies with infants in the large group setting and clinicians

	coach is doing while the caregiver observes.	modeled and narrated during individual coaching sessions.
Guided practice with feedback	Coach offers specific recommendations or suggestions in the context of the routine to help the caregiver implement the strategy or maintain the child's engagement and participation. The caregiver and coach may be jointly supporting the child or taking turns.	Clinicians and caregivers worked together to practice the targeted strategies for engagement and turn-taking with the infant during individual sessions. Clinical educator support and feedback were frequently provided.
Caregiver practice with feedback	Coach offers encouragement and feedback to the dyad while the caregiver is the primary partner with the child. Feedback may be specific to the child's or caregiver's participation or performance.	Caregivers and infants recorded a 10-min. interaction video on iPads at the start of each coaching session. Clinicians used these videos in the session with caregivers to highlight use of target strategies and provide feedback. After the session videos were used to track progress and collect data.
Problem solving and/or reflection	Coach and caregiver jointly describe the child or routine status from their perspectives. The caregiver, with supports from the coach, evaluates alternatives and/or appraises,	Clinicians and caregivers devoted time each session to appraise progress from both the 10-min. videos and caregiver perception of progress at home. Various supports were provided

	assigns meaning, or expresses feelings about what happened.	to encourage reflection and goal setting.

Note. Adapted from Brown & Woods (2016) and Friedman et al. (2012).

Intervention Content. The format of the FIRST Program derived from the systematic literature review of successful caregiver-infant programs for improved language development (Harbick et al., 2019). Graduate clinicians were trained in the evidence-based intervention content, as discussed in Chapter II and as shown in Table 7.

Table 7

FIRST Program Intervention Focus and Supporting Literature

Foundational Elements of Language Ability	Evidence from Selected References
Caregiver Contingent Responsiveness	Hirsh-Pasek et al., 2015; Landry et al., 2006; McGillion et al., 2017
Joint Attention	Adamson et al., 2014; Butterworth, 1995; Corkum & Moore, 1995; Mundy et al., 2007; Salo et al., 2019
Infant-Directed Speech (IDS)	Brent & Siskind, 2001; Fernald & Mazzie, 1991; Nelson et al., 1989; Zimmerman et al., 2019
Use of gestures	Goldin-Meadow et al., 2007; Salo et al., 2019; Vihman & Miller, 1988
Verbal and non-verbal turn-taking	Bloom et al., 1987; Donnelly & Kidd, 2021; Gilkerson et al., 2018; Masataka, 1993; Romeo et al., 2018; Tauzin & Gergely, 2019

Graduate clinicians were trained to present these caregiver behaviors and skills, using a framework developed by the Thirty Million Words (TMW) Center for Early Learning + Public Health (TMW Center, n.d.) and presented in the book "Thirty Million Words: Building a Child's Brain" (Suskind et al., 2015). The TMW framework provides easy-to-remember phrases for the key caregiver behaviors: "The 3Ts." Responsivity and joint attention were discussed using the phrase "Tune In." Characteristics of and opportunities for IDS were discussed using the phrase "Talk More." Use of back-and-forth communication was highlighted with the phrase "Take Turns." Also, unique to the FIRST Program, was an additional phrase emphasizing the importance of touch and gesture for communication with infants, "Use Touch."

As the FIRST Program Director and instructor, I offered evidence-based presentations, video examples, and interactive demonstrations in training the graduate clinicians, and as instructional content at the beginning of every intervention session with all participants, graduate clinician coaches with assigned caregivers-infants, and supervising clinical educators assembled together in a large group setting. Some of the supporting resources were developed by the TMW Center which provided true-to-life video examples of caregivers using the 3Ts as well as animated illustrations of scientific concepts using plain language (Leung et al., 2020). Table 8 presents additional resources available to the graduate clinicians.

Table 8

FIRST Program Coaching Resources

Coaching Guide	A summarization of *Thirty million words: Building a child's brain* (Suskind et al., 2015), this guide connected the 3Ts intervention targets back to the research evidence and provided specific coaching tips and strategies that clinicians could draw upon when working with families. (Appendix D)
Coaching Content Idea Guide	A menu of options to accompany the focus of each intervention session, clinicians used this guide to plan individualized sessions in conjunction with insights from session data collection and clinical educator input. (Appendix B)
Zero to five: 70 essential parenting tips based on science by Cutchlow (2014)	Used as the "caregiver text", clinicians selected topics within the book that reinforced the content of each intervention session and incorporated these into session discussion and activities. Each caregiver was given their own copy of this book after post-testing was completed.
The CDC Developmental Milestone Webpages	Content from these webpages was used by clinician to discuss infant progress in multiple areas of development. Of note are video examples of each developmental milestone. https://www.cdc.gov/ncbddd/actearly/freematerials.html#customizematerials
TMW Center for Early Learning + Public Health	Used to reinforce large group instructional content, clinicians could select true to life videos of caregiver-infant interactions that demonstrated the 3Ts and other strategies to foster interaction such as labeling, narration, and expansion. https://tmwcenter.uchicago.edu/

Program scheduling and consenting. Graduate clinicians were trained in the scheduling needs of the FIRST Program, both for consistency across the different groups and for consistency within the intervention and assessment schedules. The specific

schedules for each condition are presented below (Tables 9 and 10). The schedules for assessment days differed from the schedules for intervention days.

Table 9

Assessment Day Schedule

8 Session Group	4 Session Group	1 Session Group
9:00 AM Set up	4:00 PM Set up	9:00 AM Set up
9:30 -Participant arrival -Breakfast	5:00 -Participant arrival -Caregiver-Infant interaction video recording	9:30 -Participant arrival -Caregiver-Infant interaction video recording
10:00 -Caregiver-Infant interaction video recording	5:15 -Assessment Battery in individual coaching groups	9:45 -Assessment Battery in individual coaching groups
10:00 -Assessment Battery in individual coaching groups	Families depart when all assessment components are finished	Families depart when all assessment components are finished
Families depart when all assessment components are finished		

Table 10

Intervention Day Schedule

8 Session Group	4 Session Group	1 Session Group
9:00 AM Set up	4:00 PM Set up	9:00 AM Set up
9:30 -Participant arrival -Breakfast	5:00 -Participant arrival -Large group interactive education/presentation	9:30 -Participant arrival
10:00 -Large group interactive education/presentation	5:30 -Caregiver-Infant interaction video recording	9:45 -Large group interactive education/presentation (all content)
10:30 -Caregiver-Infant interaction video recording	5:40 -Coaching session	10:45 -Caregiver-Infant interaction video recording
10:40 -Coaching session	6:30 -Participants depart -Clinical debriefing -Clean up	10:55 -Coaching session
11:30 -Support Groups		11:45 -Participants depart -Clinical debriefing -Clean up
12:00 -Participants depart -Clinical debriefing -Clean up		

Graduate clinicians were also trained to their paired roles in large group and individual caregiver-infant sessions. Clinicians worked together to engage both the infant and the caregiver in the content of each intervention session during the large group instructional time and in the customized session they planned for each dyad following the large group. Tables 11-13 summarize the instructional emphases for each intervention

session. The 8-session group received multiple contexts for application of the 3Ts with the support of community "experts."

Table 11

Large Group Content and Coaching Session Focus for 8 Session Group

8 Session Group		
Intervention 1: *Tune In*	**Intervention 2: *Talk More***	**Intervention 3: *Attachment***
• Language environments • Learning to identify infant focus of attention • Responsivity • How do preverbal infants communicate?	• Identifying opportunities for infant interaction within daily routines • Using description, labeling, and narration to talk with infants • Using parentese to facilitate infant attention	• Attachment Therapist (LPC) discussed developmental milestones of healthy attachment • The basics of healthy attachment are facilitated by caregiver-infant interaction and responsivity
Intervention 4: *Take Turns*	**Intervention 5: *Music Play***	**Intervention 6: *Feeding***
• Neurological changes that occur during turn-taking • Turn taking opportunities during book sharing • Turn taking using preverbal infant skills like eye gaze and vocalization • Turn taking during play routines	• Music therapist discussed and demonstrated opportunities for caregiver-infant interaction in various forms of music play	• SLP with feeding expertise addressed feeding milestones and recommendations • Addressed previously submitted participant questions • Discussed opportunities for use of the 3Ts within feeding routines

Intervention 7: ***Touch & Gesture***	**Intervention 8:** ***Sleep and Motor Development***
• SLP with expertise in gestural development and communication discussed and illustrated gestural basis of later spoken language development	• Pediatric Nurse Practitioner addressed sleep concerns, routines, and motor development • Addressed previously submitted participant questions • Discussed opportunities for use of the 3Ts within daily routines • Discussed how motor development facilitates language development

Table 12

Large Group Content and Coaching Session Focus for 4 Session Group

4 Session Group	
Intervention 1: ***Tune In***	**Intervention 2:** ***Talk More***
• Language environments • Learning to identify infant focus of attention • Responsivity • How do preverbal infants communicate?	• Identifying opportunities for infant interaction within daily routines • Using description, labeling, and narration to talk with infants • Using parentese to facilitate infant attention
Intervention 3: ***Take Turns***	**Intervention 4:** ***Touch & Gesture***
• Neurological changes that occur during turn-taking • Turn taking opportunities during book sharing • Turn taking using preverbal infant skills like eye gaze and vocalization • Turn taking during play routines	• SLP with expertise in gestural development and communication discussed and illustrated gestural basis of later spoken language development

Table 13

Large Group Content and Coaching Session Focus for 1 Session Group

1 Session Group
Intervention 1: *Key Highlights of the 3Ts*
• Language environments • Learning to identify infant focus of attention • Responsivity • How do preverbal infants communicate? • Identifying opportunities for infant interaction within daily routines • Using description, labeling, and narration to talk with infants • Using parentese to facilitate infant attention • Neurological changes that occur during turn-taking • Turn taking opportunities during book sharing • Turn taking using preverbal infant skills like eye gaze and vocalization • Turn taking during play routines

Note. The No-session group received a single session of intervention after follow-up testing in May 2020 via virtual means (due to the pandemic).

Graduate clinicians were responsible for the consenting process integral to clinical research. Caregivers were individually engaged in understanding and giving consent one-on-one with the graduate clinicians they were assigned to. The graduate clinicians were trained to explain the consent forms to caregivers who had varying levels of literacy. Specific examples of phrases in the consent forms, such as educational outreach activities, were provided to ensure that caregivers understood to what they were consenting. Graduate students made clear the need for video-audio recordings, both as critical to the FIRST Program and for graduate student training. Graduate clinicians also assisted caregivers with the completion of other forms that were established procedure at client intake, including an allergy form and the Notice of Privacy Practice and Consent

for video recording for educational purposes. A Covid-19 screening form was completed by the graduate clinician for each participant prior to every assessment or intervention session during the 2021 programming.

Other Location, Time of Day, and Scheduling Considerations. The 8-session group in 2019 attended morning sessions on the campus of James Madison University. Some families drove to the sessions, others were dropped off, and a few walked to the clinic location or took public transportation. On assessment days, families were greeted by their graduate clinicians, offered breakfast, and taken directly to individual coaching rooms within the JMUSLC for data collection. On intervention days, the large group portion of the program was conducted in a large classroom with breakfast provided. Blankets and toys were spread in the center of the room and infants, caregivers, graduate clinicians, clinical educators, and researchers sat on the floor in a wide circle. Following this instructional portion of the morning, caregivers, infants, and graduate clinicians moved to individual rooms for data collection and coaching. Clinical educators supervised from a video observation room and/or from within the session itself. Undergraduate research assistants participated in guided observation with the clinical educators during this segment. Following the coaching sessions, 8-session caregivers, infants, and graduate clinicians joined one of two smaller support groups consisting of 3-4 caregivers in another classroom for discussion of topics of interest identified by the caregivers. Families departed from the support group time with incentives (diapers or board books) in addition to their individual iPads.

The 4-session group in 2021 attended early evening sessions designed to coincide with the end of the workday and daycare pick up. The FIRST Program was run across

three different days during this programming block, with 7 families in a group on Tuesday that met at JMU, 4 families in a group on Wednesday that met at a daycare center, and 4 families in a group on Thursday that met at JMU. The daycare location in New Market, VA, about 25 minutes from JMU's campus, was at The Community Care & Learning Center (CCLC), a Virginia Department of Social Services Childcare Subsidy Provider with a mission to provide accessible, quality childcare that supports parents' ability to maintain stable employment while knowing their children are in a safe, nurturing, and enriching environment. FIRST Programming at the CCLC took place at the end of the day when most families were picking up their children. On assessment days, families were greeted by their graduate clinicians and taken directly to individual coaching rooms within the JMUSLC or individual areas within the daycare center. On intervention days, the large group portion of the program was conducted in a large classroom at JMU and in a large daycare classroom at the CCLC. Individual felt-backed wipeable tablecloths were spread on the floor for each family-clinician group, to ensure distancing between participants per Covid-19 protocols. Following the instructional portion of the evening, caregivers, infants, and graduate clinicians at the JMU location moved to individual rooms for data collection and coaching within the JMUSLC. Clinical educators supervised from a video observation room and/or from within the session itself. Undergraduate research assistants participated in guided observation with the clinical educators during this segment. At the CCLC, four separate spaces were utilized for individual coaching groups with attempts to control the volume of ambient noise for video data collection. This meant that some groups did coaching in a hallway, another in a kitchen area, and two groups stayed in the larger classroom separated by a partial wall.

Clinical educators alternated between groups for observation and supervision and undergraduate research assistants observed along with the clinical educators. Following the coaching sessions, the 4-session group received take home snacks and drinks along with the other take-home incentives. Small-group sessions were suspended as a consequence of Covid-19 restrictions.

The 1-session and no-session groups in January and February 2020 attended morning sessions on the campus of James Madison University. On assessment days families were greeted by their graduate clinicians and taken directly to individual coaching rooms within the JMUSLC. All set-up and scheduling parameters for this study arm were consistent with those used in the previous 8-session arm. Families in this condition did not participate in smaller support groups and departed from the coaching time with incentives. The no-session group was to receive a single intervention and coaching session after the follow-up assessments were complete in May 2020. Due to Covid-19 restrictions, this single intervention was conducted (like the follow-up assessment itself) virtually using Webex. The participants were in their homes and graduate clinicians and clinical educators coached and supervised remotely. The previously recorded instructional content was shown to families prior to the virtual coaching session.

Caregiver-Infant Assessment. Graduate clinicians were trained in the FIRST Program Assessment Battery, the specific assessment instruments and procedures for administration, scoring, and sharing results with caregivers. Assessment consisted of several standardized and nonstandard measures commonly encountered in infant

assessment and research. As research tools, standardized measures allow for comparison to discern effects of the intervention or preventive treatment.

Infant Outcomes. Graduate clinicians were trained to administer three standard assessments, the Preschool Language Scales, 5th edition (Zimmerman et al., 2011), the Rossetti Infant-Toddler Language Scale *(*Rossetti, 2006), and the MacArthur-Bates Communicative Development Inventories (Fenson et al., 2006). These instruments are common to the early intervention literature and to clinical training programs.

The Preschool Language Scales, 5th edition (PLS-5) is a play-based assessment of receptive and expressive language skills from birth through age 7:0. Skills through age 2:0 are scored from observed, elicited or reported behaviors. Besides standardization, an attractive feature of the PLS-5 for this battery is that it can be used through preschool to assess the communication progress of FIRST participants relative to the normative sample. Based on 2008 census data, the PLS-5 normative sample includes low SES children and has been used in other studies to discriminate between low and high SES infants under 12 months of age (Hurt & Betancourt, 2016).

The Rossetti Infant-Toddler Language Scale (RI-TLS), a criterion-referenced scale for birth to age 3:0, assesses preverbal and verbal skills in a play-based context as well as these developmental domains: Interaction-Attachment, Pragmatics, Gesture, Play, Language Comprehension, and Language Expression. Observed or elicited behaviors, in addition to clinician and caregiver reports, are used to complete the scale. Students were trained to administer the RI-TLS and the PLS-5 collaboratively, both in terms of overlapping content which presents items in multiple ways (facilitating caregiver and graduate clinician understanding of the item) and as a measure of reliability.

Additionally, the reporting format of the RI-TLS presents a helpful visual of areas of developmental mastery or emergent skill that graduate clinicians used, along with the PLS-5, to explain assessment results with caregivers.

The MacArthur-Bates Communicative Development Inventories (MB-CDI) is a widely-used parent report instrument for assessing communicative skills in infants and toddlers. The Words and Gestures MB-CDI measures infant language comprehension and use (vocally, verbally and gesturally) through age 18 months. It provides a sample of a child's language from a caregiver perspective, arguably more representative than what can be captured in an assessment session with unfamiliar people in an unfamiliar environment. While normative data are available for the MB-CDI, the assessment manual, as well as other published research (Fenson et al., 2006; Fenson et al., 2000), cautions that because the normative sample was skewed toward families of higher socioeconomic status, applicability of the normative information to low education/low-income families may be limited. Thus, the analysis for this study used raw scores for group comparisons.

Session Recordings and Data Collection. Students were trained to record their assigned caregivers and infants in different contexts and to record their interactions with caregivers and infants in each intervention session. A key component of each coaching session was clinician and caregiver review of video clips of the caregiver and infant interacting. At the beginning of each intervention session, the caregiver and infant were video recorded on an iPad engaging in interaction for 10 minutes. The graduate clinicians were responsible for setting up the recording equipment from different angles and were expected to leave the room during this time to reduce the likelihood of a Hawthorne

effect. The iPad continued to record the remainder of the coaching session. After the coaching session, the graduate clinicians (supervised by clinical educators) reviewed and analyzed the 10-minute interaction portion of the video.

Graduate clinicians were given a standard data collection tool (Appendix C) that specified collection of turn-taking data (how many turns, and which partner initiated) and tracked the modes of communication used in these turn-taking exchanges. The communication modalities were identified as non-verbal, gesture or touch, non-verbal visual referencing, vocalizations, and verbalizations (included sign and word approximation). Percentages of each modality used in communication during this segment were calculated. Qualitative observations of the caregiver and infant during this time were recorded with particular attention to anything that the clinicians observed to impact the data positively or negatively (e.g., pacifier use, diaper changes, period of fussiness, caregiver taking a phone call).

Following this detailed analysis of the recording, graduate clinicians chose 2 to 3 video segments that exemplified responsive interactions between the caregiver and infant. These focus segments were then used in the following session to reinforce the caregiver behaviors targeted by the FIRST Program. Caregivers were asked to view the segments and reflect, with clinician support as needed, on the significance of the interaction and how it was an example of FIRST Program content. Graduate clinicians (with clinical educator supervision and support as needed) then planned activities and topics for the next session.

Graduate clinician training in data collection extended beyond the specific roles detailed above (e.g., coaching, assessment, recordings) to include several within- and

cross-session expectations. Student training in *fidelity* to the intervention content was facilitated by the use of coaching guides and idea lists (Appendix B and D). Clinician fidelity to the assessment protocols was supported by detailed checklists that students initialed as they completed each assessment component (Appendix G). Clinical educators invested attention and expertise to ensure *reliability* of graduate clinician collected outcomes during assessments and intervention sessions. Students were also trained in *generalization mechanisms* designed to assist caregivers in taking the content of the FIRST Program home. One such mechanism was the free app, Vroom (www.vroom.org). Like the FIRST Program, Vroom turns evidence about early brain development into actionable activities that can be understood and incorporated by caregivers into everyday routines. Graduate clinicians worked with caregivers during at least one session of the FIRST Program to load the app onto their phone and explore the options for daily, developmentally appropriate activity ideas. Student training also encouraged the creation of personalized materials (e.g., handouts, flashcards, and other reminders that might be meaningful to a caregiver's environments) as generalization mechanisms. Often developed in conjunction with caregivers, these materials were designed for use during sessions and to take home to share with other caregivers not attending the program.

The 8-session clinicians created short video summaries of the content of the coaching session and suggested activities for home implementation with other caregivers. These were recorded at the very end of the session and caregivers took the videos home with them on provided iPads. Caregivers returned with the iPads each session for the addition of new content. The iPads were set to restricted use to just viewing of these

videos during the intervention period. These iPads were given to 8-session families in an unlocked state following completion of the entire program and all three assessments.

Implementation of the FIRST Program

Implementing the FIRST Program required student attention to clinical protocols both common to standard clinical practice and some unique to the FIRST Program. Common procedures required room preparation (e.g., safe set ups, materials selection, sterilization of items and surfaces, recording equipment set up and checks before and after use), student escorts from and to parking lots, scheduling infant audiological screenings with audiology graduate students and clinical educators, and ongoing clinical educator observations and session debriefings. Undergraduate research assistants participated in all phases project including clinical training, data entry, management of materials and equipment, and preparation of take-home incentive packages (e.g., diapers, board books, snacks, meals). As director of the FIRST Program, I also gathered and secured student documentation of parent release forms, infant assessment forms, clinical session data, and Covid-19 screening results. I called, texted, and emailed caregivers to remind them of scheduled appointments. I planned the "final" large group gatherings for the 8-session and 4-session groups in which each infant was recognized as a "graduate" of the FIRST Program with a graduation celebration. There were several outcome measures that I was soley responsible for, including those for caregivers, caregiver-infant interaction video analysis, and graduate clinicians.

Caregiver Outcome Measures. At each assessment timepoint (pre-, post-, and follow-up) caregivers were given a packet that included the Survey of Parent/Provider Expectations and Knowledge - II (Suskind et al., 2018) and a series of questions to

answer about their child's development and their own learning in the FIRST Program. The SPEAK-II is a 17-item questionnaire administered to caregivers to assess knowledge and beliefs regarding child development and the caregiver role in child language and cognitive development. Higher SPEAK-II scores are correlated with greater language stimulation available to children in the home (Suskind et al., 2018) as well as enriched caregiver-child interaction, and greater vocabulary, math, and social-emotional skill development (List et al., 2021).

Immediately after the conclusion of the intervention stage of the FIRST Program and again during the follow-up assessment session, caregivers were asked to reflect on their experiences in the program and how they were using the information and skills that they gained. The responses to these questions were intended to inform subsequent iterations of the FIRST Program and provide qualitative information about the FIRST Program from the caregiver perspective. Additionally, in 2019 the 8-session families were interviewed about their impressions of the program by an unfamiliar member of the research team and one of the clinical educators. In 2021, the 4-session families were interviewed by one of the clinical educators. (The 2020 participants were not interviewed due to the disruption to the end of the program caused by the Covid-19 pandemic.)

Interaction Video Analysis. The observation and measurement of caregiver and infant communication behaviors and interactions before and after the FIRST Program was a crucial component of evaluating the effectiveness of the preventive intervention. The first 5 minutes of caregiver-infant interaction were coded from the interaction video assessment for caregiver vocal and verbal behavior, infant vocal and verbal behavior, and for the characterization of the quantity and quality of the caregiver-infant interaction

itself. Each of the targeted intervention emphases, responsivity, IDS, and turn-taking exchanges across modalities were evaluated through the observation and measurement of these coded behaviors. The coding manual is provided in Appendix E.

Caregiver Vocal and Verbal Behavioral Coding: Using ELAN, caregiver vocal and verbal utterances were identified, segmented, and orthographically transcribed. The coding of these productions enabled analysis of both the quantity of infant-directed speech and of the content of the speech.

Infant Vocal and Verbal Behavioral Coding: Using ELAN, all audible infant sounds were identified, segmented, and described using a coding protocol which divided infant productions into those that were "speech-like" or could be described according to the adult models of speech (e.g., containing describable vowels, consonants, and combinations of consonants and vowels), and those that were "non-speech-like" and were difficult to associate with adult speech models (e.g., reflexive sounds made while feeding or exerting effort, fussing, or giggling). These categories were originally defined and termed by Bloom (1988) as syllabic vocalizations and vocalic vocalizations. Previous studies have shown that responsive caregiver verbal interactions with infants as young as 3- and 4- months-old are associated with increases in speechlike vocalizations (Bloom, 1988; Masataka, 1993). Similarly, infants appear to have more non-speech-like vocalizations when their caregiver is unresponsive (Legerstee, 1991). It is expected that as caregivers become more responsive in their communication attempts, their infants would increase their ratio of speechlike to non-speechlike utterances.

Caregiver-Infant Interaction Coding: A relational coding system developed by Fogel and collaborators (Fogel & Lyra, 1997; Hsu & Fogel, 2001) to characterize

patterns of caregiver-infant interaction was used to identify, quantify, and examine changes across time in dyad interaction in the FIRST Program. Each second of the 5 minutes of analyzed interaction was coded using five possible communication patterns. Table 14 defines each of the communication patterns using concepts and language from the FIRST Program curriculum.

Table 14

Communication Pattern Definitions for the FIRST Program

Symmetrical Responsive Pattern	Partner 1 and Partner 2 are **tuned in**to the same activity or each other (**joint attention**) Both partners are **taking turns** and contribute to keeping the interaction going Turn taking can happen in any modality: movement, gesture, eye gaze, babble, or vocalization	*Example* Caregiver and infant are actively engaged in a peek-a-boo game. The caregiver covers and uncovers the infant's face. The infant smiles, laughs, and shows excited body movements when he pauses to indicate the desire for more interaction.
Asymmetrical Responsive Pattern	One partner is **tuned in** to the other (usually caregiver to infant). The other partner is also tuned in (**joint attention)** and paying attention but just watching, not initiating or responding to communication bids.	*Example* Caregiver is wiggling her fingers and beginning to walk her fingers up the infant's tummy. The infant observes the caregiver's actions but shows no other behaviors or signs of participation in the game.
Unilateral Responsive Pattern	Partner 1 is *attempting* to **tune in** effectively to Partner 2 and is **talking more**; providing opportunities for communication. However, Partner 2 is not successfully engaged and has their attention elsewhere.	*Example* Infant is manipulating a set of toy keys. Caregiver infers that the infant is attending to the keys and begins to talk about them and provides pauses for infant responses. The infant shows no indication of responding contingently to these attempts but

		keeps manipulating the keys or turns to another toy. No eye gaze or movement towards the caregiver occurs.
Disruptive	One partner tries to interrupt and/or change the activity of the other who then shows active avoidance or resistance.	*Example* Infant is focused on sucking their thumb and the caregiver takes his hand and pulls his thumb out of his mouth and the infant fusses to protest this change.
Unengaged	No tuning in or engagement in either partner. No attention to the other.	*Example* Infant is focused on looking at something on the wall. Caregiver is looking for something in her bag.

Note. Adapted from Hsu, H. C., & Fogel, A. (2001). Infant vocal development in a dynamic mother-infant communication system. *Infancy*, *2*(1), 87-109.

The top three communication patterns (symmetrical, asymmetrical, and unilateral) are indicative of caregiver responsivity. The more time that a caregiver devotes to responsive communication intentions, the more opportunities are presented to an infant to engage in back-and-forth communication. Time spent in symmetrical communication patterns, the only pattern that describes turn-taking between communication partners, should be an important measure of how well a caregiver and infant are progressing with the intervention targets of the FIRST Program.

Graduate Clinician Outcomes. Graduate clinician confidence in infant assessment and intervention and caregiver counseling were examined using a set of researcher-created questions (Appendix H) and a set of survey questions. Immediately after the conclusion of the intervention stage of the FIRST Program, graduate clinicians

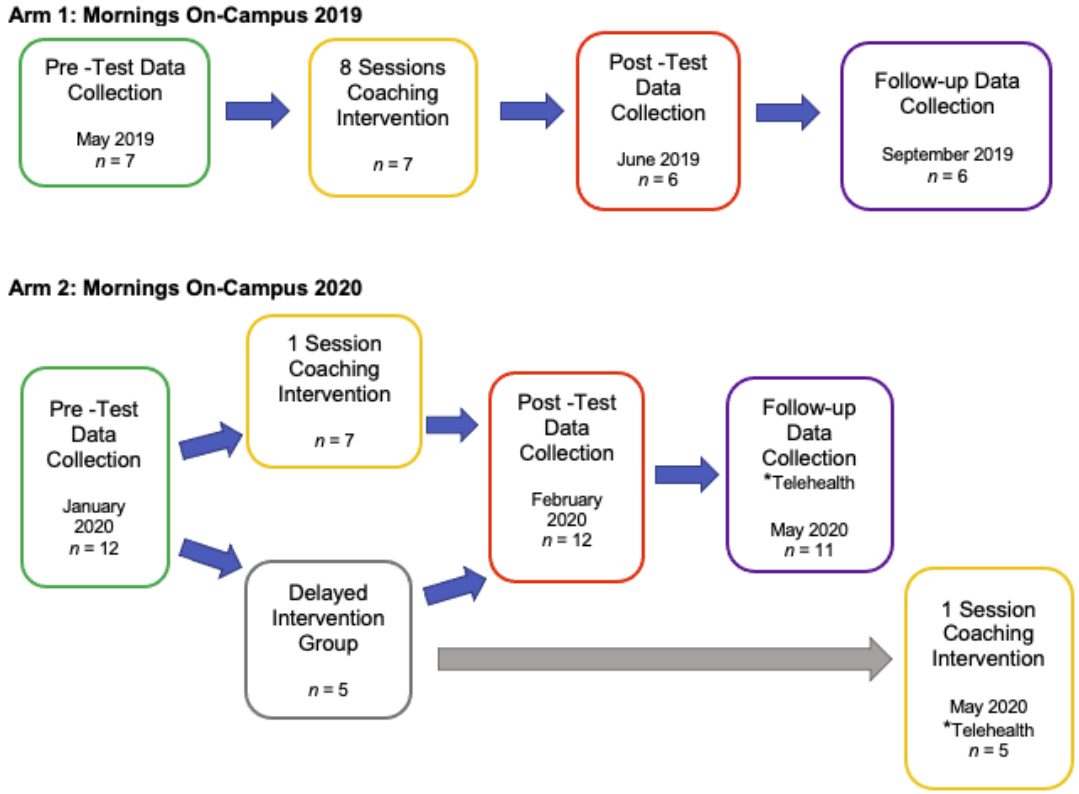
were asked to reflect on their experiences in the program, as well as knowledge and skills gained. The responses to these questions were intended to inform subsequent iterations of the FIRST Program and provide qualitative information about the FIRST Program from the graduate clinician perspective.

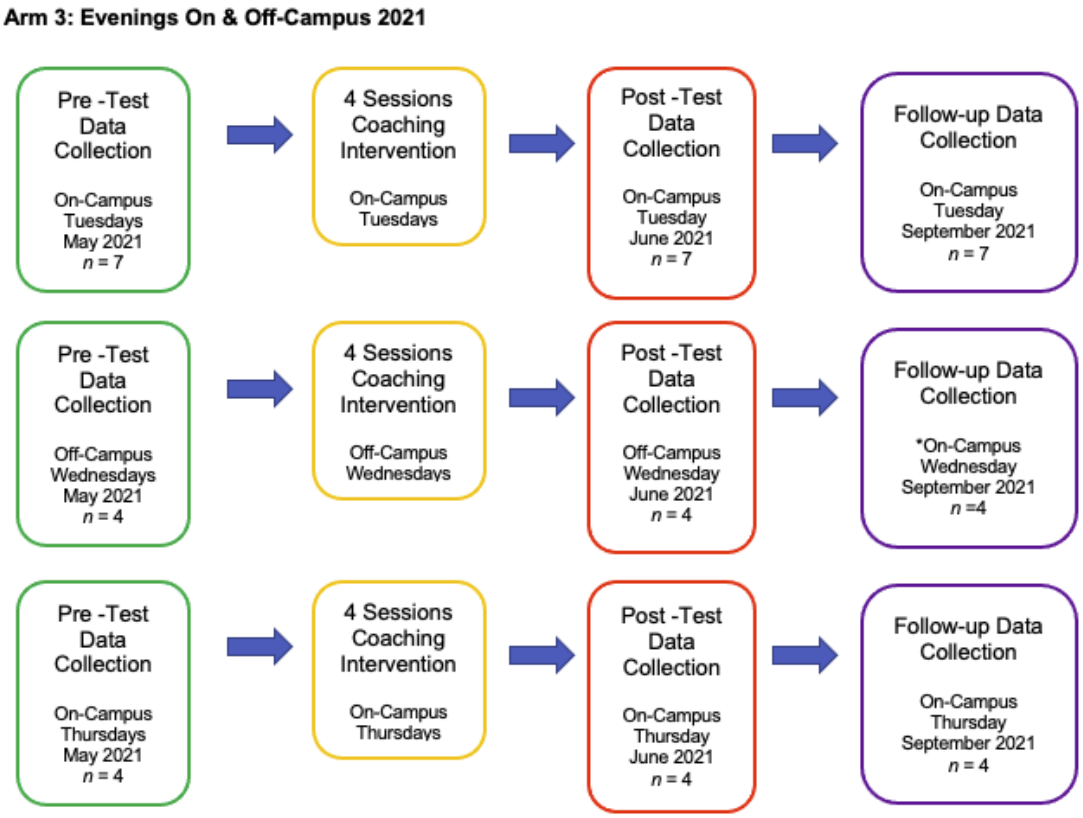
Research Design

The quasi-experimental research design involved three separate arms representing distinct delivery conditions of the preventive intervention. Assessment outcomes were collected at pre-test, post-test, and at the 3-month follow-up test. Figure 5 summarizes the three-arm assessment schedule for each experimental condition.

Figure 5

A Quasi-Experimental Intervention Design for Evaluation of the FIRST Program





Note: *****4-session off-campus group was seen on-campus for follow-up data collection due to temporary closure of daycare facility due to high COVID case counts in September 2021.

Assessment Battery

Outcome measures were collected for caregiver, infant, and graduate clinician participants as summarized in Table 15.

Table 15

The FIRST Program Participant Assessment Battery and Schedule

Pre-Test	**Post-Test**	**Follow-Up**
(At intake)	(Following 5 weeks intervention)	(3 months after post-test)
Infant Age: 6-12 mo.	Infant Age: 7-13 mo.	Infant Age: 10-16 months

- 10-Minute Caregiver-Infant Interaction Video Assessment - PRE, -POST
- Preschool Language Scales - 5th edition (PLS-5) - ALL
- Rossetti Infant-Toddler Language Scale (RI-TLS) - ALL
- MacArthur-Bates Communicative Development Inventory (MB-CDI) - ALL
- Survey of Parent Expectations and Knowledge (SPEAK-II) - ALL
- Graduate Clinician Confidence Scales - PRE, POST

Note. ALL - component of each assessment battery, PRE - pre-test component, POST - post-test component

Fidelity and Reliability

Intervention fidelity was facilitated by the usage of the same slides, scripts, materials, and resources across participants and across session groups. Most of the clinical educators participated across all three programming blocks and this consistency added an additional element to ensuring assessment, intervention, and data collection fidelity within and across the graduate clinicians. Clinical educators observed, guided, reviewed, and approved all assessment and session outcome data and materials used. Clinical educators verified and approved all clock hours earned by all graduate clinicians.

All graduate clinician groups and clinical educators were trained in administration of the outcome measures during orientation and provided detailed checklists that clinicians initialed to ensure accuracy and completion of all assessment components (Appendix G). Direct clinical educator supervision also enhanced the reliability of the

assessment data. All scored assessments were double-checked for scoring accuracy prior to data entry.

Caregiver-infant interactive videoclips produced at pre-test, post-test, and follow-up assessment sessions were analyzed by teams consisting of 2 coders (4 teams of undergraduate coders and 1 team of SLPs experienced in infant coding). The undergraduate coding teams were trained to 80% agreement on training videos that were consensus coded by the experienced SLPs. Following the training period, the coding teams were assigned videos to code and were blinded to the assessment times. The experienced SLP coding team then double-coded 25% of the same videos, with 92.43% intercoder agreement achieved.

Chapter IV: Results

Statistical Approach

Mixed-effects modeling was chosen to answer the research questions as this approach has several advantages over repeated-measures analysis of variance (Harel & McAllister, 2019). Mixed-effects models permit use of all available data, including data for participants who miss an assessment session, which avoids the loss of sample size and increases the power of the model to detect effects and interactions. Mixed-effects models also do not require the assumption of sphericity important to repeated-measures analysis of variance. Multiple predictor variables that may vary over time can also be included in mixed-effect models while repeated-measures analysis of variance measures are limited to predictor variables that do not vary. Mixed-effects models can also handle dichotomous, categorical, and continuous measures within the same model.

The mixed-effects models used in this analysis also had the advantage of controlling for inter-subject variability by including random effects for subjects using random intercepts. Models that include random intercepts are less vulnerable to Type I and Type II errors when rejecting or failing to reject a null hypothesis because they more precisely model the relationship between the outcome variable and the predictor variables (Gordon, 2019). In their tutorial for CSD, Harel and McAllister (2019) explained:

> Multilevel models extend the standard regression framework by modeling the levels inherent in the data by organizing observations into known clusters. By using random effects in the specification of the model, it is possible to account for between-cluster differences (i.e. participants) in a precise manner. This allows a

> multilevel model to account for any characteristics at the participant level that have not been observed directly, yielding new insights into how participants differ from each other. (p. 786)

Summary of Model Specifications

The mixed-effects models used to analyze the FIRST Program outcome data and answer the research questions were random intercept models conducted in SPSS (version 28) that examined the fixed effects of time as a categorical variable (pre-test, post-test, and follow-up), session as a categorical variable (8-, 4-, 1-, and No), and SES as a categorical variable (low and mid-high). The outcome measures for each research question were continuous variables. The repeated measures for each participant were controlled for as a random effect and each participant had their own random intercept. The SPSS syntax used for all analyses is shared in Appendix I.

Fixed effects for Session and SES

When fitting models to the FIRST Program data set, it became clear that the 8-session intensity group participants and the participants who could be assigned to a low SES group were difficult to separate out statistically. Most of the low SES families included in the data set were in the 8-session group and thus when both variables (session and SES) were included in the models it was unlikely that these groups would distinctively contribute to the models. The decision was made to remove SES from the models and instead view the 8-session group as a low SES comparison group and to consider these factors when analyzing the results from this standpoint. More data for families of multiple SES status in the 8-session condition as well as more low SES

families in the 0, 1, and 4-session conditions should be pursued in the future to better understand the impact of session number separately from SES.

In the following sections, the results of the FIRST Program outcome measures are organized by research question and compared to the original hypotheses.

Research Question 1a. Does the FIRST Program make a difference or effect a change in caregiver knowledge immediately after the program and three months after the program?

To answer the research question pertaining to language development knowledge of caregivers enrolled in the FIRST Program, caregiver scores on the SPEAK-II were examined using the random intercept mixed-effects model previously described. The SPEAK-II means, standard deviations, and range for each session group are presented in Table 16. The mixed-effects model revealed statistically significant main effects of time ($F(2) = 12.079$, $p < .001$) and a statistically significant interaction of time and session ($F(6) = 3.001$, $p = .014$).

Using the model results shown in Table 17 the following formula can estimate SPEAK-II scores across time and session:

predict(SPEAK-II) =

66.6 + (1.904 * *Post-test*) + (-1.000 * *Pre-test*) +

(-9.600 * *1-session*) + (-7.733 * *4-sessions*) +

(-18.743 * *8-sessions*) + (1.462 * *Post-test by 1-session*) +

(2.030 * *Post-test by 4-sessions*) + (8.562 * *Post-test by 8-sessions*) +

(4.158 * *Follow-up by 1-session*) + (3.467 * *Follow-up by 4-sessions*) +

(11.466 * *Follow-up by 8-sessions*)

The values for variables (shown above in *italics*) should be entered as either 0 or 1 depending on the desired prediction. For example to predict the SPEAK-II score for an 8-sessions participant at post-test the following formula would be calculated:

predict(SPEAK-II) =

66.6 + (1.904 * **1**) + (-1.000 * **0**) +

(-9.600 * **0**) + (-7.733 * **0**) +

(-18.743 * **1**) + (1.462 * **0**) +

(2.030 * **0**) + (8.562 * **1**) +

(4.158 * **0**) + (3.467 * **0**) +

(11.466 * **0**) = 58.332

Using this model, the pairwise contrasts shown in Table 18 reveal significant increases of SPEAK-II scores at post-test and follow-up (compared to pre-test) for the 8-session group, and a significant increase of SPEAK-II scores at post-test for the 4-session group. The SPEAK-II scores for the No-session and 1-session groups were not statistically significant between pre-, post-, and follow-up tests. This model result is consistent with the collected data plotted in Figure 6.

Table 16

Descriptive Statistics of SPEAK-II Scores by Group

	Pre-Test	Post-Test	Follow-up
	M (SD) Range [min, max]	M (SD) Range [min, max]	M (SD) Range [min, max]
8 Session (*n* = 7)	47.86 (16.263) 48 [17, 65]	56.00 (11.189) 33 [37, 70]	56.00 (14.505) 40 [29, 69]
4 Session (*n* = 15)	58.87 (6.823) 21 [47, 68]	62.80 (4.974) 17 [54, 71]	61.33 (6.032) 18 [52, 70]
1 Session (*n* = 7)	57.00 (7.616) 20 [46, 66]	62.75 (4.856) 10 [60, 70]	61.80 (4.266) 11 [58, 69]
No Session (*n* =5)	66.60 (2.408) 6 [64, 70]	67.67 (1.155) 2 [67, 69]	65.60 (4.336) 11 [58, 69]

Table 17

Random Intercept Mixed-Effects Model with Time and Session as Fixed Effects and SPEAK-II Scores as the Dependent Variable

Parameter	Estimate	Test (*df*)	*p*
Intercept	66.600	*t* = 17.90 (36.84)	<.001
Time - Pre-Test (base)	0		

Parameter	Estimate	Test (*df*)	*p*
Time - Post-Test	1.904	*t* = .68 (51.37)	.50
Time - Follow-up	-1.000	*t* = -.44 (50.19)	.66
Session - 8 Session	-18.743	*t* = -3.85 (36.84)	<.001
Session - 4 Session	-7.733	*t* = -1.80 (36.84)	.08
Session - 1 Session	-9.600	*t* = -1.97 (36.84)	.06
Session - No Session (base)	0		
Post-Test x 8 Session	8.562	*t* = 2.48 (51.40)	.02
Post-Test x 4 Session	2.030	*t* = .66 (51.16)	.51
Post-Test x 1 Session	1.462	*t* = .40 (51.74)	.69
Follow-up x 8 Session	11.466	*t* = 3.74 (50.76)	<.001
Follow-up x 4 Session	3.467	*t* = 1.32 (50.19)	.19
Follow-up x 1 Session	4.158	*t* = 1.31 (50.98)	.20

Table 18

Estimated Marginal Means Comparisons of SPEAK-II scores by Session and Time

	Mean Difference	Standard Error	df	*p*
8 Session				
Pre - Post	10.466*	2.06	51.44	<.001
Pre - Follow-up	10.466*	2.06	51.44	<.001
4 Session				
Pre - Post	2.467	1.31	50.19	.13
Pre - Follow-up	3.933*	1.31	50.19	.01
1 Session				
Pre - Post	3.158	2.21	51.81	.31
Pre - Follow-up	3.366	2.42	52.23	.34
No Session				

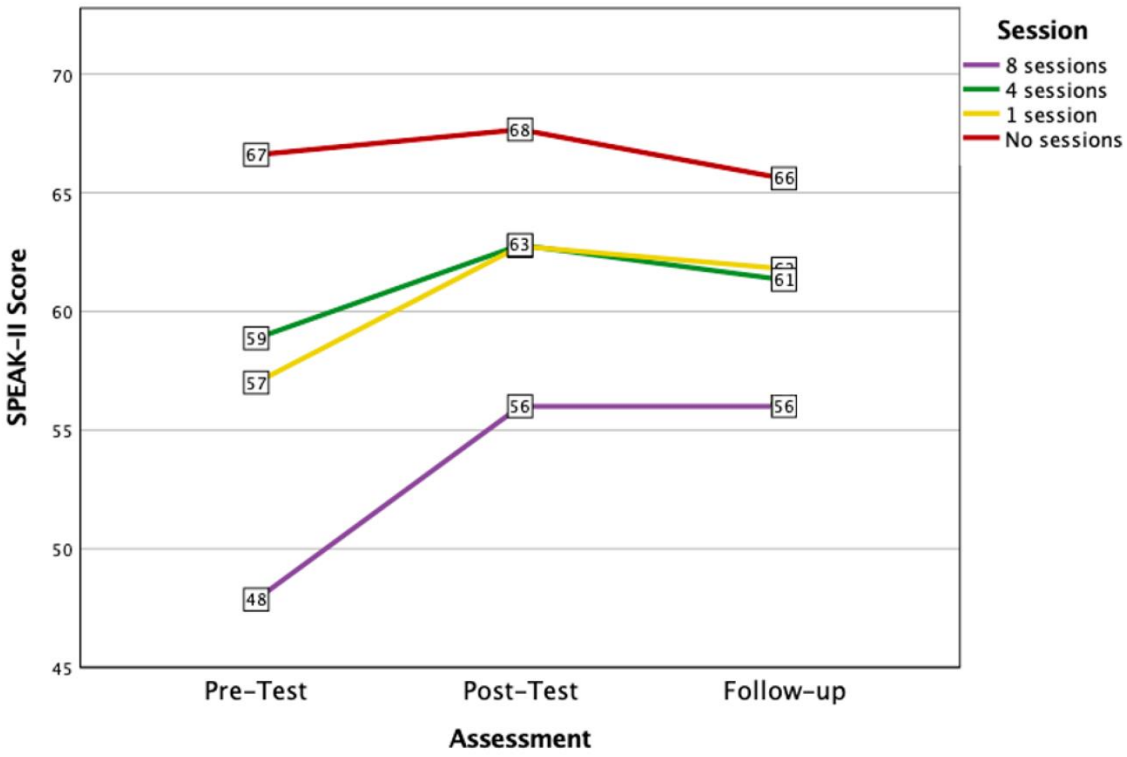
	Mean Difference	Standard Error	df	*p*
Pre - Post	-1.000	2.27	50.19	1.00
Pre - Follow-up	1.904	2.77	51.37	.99

*The mean difference is significant at the .05 level.

Data above reflect the Bonferroni adjustment for multiple comparisons.

Figure 6

Changes in Caregiver SPEAK-II Scores as a Function of Session and Time



Hypothesis for RQ 1a: Caregiver knowledge using the SPEAK-II outcome data.

The results indicate an association of numbers of sessions on SPEAK-II scores with participants in the 8-session condition and 4-session condition improving scores

significantly at post-test, an improvement that the 8-session group maintained at the 3-month follow-up assessment. The results also offer support for the hypothesis that low SES caregivers will improve their scores on this measure more than mid-high SES caregivers.

Research Question 1b. Does the FIRST Program make a difference or effect a change in caregiver behaviors immediately after the program and three months after the program?

One of the key coaching emphases of the FIRST Program was to support caregivers to spend increased time responsively engaged with their infant and to facilitate reciprocal turn-taking exchanges. The video interaction protocol was designed to enable measurement of caregiver and infant interaction behaviors to assess the impact of the FIRST Program on interaction variables. To answer this research question, time spent in symmetrical communication patterns (SYM) during the pre-test video and the post-test video was examined in SPSS using a generalized linear mixed-effects model with a binomial distribution and a logit link. The outcome measure was the number of coded seconds that the caregiver-infant dyad spent in symmetrical communication patterns out of 300 possible seconds in the 5-minute video. The SYM means, standard deviations, and range for each session group are presented in Table 19 and a bar graph showing the change in time spent in a symmetrical pattern from pre-test to post-test is presented in Figure 7. Total participant numbers are reduced for the analyzed video data for the following reasons: in the 8-session group, one dyad had dropped out by post-test, another dyad had a child who was out of the camera range during post-testing making video analysis unreliable; and the dyad with the 3-month-old was not expected to engage

developmentally as the more interactive 6- to 12-month-olds. Similarly, for the 4-session group, one dyad was excluded because both the mother and father were in the video. For the 1-session group, one dyad was excluded because the mother was the interaction partner at pre-test and the father was the partner at post-test.

The mixed-effects model revealed statistically significant main effects of time ($F(7, 42) = 103.514$, $p < .001$) and a statistically significant interaction of time and session ($F(3,42) = 71.882$, $p = <.001$).

Using the model results shown in Table 20 the following formula can estimate the odds of a participant in a particular session group having more time spent in a symmetrical communication pattern at post-test versus pretest.

predict(SYM) =

.046 + (-2.408 * *Pre-test*) + (.245 * *No-session*) + (-.276 * *1-session*) +

(-.865 * *4-sessions*) + (1.147 * *Pre-test by No-session*) +

(1.731 * *Pre-test by 1-session*) + (1.829 * *Pre-test by 4-sessions*)

The values for variables (shown above in *italics*) should be entered as either 0 or 1 depending on the desired prediction. For example to predict the SYM score for a 4-sessions participant at post-test the following would be calculated:

predict(SYM) =

.046 + (-2.408 * ***0***) + (.245 * ***0***) + (-.276 * ***0***) +

(-.865 * ***1***) + (1.147 * ***0***) +

(1.731 * ***0***) + (1.829 * ***0***)

= -0.819

This formula resulted in a number that *when exponentiated* is the odds for this particular session at this particular time point for this particular event. The odds for an event of interest (e.g., a dyad being in SYM at one of the 300 timepoints) is related to but not the same as the probability of an event of interest. Odds is defined as:

Odds = p/(1-p) where p is the probability of the event occurring

These odds were converted into probabilities and are reported in Table 21. The comparison of odds for one group versus another are called "odds ratios" and are also reported in Table 21. An odds ratio greater than 1 indicates that the event (more time in SYM at post-test) is more likely to occur in the first group than the second in the comparison. The converse is true for an odds ratio less than 1.

These analyses present a useful way to compare group changes in use of communication patterns across time points. With the current data, the 8-session group had a change in use of a symmetrical communication pattern from pre-test to post-test that was more than double that of the other groups. When analyzed statistically this contrast was less impressive and suggested a slightly greater than 50% chance of increasing use of symmetrical patterns for both the 8-session group and the no-session group. It is notable, however, that the families analyzed from the low SES 8-session group started the FIRST Program with a mean time spent in a symmetrical communication pattern of 30.5 seconds, which was half of the next lowest group (4-session) and three times lower than the mid-high SES No-session group. By the end of the program, these same families demonstrated similar time spent in symmetrical patterns to that of the No-session group and higher than the other two groups.

Table 19

Descriptive Statistics of Time (in seconds) Spent in Symmetrical Communication Pattern (SYM) by Group

	Pre-Test	Post-Test	Change in SYM from Pre- to Post-Test
	M (SD)	M (SD)	
8 Session (*n* = 4)	30.50 (53.92)	152.75 (43.15)	+ 122.25 seconds
4 Session (*n* = 14)	69.21 (50.58)	100.43 (65.28)	+ 31.22 seconds
1 Session (*n* = 3)	89.00 (93.61)	134.00 (85.61)	+ 45.00 seconds
No Session (*n* =4)	98.25 (101.09)	161.50 (92.34)	+ 63.25 seconds

Table 20

General Linear Mixed-Effects Model with Time and Session as Fixed Effects and Time (in seconds) Spent in Symmetrical Communication Pattern (SYM) as the Dependent Variable

Parameter	Estimate	Test	*p*
Intercept	.046	*t* = .090	.928
Time - Pre-Test	-2.408	*t* = *-20.258*	<.001
Time - Post-Test (base)	0		
Session - No Session	.245	*t* = .339	.737
Session - 1 Session	-.276	*t* = -.354	.723
Session - 4 Session	-.865	*t* = -1.493	.143
Session - 8 Session (base)	0		
Pre-Test x No Session	1.147	*t* = 7.219	<.001
Pre-Test x 1 Session	1.731	*t* = 11.085	<.001
Pre-Test x 4 Session	1.829	*t* = 14.096	<.001

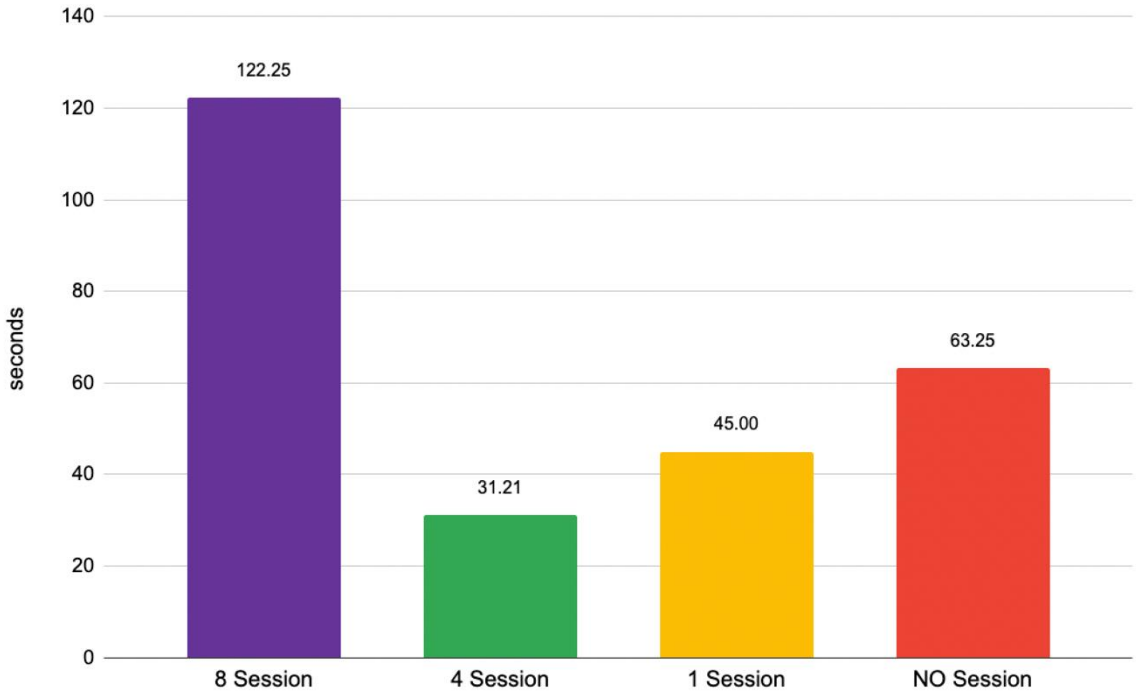
Table 21

Predicted Odds of Spending More Time in Symmetrical Communication Pattern (SYM) at Post-Test and Odds Ratio Comparisons

	Predicted Odds	**Probability** that time in SYM will be higher at post-test than pre-test
8 Session	1.047	51.2%
4 Session	0.44	30.7%
1 Session	0.79	44%
No Session	1.34	57.3%
Odds Ratio Comparisons		
8 Session vs. 4 Session	1.047/.44 = 2.38	
8 Session vs. 1 Session	1.047/.79 = 1.33	
8 Session vs. No Session	1.047/1.34 = .78	
No Session vs. 8 Session	1.34/1.047 = 1.27	

Figure 7

Changes in Time Spent in Symmetrical Pattern from Pre- to Post-Test by Group



Hypothesis for RQ 1b: Caregiver behavior using the video interaction data.

The descriptive means of time spent in symmetry for the 8-session group show a large increase in turn-taking interactions for these low SES caregiver-infant dyads and notable differences between this predominantly low SES group at pre-test compared to the other groups of mixed SES families.

Caregiver Observations on Their Experiences in the FIRST Program

Post-intervention surveys were completed by all FIRST caregivers (Appendix J). The following results were compiled, analyzed for common themes, and reported here for the 8-session and 4-session groups.

8-session 2019 caregiver post-intervention themes:

- The language of the “3Ts” specifically was memorable and helpful for recall.

- All participants reported feeling that their baby was more “engaged” with them and the world around them since the start of the FIRST Program.
- Several participants wished that it lasted longer than 8-sessions (5 weeks) and that a version for older toddlers would be offered.
- Breakfast and the guest speakers were appreciated. One caregiver noted that having access to “experts” in a particular area was especially meaningful to them because they didn’t feel like their Medicaid healthcare typically gave them access to “the best of the best”.
- The length of the sessions (2.5 hours) was seen as appropriate for all participants.
- The support group component was appreciated as a time to get to know and talk with other caregivers.
- The iPads that were taken home were seen as helpful to share information learned in the program with others at home. Some caregivers also really appreciated being given homework assignments.
- Nametags for all participants were suggested to help with community building efforts.
- Some participants would have liked more or longer video examples of each of the targeted caregiver behaviors and skills.

4-session 2021 caregiver post-intervention themes:

- Identifying an infant’s focus of attention and following the infant’s lead were mentioned by a majority of caregivers.
- Caregivers reported increase in infant engagement as well as greater awareness of developmental milestones.

- Many 2021 caregivers reported that the FIRST Program was their infant's first exposure to other infants and that their baby showed interest in other babies and caregivers.
- All but one of the caregivers reported that they shared with others about what they learned in the FIRST Program. They reported sharing with other primary caregivers, babysitters, friends, other family members, and co-workers.
- Caregivers gave feedback requesting more programming, more activity ideas, and one caregiver even suggested the use of outside area experts (they were not aware of these aspects of the 8-session program).
- Caregivers understood the limitations of Covid-19 protocols but would have enjoyed more interactions opportunities for infants and caregivers.
- The evening time frame was appreciated, and 1.5 hours seemed like enough time though a few families would have liked starting an hour earlier (4:00 PM).

Research Question 2a. Does the FIRST Program make a difference or effect a change in infant language outcomes on standardized measures of language development immediately after the program and three months after the program?

To answer the research question pertaining to the language development of infants enrolled in the FIRST Program, infants' standardized scores on the PLS-5 for the Auditory Comprehension Subtest (AC), Expressive Communication Subtest (EC), and the Total Language Score (TL) were examined within and between groups using random intercept mixed-effects models. These models all included the fixed effects of time as a categorical variable (pre-test, post-test, and follow-up) and session as a categorical variable (8-, 4-, 1-, and No). Infant age is part of the standardized scoring metric so it is

not analyzed separately. The continuous dependent variables were the standardized PLS-5 scores. The repeated measures for each participant were controlled for as a random effect and each participant had their own random intercept.

The mixed-effects models revealed statistically significant main effects of time for the Expressive Communication Subtest ($F(2) = 16.0423$, $p < .001$) and the Total Language Score ($F(2) = 8.208$, $p < .001$). Descriptive statistics for all subtests and all groups on the PLS-5 are presented in Table 22. Univariate tests of the simple effects of time within each session group for the Expressive Communication Subtest are consistent with paired samples t-tests of the EC means for each session group compared at post-test and follow-up (Table 23). The 8-session group ($F(2) = 4.783$, $p = .01$), 4-session group ($F(2) = 4.180$, $p = .02$), and 1-session group ($F(2) = 8.805$, $p < .001$) all had significantly increased EC scores compared to pre-test scores. Similarly, univariate tests of the simple effects of time within session group for the Total Language Score are also similar to paired samples t-test outcomes (Table 23).

The mixed-effects models also indicated an interaction effect for time by session for the Expressive Communication Subtest that trended closer toward significance than the other interactions examined, ($F(6) = 1.501$, $p = .196$). This trend suggests (in conjunction with the within subject repeated measures analysis) that though the fixed variables in this conservative model (time and session) do not yet predict PLS-5 Expressive Communication Subtest scores, with increased sample size these differences may become detectable.

Table 22

Descriptive Statistics of PLS-5 Scores by Group

	Pre-Test	Post-Test	Follow-up
	M (SD) Median [min, max]	M (SD) Median [min, max]	M (SD) Median [min, max]
8 Session (*n* = 7)			
AC SS[a]	97.43 (18.645) 44 [79, 123]	105.50 (19.347) 46 [79, 125]	107.17 (19.813) 47 [83, 130]
EC SS[b]	98.43 (13.685) 39 [79, 118]	112.33 (15.055) 46 [90, 136]	110.67 (18.184) 53 [85, 138]
TL SS[c]	98.57 (15.925) 39 [81, 120]	109.17 (17.163) 49 [83, 132]	109.50 (19.967) 53 [83, 136]
4 Session (*n* = 15)			
AC SS[a]	104.20 (11.651) 39 [84, 123]	102.00 (10.522) 29 [90, 119]	103.73 (9.580) 37 [83, 120]
EC SS[b]	100.27 (9.535) 34 [78, 112]	107.47 (7.520) 28 [95, 123]	107.60 (12.070) 39 [86, 125]
TL SS[c]	102.27 (9.816) 32 [83, 115]	105.00 (7.910) 28 [92, 120]	105.40 (10.133) 31 [89, 120]
1 Session (*n* = 7)			
AC SS[a]	102.29 (8.807) 28 [91, 119]	107.20 (5.020) 14 [100, 114]	112.80 (18.913) 43 [100, 143]
EC SS[b]	96.71 (11.743) 27 [82, 109]	114.80 (8.701) 23 [100, 123]	109.00 (6.442) 48 [17, 65]
TL SS[c]	99.29 (8.807) 22 [88, 110]	111.80 (5.541) 13 [104, 117]	112.60 (8.264) 48 [17, 65]
No Session (*n* =5)			

	Pre-Test	Post-Test	Follow-up
	M (SD) Median [min, max]	M (SD) Median [min, max]	M (SD) Median [min, max]
AC SS[a]	110.60 (18.022) 40 [96, 136]	112.75 (20.056) 40 [96, 136]	113.80 (17.456) 48 [87, 135]
EC SS[b]	109.80 (14.789) 39 [86, 125]	125.25 (6.238) 15 [117, 132]	109.80 (15.707) 39 [86, 125]
TL SS[c]	110.60 (12.973) 35 [93, 128]	120.75 (10.720) 20 [111, 131]	112.60 (14.960) 33 [98, 131]

[a]AC SS = Auditory Comprehension Standard Score, [b]EC SS = Expressive Communication Standard Score, [c]TL SS= Total Language Standard Score

Table 23

Paired-Samples T-Tests of Significant Within Group Differences in PLS-5 Scores

	Std. Error Mean	Test (df)	*p*
8 Session			
EC SS[b] Pre-Test vs. Post-Test	2.845	*t* (5) = -4.159	.004
EC SS[b] Pre-Test vs. Follow-up	2.994	*t* (5) = -3.396	.01
TL SS[c] Pre-Test vs. Post-Test	2.940	*t* (5) = -2.608	.02
4 Session			
EC SS[b] Pre-Test vs. Post-Test	2.584	*t* (14) = -2.786	.007
1 Session			
EC SS[b] Pre-Test vs. Post-Test	4.841	*t* (4) = -4.379	.006
EC SS[b] Pre-Test vs. Follow-up	2.746	*t* (4) = -4.176	.006
TL SS[c] Pre-Test vs. Post-Test	3.435	*t* (4) = -4.658	.005
TL SS[c] Pre-Test vs. Follow-up	5.938	*t* (4) = -2.257	.04

[a]AC SS = Auditory Comprehension Standard Score, [b]EC SS = Expressive Communication Standard Score, [c]TL SS= Total Language Standard Score

Figure 8

Changes in PLS-5 Auditory Comprehension Scores as a Function of Session and Time

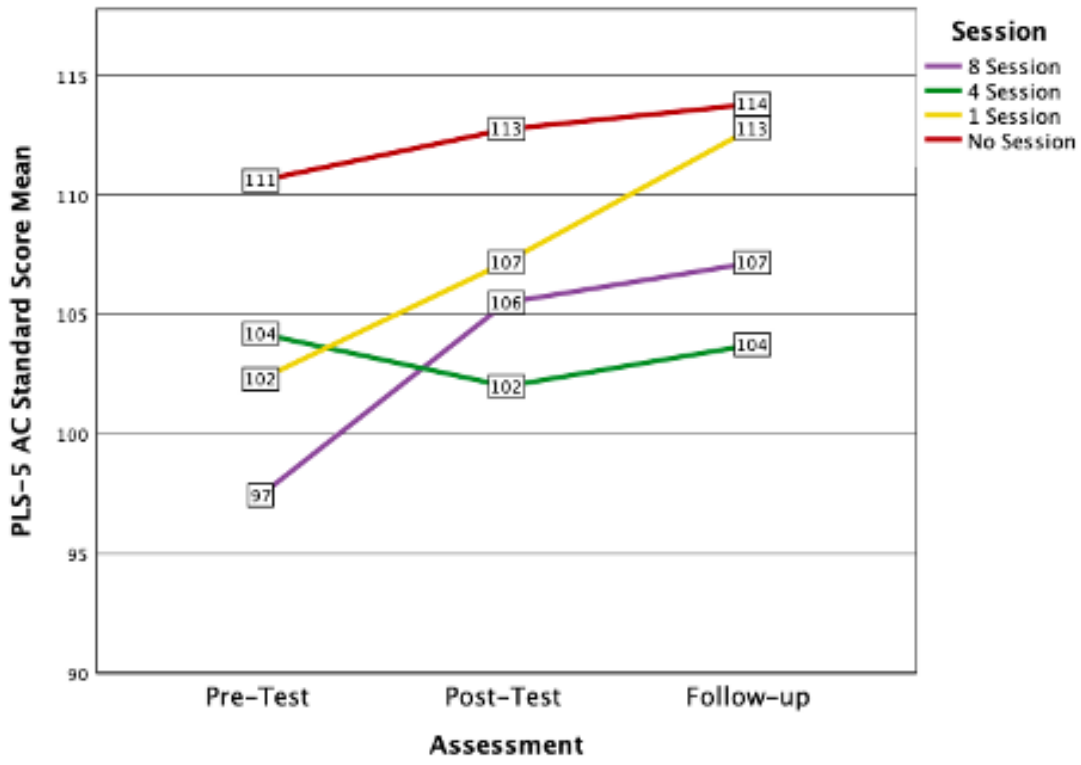
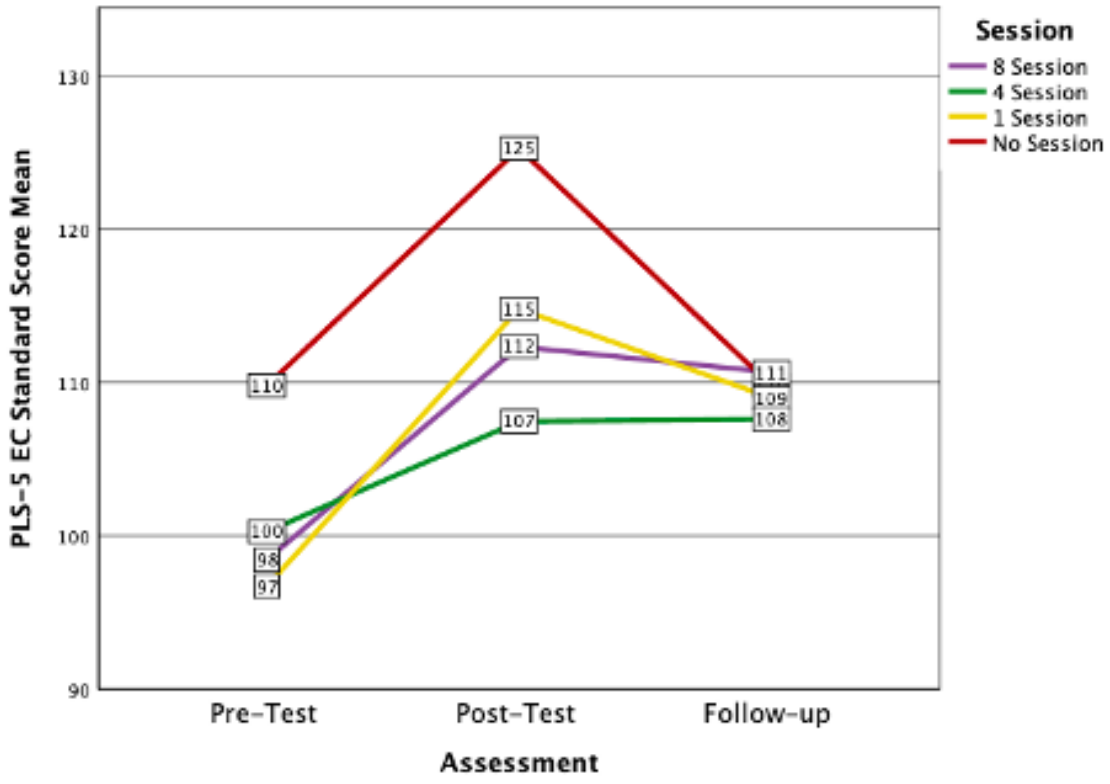


Figure 9

Changes in PLS-5 Expressive Communication Scores as a Function of Session and Time



Hypothesis for RQ 2a: Infant language development as measured by the PLS-5

The outcome data indicate significantly increased expressive communication scores for all of the intervention groups, irrespective of intensity, as well as increased total language scores for the 8-session and 1-session groups. Though these differences are not strong enough to serve as predictors of PLS-5 scores in the mixed effects models, they do suggest that FIRST Program participation makes a difference in PLS-5 scores. A significant increase in standardized scores across time is a notable change for FIRST Program participants that was not observed in the control group.

Research Question 2b - RI-TLS. Does the FIRST Program make a difference or effect a change in infant language outcomes on nonstandard measures of language development immediately after the program and three months after the program?

Infant language skill acquisition across all subscales of the Rossetti Infant-Toddler Language Scale was examined in SPSS using generalized linear mixed-effects models with a binomial distribution and a logit link. As with the other mixed-effect analyses these models all included the fixed effects of time as a categorical variable (pre-test, post-test, and follow-up) and session as a categorical variable (8-, 4-, 1-, and No). These models using nonstandard data also included the fixed effect of infant age in weeks at pre-test to account for age differences between participants. The dependent variable was the number of skills that an infant was reported to demonstrate for a particular subscale at each testing timepoint. Each subscale had a different number of skills possible. The RI-TLS means and standard deviations for each subscale by session group are presented in Tables 24-29 as well as the mean age at pretest (in months) of each group. Younger children are expected to have lesser scores on this criterion referenced measure.

The mixed-effects models all showed statistically significant main effects for *time*, as should be the case for a nonstandard measure. Typically developing infants should gain skills across time. None of the models developed for the interaction-attachment subscale, pragmatics subscale, gesture subscale, play subscale, language comprehension subscale, or language expression subscale indicated that *session* might be a factor that could predict scores on the RI-TLS.

Table 24

Descriptive Statistics of Skills Demonstrated on the Interaction-Attachment RI-TLS[a] Subscale by Group

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	14.71 (2.43) *n* = 7	16.00 (2.76) *n* = 6	19.67 (2.07) *n* = 6
4 Session (8.4 mo.)	17.27 (2.96) *n* = 15	19.07 (2.37) *n* = 15	20.00 (1.51) *n* = 15
1 Session (8.0 mo.)	18.83 (3.87) *n* = 6	18.00 (3.61) *n* = 3	19.25 (2.22) *n* = 4
No Session (6.6 mo.)	15.20 (3.42) *n* = 5	17.25 (2.75) *n* = 4	19.20 (3.03) *n* = 5

[a]Rossetti Infant-Toddler Language Scale

Table 25

Descriptive Statistics of Skills Demonstrated on the Pragmatics RI-TLS[a] Subscale by Group

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) n =	M (SD) n =	M (SD) n =
8 Session (7.0 mo.)	12.14 (2.27) n = 7	14.83 (2.27) n = 6	17.83 (3.49) n = 6
4 Session	14.60 (4.41)	17.13 (4.03)	19.53 (3.31)

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
(8.4 mo.)	n = 15	n = 15	n = 15
1 Session (8.0 mo.)	15.33 (5.28) n = 6	14.00 (5.29) n = 3	19.00 (4.76) n = 4
No Session (6.6 mo.)	12.40 (4.04) n = 5	14.75 (3.40) n = 4	16.20 (3.27) n = 5

[a]Rossetti Infant-Toddler Language Scale

Table 26

Descriptive Statistics of Skills Demonstrated on the Gesture RI-TLS[a] Subscale by Group

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	2.00 (2.08) *n* = 7	2.83 (2.14) *n* = 6	5.50 (3.67) *n* = 6
4 Session (8.4 mo.)	2.40 (3.58) *n* = 15	4.80 (4.63) *n* = 15	8.13 (4.90) *n* = 15
1 Session (8.0 mo.)	5.50 (7.56) *n* = 6	6.00 (10.39) *n* = 3	9.00 (8.17) *n* = 4
No Session (6.6 mo.)	0.40 (0.89) *n* = 5	1.00 (1.41) *n* = 4	5.00 (3.81) *n* = 5

[a]Rossetti Infant-Toddler Language Scale

Table 27

Descriptive Statistics of Skills Demonstrated on the Play RI-TLS[a] Subscale by Group

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	14.14 (5.90) *n* = 7	16.67 (5.82) *n* = 6	19.33 (4.55) *n* = 6
4 Session (8.4 mo.)	15.00 (4.42) *n* = 15	18.80 (5.93) *n* = 15	23.73 (7.04) *n* = 15
1 Session (8.0 mo.)	17.50 (9.01) *n* = 6	22.33 (11.37) *n* = 3	23.50 (10.79) *n* = 4
No Session (6.6 mo.)	12.20 (4.38) *n* = 5	14.75 (3.30) *n* = 4	20.40 (6.15) *n* = 5

[a]Rossetti Infant-Toddler Language Scale

Table 28

Descriptive Statistics of Skills Demonstrated on the Language Comprehension RI-TLS[a] Subscale by Group

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	20.57 (9.01) *n* = 7	23.50 (5.58) *n* = 6	32.17 (7.20) *n* = 6
4 Session (8.4 mo.)	24.07 (10.48) *n* = 15	29.13 (8.91) *n* = 15	35.80 (7.62) *n* = 15

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
1 Session (8.0 mo.)	23.83 (11.41) *n* = 6	23.33 (9.71) *n* = 3	31.50 (10.28) *n* = 4
No Session (6.6 mo.)	18.80 (7.16) *n* = 5	20.00 (7.96) *n* = 4	30.20 (7.29) *n* = 5

[a]Rossetti Infant-Toddler Language Scale

Table 29

Descriptive Statistics of Skills Demonstrated on the Language Expression RI-TLS[a] Subscale by Group

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	22.57 (7.98) *n* = 7	28.00 (3.16) *n* = 6	37.33 (8.31) *n* = 6
4 Session (8.4 mo.)	26.67 (8.90) *n* = 15	32.20 (8.62) *n* = 15	38.93 (6.95) *n* = 15
1 Session (8.0 mo.)	27.83 (15.11) *n* = 6	29.67 (14.36) *n* = 3	37.25 (13.60) *n* = 4
No Session (6.6 mo.)	23.00 (8.69) *n* = 5	26.50 (9.26) *n* = 4	33.60 (6.43) *n* = 5

[a]Rossetti Infant-Toddler Language Scale

Hypothesis for RQ 2b-i: Infant language development as measured by the Rossetti Infant-Toddler Language Scale

The outcome data from the RI-TLS do not suggest group differences between the different sessions or the control group as hypothesized.

Research Question 2b - MB-CDI. Does the FIRST Program make a difference or effect a change in infant language outcomes on unstandardized measures of language development immediately after the program and three months after the program?

Infant spoken language development was examined by analyzing parent reports of phrases their infants understood, words their infants understood, words their infants said, and gestures their infants produced using the Mac-Arthur Bates CDI Words and Gestures Inventory (MB-CDI). Total items responded to for each of the categories measured were recorded for each infant at all three assessment time points and analyzed in SPSS using generalized linear mixed-effects models with a negative binomial distribution and a log link. As with the other mixed-effect analyses these models all included the fixed effects of time as a categorical variable (pre-test, post-test, and follow-up) and session as a categorical variable (8-, 4-, 1-, and No). These models using nonstandard data also included the fixed effect of infant age in weeks at pre-test to account for age differences between participants. The dependent variable was the measure of interest (total number of: phrases understood, words understood, words produced, gestures produced) reported by parents about their infant at each testing timepoint. The MB-CDI means and standard deviations of each of the measures spoken by session group are presented in Tables 30-33 and Figures 10-13 as well as the mean age at pretest (in months) of each group.

Table 30

Descriptive Statistics of Phrases Understood on the MB-CDI[a] by Group

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	6.33 (3.83) *n* = 6	10.17 (5.71) *n* = 6	14.00 (6.23) *n* = 6
4 Session (8.4 mo.)	6.00 (5.17) *n* = 15	11.93 (8.76) *n* = 15	16.53 (8.37) *n* = 15
1 Session (8.0 mo.)	8.83 (9.87) *n* = 6	10.00 (10.14) *n* = 6	14.83 (7.94) *n* = 6
No Session (6.6 mo.)	5.60 (4.93) *n* = 5	6.60 (3.78) *n* = 5	13.40 (7.50) *n* = 5

[a]MacArthur-Bates Communicative Development Inventories

Figure 10

Changes in Phrases Understood on the MB-CDI[a] as a Function of Session and Time

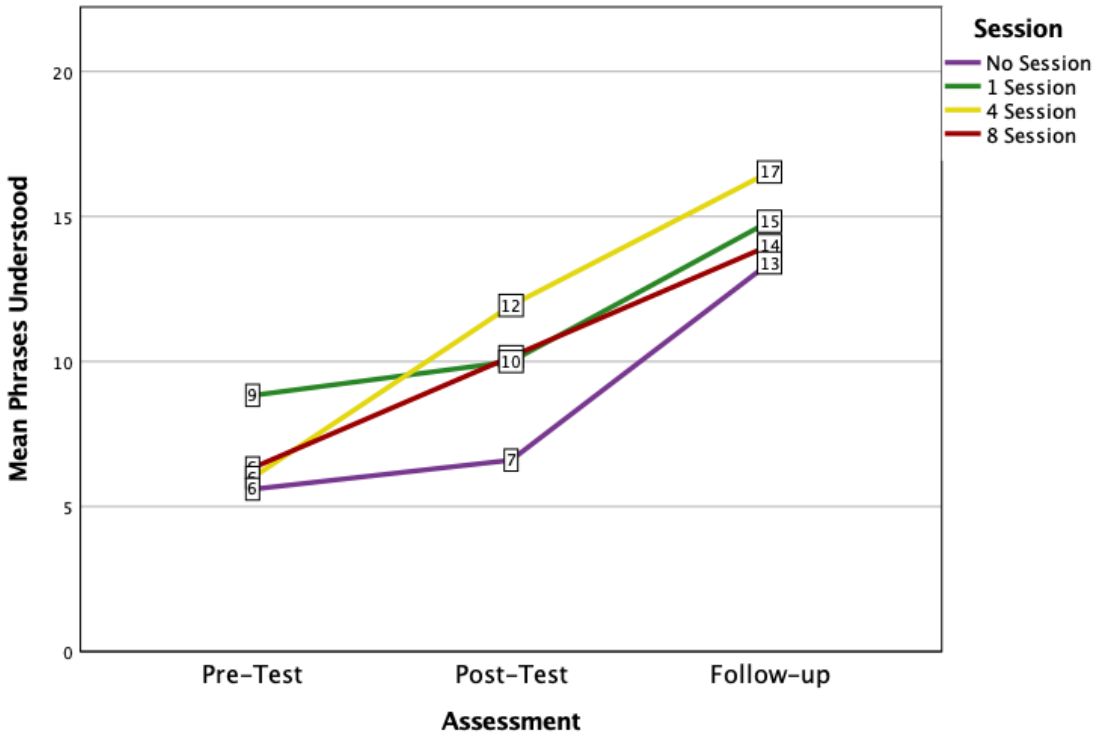


Table 31

Descriptive Statistics of Words Understood on the MB-CDI[a] by Group

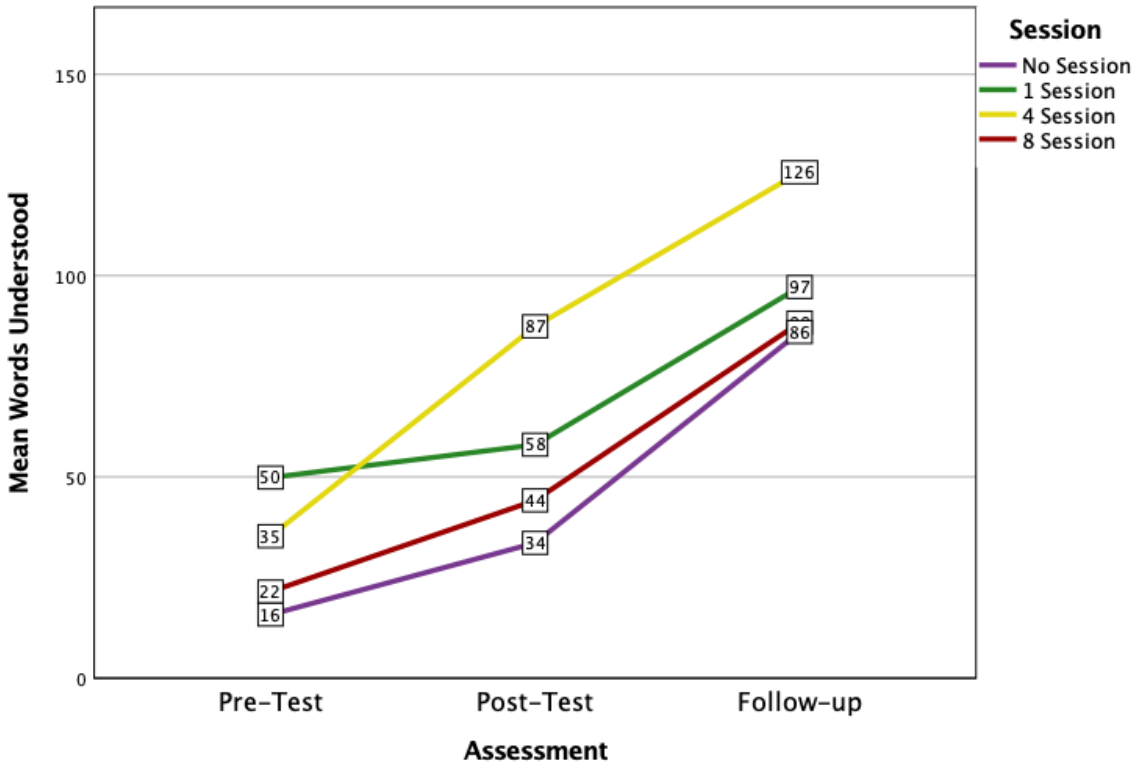
Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	21.50 (17.04) *n* = 6	44.17 (31.35) *n* = 6	88.33 (104.94) *n* = 6
4 Session (8.4 mo.)	35.27 (44.46) *n* = 15	87.40 (104.44) *n* = 15	125.67 (17.03) *n* = 15

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
1 Session (8.0 mo.)	49.83 (78.26) *n* = 6	58.00 (83.74) *n* = 6	97.17 (93.512) *n* = 6
No Session (6.6 mo.)	15.80 (22.25) *n* = 5	33.60 (37.06) *n* = 5	86.00 (62.96) *n* = 5

[a]MacArthur-Bates Communicative Development Inventories

Figure 11

Changes in Words Understood on the MB-CDI[a] as a Function of Session and Time



[a]MacArthur-Bates Communicative Development Inventories

Table 32

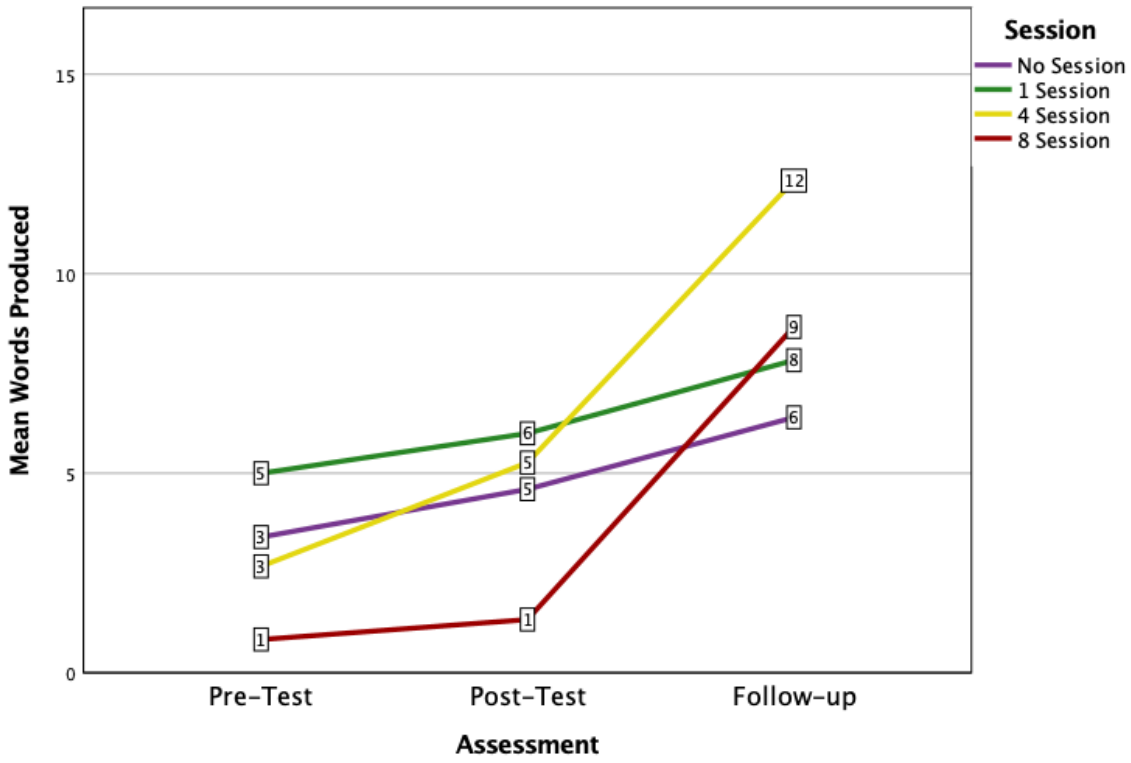
Descriptive Statistics of Words Produced on the MB-CDI[a] by Group

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	.83 (.983) *n* = 6	1.33 (.816) *n* = 6	8.67 (11.13) *n* = 6
4 Session (8.4 mo.)	2.67 (5.58) *n* = 15	5.27 (8.86) *n* = 15	12.33 (19.65) *n* = 15
1 Session (8.0 mo.)	5.00 (8.65) *n* = 6	6.00 (9.63) *n* = 6	7.83 (10.76) *n* = 6
No Session (6.6 mo.)	3.40 (7.60) *n* = 5	4.60 (8.71) *n* = 5	6.40 (10.07) *n* = 5

[a]MacArthur-Bates Communicative Development Inventories

Figure 12

Changes in Words Produced on the MB-CDI[a] as a Function of Session and Time



[a]MacArthur-Bates Communicative Development Inventories

Table 33

Descriptive Statistics of Gestures Produced on the MB-CDI[a] by Group

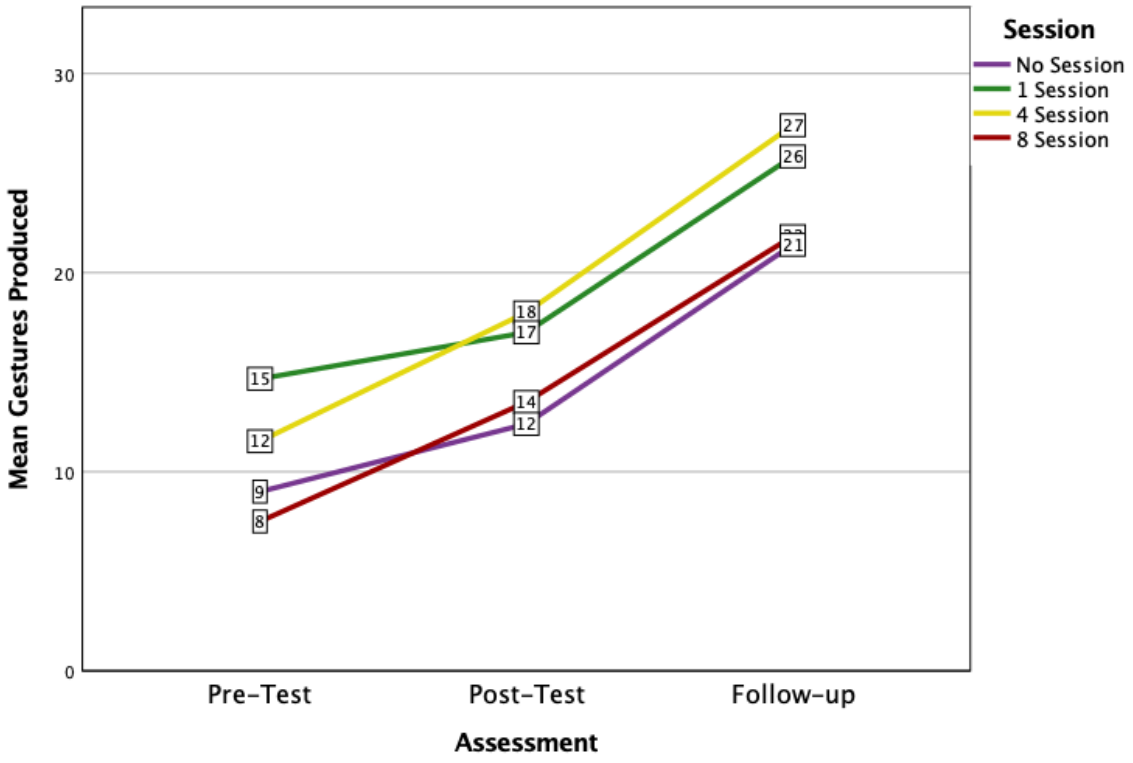
Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
8 Session (7.0 mo.)	7.50 (5.47) *n* = 6	13.50 (9.63) *n* = 6	21.83 (13.99) *n* = 6
4 Session (8.4 mo.)	11.53 (7.827) *n* = 15	18.00 (10.65) *n* = 15	27.40 (12.30) *n* = 15

Session Mean age at pretest (mo.)	Pre-Test	Post-Test	Follow-Up
	M (SD) *n* =	M (SD) *n* =	M (SD) *n* =
1 Session (8.0 mo.)	14.67 (16.56) *n* = 6	17.00 (15.88) *n* = 6	25.83 (17.86) *n* = 6
No Session (6.6 mo.)	9.00 (7.71) *n* = 5	12.40 (6.69) *n* = 5	21.40 (4.78 *n* = 5

[a]MacArthur-Bates Communicative Development Inventories

Figure 13

Changes in Gestures Produced on the MB-CDI[a] as a Function of Session and Time



[a]MacArthur-Bates Communicative Development Inventories

The mixed-effects models all showed statistically significant main effects for *time*, as should be the case for a nonstandard measure. Typically developing infants should gain skills across time. None of the models developed for measures of interest indicated that *session* might be a factor that could predict scores on the MB-CDI. The graphs of plotted means for **words produced** visualize a greater change in scores from post-test to follow up for the 4-session and 8-session group than the change in scores for the 1-session and no-session groups. When the change in means from post-test to follow-up is analyzed by session, only the 4-session group shows a statistically significant change (t (14) = -2.42, p = .01), although the 8-session group mean difference did trend toward significance (t (5) = -1.66, p = .079).

Hypothesis for RQ 2b-i: Infant language development as measured by the MacArthur-Bates Communicative Development Inventory:

The outcome data from the phrases understood, words understood, and gestures produced measures of the MB-CDI do not suggest group differences between the different sessions or the control group as hypothesized. Words produced was not predicted by the number of sessions in the mixed-effects modeling; however, group means were significantly increased from post-test to follow-up for the higher intensity groups as hypothesized.

Research Question 3. Does the FIRST Program make a difference or effect a change in graduate clinician confidence in infant assessment and caregiver coaching immediately after the program?

To answer the research question pertaining to confidence in infant assessment and caregiver coaching for graduate clinicians enrolled in the FIRST Program, clinician responses to a set of researcher-created questions (Appendix H) were examined using the random intercept mixed-effects model previously described. The clinician confidence means and standard deviations for each session group are presented in Table 34.

The mixed-effects model revealed statistically significant main effects of time ($F(1) = 108.42$, $p < .001$) and session ($F(3) = 5.06$, $p = .003$), as well as a statistically significant interaction of time and session ($F(3) = 6.59$, $p < .001$).

Using the model results shown in Table 35 the following formula can estimate Graduate Clinician Confidence scores across time and session:

predict(Clinician Confidence) =

31 + (-8.625 * *Pre-test*) + (-2.724 * *4-sessions*) +

(-2.615 * *1-session*) + (-2.777 * *No-session*) +

(5.402 * *Pre-test by No-session*) + (4.471 * *Pre-test by 1-session*) +

(-.512 * *Pre-test by 4-sessions*)

The values for variables (shown above in *italics*) should be entered as either 0 or 1 depending on the desired prediction. Using this model, the estimated marginal mean comparisons shown in Table 36 reveal significant increases in self-reported clinician confidence for all session conditions but with notably larger increases in mean differences for confidence for the 8-session and 4-session groups. This model result is consistent with the collected data plotted in Figure 14.

Table 34

Descriptive Statistics of Clinician Confidence Scores by Group

	Pre-Test M (SD) Range [min, max]	Post-Test M (SD) Range [min, max]
8 Session (*n* = 16)	22.38 (4.08) 16 [13, 29]	31.00 (4.43) 11 [24, 35]
4 Session (*n* = 29)	19.14 (3.44) 15 [11, 26]	28.28 (3.21) 14 [21, 35]
1 Session (*n* = 13)	24.23 (3.30) 12 [18, 30]	28.38 (3.02) 10 [24, 34]
No Session (*n* =9)	25.00 (7.05) 23 [11, 34]	28.22 (2.86) 9 [25, 34]

Table 35

Random Intercept Mixed-Effects Model with Time and Session as Fixed Effects and Clinician Confidence Scores as the Dependent Variable

Parameter	Estimate	Test (*df*)	*p*
Intercept	31.000	*t* = 33.29 (117.86)	<.001
Time - Pre-Test	-8.625	*t* = -7.629 (63)	<.001
Time - Post-Test (base)	0		
Session - 8 Session (base)	0		
Session - 4 Session	-2.724	*t* = -2.35 (117.86)	.02

Session - 1 Session	-2.615	t = -1.88 (117.86)	.06
Session - No Session	-2.777	t = -1.79 (117.86)	.08
Pre-Test x No Session	5.402	t = 2.87 (63)	.01
Pre-Test x 1 Session	4.471	t = 2.65 (63)	.01
Pre-Test x 4 Session	-.512	t = -.36 (63)	.72

Table 36

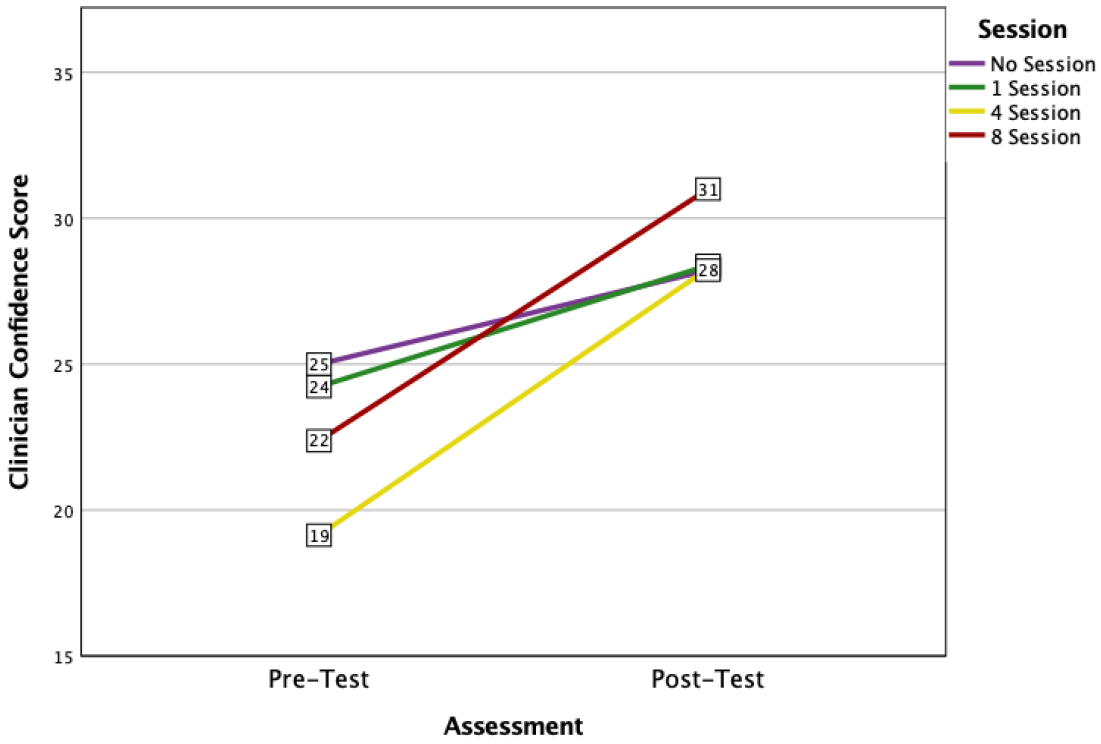
Estimated Marginal Mean Comparisons of Clinician Confidence Scores by Session

	Mean Difference	Standard Error	df	*p*
8 Session	8.625*	1.131	63	<.001
4 Session	9.138*	.84	63	<.001
1 Session	4.154*	1.254	63	.002
No Session	3.222*	1.507	63	.036

*The mean difference is significant at the .05 level.
Data above reflect the Bonferroni adjustment for multiple comparisons.

Figure 14

Changes in Clinician Confidence Score as a Function of Session and Time



Hypothesis for RQ3: Intervention intensity will influence scores on measures of self-reported confidence in early intervention.

The data analyses for these researcher-created questions support the hypothesis that experience in conducting more sessions of coaching (8-sessions and 4-sessions) would result in greater gains in graduate clinician confidence at post-test compared to 1-session or no-sessions of coaching experience. All graduate clinicians participated in the same number of assessment sessions which likely contributed to the overall improvement of confidence in the entire group.

Graduate Clinician Observations on Their Experiences in the FIRST Program

Post-intervention surveys were completed by all FIRST graduate clinicians (Appendix H). The following results were compiled, analyzed for common themes, and reported here by session group.

8-Session 2019 graduate clinician post-intervention themes:

- Graduate clinicians reported that the FIRST Program was beneficial to their development as an SLP. They highlighted the unique clinical experience that gave them exposure to infant development, counseling, and a chance to increase their cultural sensitivity. Many clinicians appreciated their increased confidence in working with infants. One clinician noted that the caregiver she worked with was difficult to connect with and she was surprised to learn that even though she struggled relationally with the caregiver, she felt like she was able to make a difference in the lives of the caregiver and infant.
- Graduate clinicians would have liked to have taken an early intervention course before their experience in the FIRST Program as well as a longer timeframe for orientation.
- Graduate clinicians suggested that having the guest speakers spend time in consultation directly with each participant during the coaching time would be an additional benefit.

4-session 2021 graduate clinician post-intervention themes:

- Graduate clinicians reported that their experiences in the FIRST Program boosted their confidence with infant interaction, working with adult caregivers, and understanding the difference between being a coach versus an interventionist.

- Graduate clinicians reported that they felt better prepared to engage in formal and informal infant assessment. They felt that it was a unique experience in which to learn about typical infant development.
- Graduate clinicians also wished for longer and more interactive group time.
- Graduate clinicians would have liked more time in orientation and explicit instruction as a whole group for how to track session data for turn-taking in the informal interaction assessment.
- Several clinicians mentioned that they would have enjoyed taking an EI course prior to this experience.

Chapter V: Discussion

Clinical education programs in speech-language pathology are well-positioned to address a critical student need for preprofessional experience in early intervention and caregiver coaching, and to provide critical preventive services to support timely and healthy language development in infants from low socioeconomic backgrounds. The literature is clear that preventive efforts for increasing the quality of caregiver-infant communication are effective in enabling infants with environmental risk variables to achieve language development that is commensurate with higher resourced peers.

Following systematic review of other preventive models, the FIRST Program was designed to capitalize on components of successful caregiver-infant interventions combining the individual coaching model of home visiting with group instruction, discussion, and modeling. Three levels of intervention dosage (8-sessions, 4-sessions, and 1-session) were trialed to test the hypothesis that more sessions would be associated with more positive participant outcomes. Two groups of participating families (low-SES and mid-high-SES) were studied to test the hypothesis that low-SES participants would experience greater change on outcome measures than mid-high-SES participants. The following discussion addresses outcomes for all participants, conclusions about hypotheses, and identifies strengths, limitations, and implications of this quasi-experimental clinical research study.

Caregiver Knowledge and Behavior Change in the FIRST Program

One of the most important findings of this study is the significant change in caregivers' knowledge of their role in their infant's language development. Consistent

with recent findings by List et al. (2021), the FIRST Program outcomes demonstrate the positive impact of SLP graduate clinician training in caregiver coaching on reducing disparities in caregiver knowledge and beliefs about their control over infant developmental trajectories. At the pre-test, caregivers with higher educational attainment scored higher in their knowledge about their impact on child development as measured by the SPEAK-II survey. List et al. (2021) also found this trend in their larger sample of parents across the spectrum of educational attainment and socioeconomic status and they reported that the more caregiver beliefs align with the scientific evidence of caregiver importance to development, the more behaviors these caregivers used to support their child's development. Designed to share scientific findings about the critical importance of caregivers to early brain, cognitive, and language development in an accessible, respectful, and individualized format, the FIRST Program successfully addressed at least one aspect of the disparities observed between economic and educational classes in a diverse community like Harrisonburg, caregiver knowledge. As Dana Suskind said, "If education is a form of equity, then all parents deserve to have this information" (Parker, 2021). The most common theme observed in caregiver responses to survey questions at post-test and follow-up was how much importance caregivers ascribed to responsivity and facilitation of turn-taking with their infants. More importantly, these coaching targets were retained by parents several months after the conclusion of programming.

The FIRST Program results showed that caregiver coaching, provided in the format detailed here, led to significant change not only in caregiver knowledge and self-efficacy for the caregivers with the least educational attainment (the 8-session group), but that this change led to behavior changes that reflected the application of new knowledge,

specifically more time spent with infants in responsive, prelinguistic turn-taking interactions. Importantly, the communication pattern interaction outcome measure adapted for the FIRST Program was not just a measure of caregiver behaviors when symmetrical exchanges are examined but also of infant responsiveness to caregiver behaviors facilitative of interaction. The communication pattern analysis revealed the impact of caregiver knowledge and behavior change on infant communication itself.

Evidence of Improved Infant Language Development in the FIRST Program

As caregivers learned more about their ability to influence their infant's development, they engaged in more symmetrical communication exchanges with their infants. Infants also became more engaged and responsive during interactions with their caregivers. Other measures of infant language development corroborated the gains observed in the video data analysis. All intervention groups experienced a significant increase in standardized PLS-5 Expressive Communication scores from pre-test to post-test that was not observed in the control group. Notably, the no-session control group was also the most highly educated group of caregivers and their infant's scores on the PLS-5 Expressive Communication Subtest were the highest of all groups at pre-test and these scores were maintained throughout the assessment periods for these infants. Infants of caregivers with the least amount of educational attainment demonstrated improvements in expressive language on the PLS-5 through the follow-up testing period that essentially boosted their performance to the same score range as the control group infants of highly educated caregivers. A similar boosting trend in expressive language was observed for the 8-session infants on the MB-CDI. Both the 8-session and no-session control group had a similar mean infant age, yet the 8-session infants were producing three fewer words

at pre-test than the no-session infants, whereas at follow-up the 8-session infants averaged two words more than the no-session infants. Expressive language gains were more prominent than receptive language gains and interestingly this is not uncommon to caregiver-focused interventions. Heidlage et al. (2020) also reported relatively poor effects of parent-implemented intervention on receptive vocabulary and receptive language skills in their meta-analysis of programs for parents of children with or at risk for language impairment.

Evidence of Benefit to SLP Graduate Clinicians

The matching of SLPs in training with caregivers of infants was an innovation unique to the FIRST Program. Graduate clinicians, regardless of session group, reported benefit from partnering with caregivers to support infant language development, both in their self-reported confidence ratings and in their survey comments and observations. Simply engaging in three separate assessment sessions increased clinician confidence; however, the greatest mean differences in confidence scores were evidenced for students who also conducted 4 or 8-sessions of coaching intervention. Students observed that gaining experience understanding and identifying typical infant development would support their future work in identifying patterns of atypical infant development.

Questions of Intensity

The questions asked about intensity in the research questions are important to understanding how much or how many sessions of coaching makes a difference in immediate and long-term outcomes for all FIRST Program participants, and from a resource allocation perspective. Other studies of caregiver-infant preventive intervention, such as the single session home visiting intervention conducted by McGillion et al.

(2017), have reported immediate gains in infant language outcomes that dissipate by the preschool years. The intensity of an intervention in terms of numbers of sessions has been posited as a factor with longer term impact on child development. The systematic literature review conducted as part of this study highlighted that many low intensity, short caregiver-focused interventions conducted at pediatric well-child visits do not result in improved infant language outcomes. List et al. (2021) also reported stronger intervention effects for caregivers and infants in their six-visit preventive intervention experiment that spanned 6 months than their shorter, well-child visit experiment.

The most compelling comparative findings in this study were those between the 8-session group and the no-session group. These comparisons were complicated, however, by the participants' demographics. The groups differed both by number of intervention sessions but also by maternal educational attainment and eligibility for public financial support. Though firm conclusions about the most effective number of sessions in the FIRST Program are difficult to draw from the results reported in this study, the trend across multiple outcome measures supported the hypothesis that greater numbers of sessions (8 in this study) provided graduate clinicians, caregivers, and infants sufficient time with the targeted concepts and practices to make a difference in learning, application, and confidence.

Strengths of the Intervention and Research Design

Not Just Feasible, but Implementable and Replicable

Several challenges confront clinicians and researchers in speech-language pathology when attempting to move interventions found to be effective in a highly structured research environment into a less structured, resource constrained clinical

setting. These challenges stress the need for research environments to more closely mimic true-to-life clinical environments if implementation is to be successful. Several research decisions were made for this clinical research program based on the need to be responsive and adaptable to real world realities. For example, the outcome measures were scored by the same clinicians who coached the intervention sessions, common to SLP testing practices in clinical settings, but also a potential source of bias which must be considered when interpreting the results. Within the FIRST Program aims, however, it was necessary to the graduate clinician experience to conduct both the assessments and the interventions, as this represents the real-life circumstances of clinical practice, which also share this potential for bias. Almost all decision points related to developing and conducting the FIRST Program required balancing the aims of the program for all participants with the need to evaluate the program for efficacy and effectiveness.

The FIRST Program, conducted with close attention to implementation fidelity across 70 graduate clinicians in speech-language pathology, was shown to be an adaptable model for several different conditions and circumstances. The program was adapted from morning to early evening hours, from an on-campus clinic to an off-campus day care setting, from in person to telehealth, and from no masking or social-distancing cautions to masking necessitated by Covid-19. Across each of these planned and unplanned environmental differences, the structure, content, and the evaluation elements of the FIRST Program were maintained and replicated across condition. The model of large group instruction and interaction followed by individualized coaching proved to be highly adaptable to a variety of circumstances and should be replicable in other settings that also train graduate clinicians as future SLPs.

In a systematic review of 140 experimental and quasi-experimental studies of language intervention with low SES children (birth to age 8), Greenwood et al. (2020) found that most were weak in their potential for scale-up, with identified weaknesses in the areas of infrastructure, community engagement, and progress monitoring. The FIRST Program model addresses many of these identified weaknesses in current preventive efforts. According to updated standards by the Society of Prevention Research (Gottfredson et al., 2015), for a prevention effort to be ready for broader dissemination it needs to have evidence of infrastructure that can support use by other groups or organizations. Examples of this infrastructure include manuals (print, video, digital) and training activities such as orientations, group instruction, and individual coaching. As demonstrated by the materials provided in the appendices to this document, the process of conducting the FIRST Program multiple times necessitated the development of training materials, manuals, and infrastructure that should make it possible for other universities or groups to replicate the program and research design.

Community engagement is another criterion for scale up that must be met. This includes evidence of interest and buy-in from community partners and participant feedback that indicates the preventive program is seen as something of value, exclusive of other incentives offered for participation. The FIRST Program has garnered widespread support from the local community in which it was started, with multiple community sectors participating in recruitment efforts including healthcare and education. Participant feedback about the value of the coaching intervention itself was exemplary in support for the social validity of the FIRST Program. Several families stated that they would participate even without the incorporation of incentives like

diapers, books, food, and technology. And finally, technology tools have been suggested as evidence of suitability for program scale up. The FIRST Program leveraged the use of iPads specifically as both coaching tools and carry-over mechanisms to home environments. iPads and the associated iOS operating system were familiar to most of the FIRST Program participants, even those who were resource limited. The high audio-video quality, and the easy-to-view large screen, made video review by multiple people during and after coaching sessions very efficient and accessible. Videos were retained, consistent with IRB protocols, for future analysis and replication of recorded sessions such as large group instruction.

Caregiver Coaching for Caregiver Empowerment and Clinician Preparation

Greenwood et al. (2020) also found that though a majority of the 140 studies included in the systematic review intended their intervention to be caregiver-implemented; they were, in fact, research staff-implemented. The difficulty of gaining caregiver engagement and investment in the intervention process and outcomes is commonly reported in early intervention literature (Brady et al., 2004; Campbell & Sawyer, 2007; Levickis et al., 2020). One of the strengths of the FIRST Program model for pairing SLP graduate clinicians with caregivers is the emphasis on coaching and becoming a joint learner with the caregiver in a truly *triadic* partnership with clinician, caregiver, and infant (Sone et al., 2021). This focus on partnership de-emphasizes the "expertise" of the clinician and instead centers on the needs of the caregiver and infant. Graduate clinicians frequently commented that they wished they felt more "expert" in the guidance they could provide to caregivers; in fact, this lack of expertise and experience may have been of benefit to both caregivers of typically developing infants and clinicians

as it minimized any perceived power differential and served to emphasize the coaching partnership. Formative experiences with caregiver coaching, uncommon in our clinical training practices, should benefit graduate clinicians later as professionals. As these graduate clinicians noted, they found the coaching and assessment experiences in the FIRST Program highly valuable to their development as SLPs. Multiple students offered sentiments similar to this statement from an 8-session clinician, "It has been the BEST experience of my education thus far in terms of impact and meaning. It helped me gain a better understanding of infant development, parent interaction/education, and how to facilitate language." As Francois et al. (2015) concluded from their survey study of pre-professional SLP preparation for practice in EI, "to empower caregivers as the primary interventionist requires professionals who are prepared to model and coach the caregiver through the systematic use of the collaborative-consultative team processes" (p. 183). The FIRST Program offered a formative pre-professional experience that directly addressed this identified need within graduate programs in speech-language pathology.

Caregiver and clinician empowerment was fostered within the FIRST Program model through interpersonal relationships and connections. Caregiving during infancy is isolating (Paris & Dubus, 2005), and so one of the greatest benefits offered during the FIRST Program was a dedicated team of people focusing on each infant, celebrating and sharing the joy in this particular child with the caregiver in all that he/she is doing and will do. Caregivers were able to form relationships with other caregivers with children of a similar age and this community of support served as a built-in incentive to participate in the entire program and may be one of the factors that influenced low attrition rates. As one parent reported, "I liked the practical tips, the time with other moms, and the visiting

experts. The feedback was really great...what I was doing good or what I am needing feedback [on]."

Personalized Caregiver-Infant Support Mechanisms Across SES

Family-centered service delivery within natural environments is mandated for early intervention service delivery by Part C of IDEA (2004). Family-centered practices are tailored to specific family needs, are strength-based by incorporating and drawing upon family strengths, and are focused on family choice and control over experiences (Douglas et al., 2020). The FIRST Program provided a framework for the provision of preventive family-centered services to families across the socioeconomic spectrum. While low-SES is a significant predictor of developmental language disorder at a macro-context level, it may be of limited value as an individual clinical indicator of risk. Increasingly, those who study caregiver-focused prevention are turning attention to individual caregiver characteristics like knowledge and self-efficacy, within samples that include low SES participants (Alper et al., 2021, List et al., 2021). Micro-context factors like those addressed in the FIRST Program—caregiver knowledge about child development, caregiver self-efficacy regarding their infant's developmental trajectories, and specific caregiver behaviors when interacting with their infant—can inform individualized coaching targets within prevention efforts and move towards a personalized approach to prevention without the stigma that can accompany the label of low SES.

Data Analysis Approach

The mixed-effects linear models applied to the collected data sets in this study are relatively novel in the field of communication sciences and disorders (CSD). An

extension of linear regression models, these models are well suited to complex, smaller data sets such as those in this investigation. They do not require meeting the assumptions of a repeated measures ANOVA, and they can handle missing data while maintaining power more flexibly than other statistical methods commonly encountered in CSD literature (Walker et al., 2019). Recent tutorials published for researchers in CSD (Gordon, 2019; Harel & McAllister, 2019) offer examples of how to conduct mixed-effect modeling and how to interpret results for clinical application. The statistical procedures described for this study can be applied to future data sets for the FIRST Assessment Battery and will enable conclusions to research questions that were not fully answered here and allow for more research questions to be asked. For replication in future studies that employ the FIRST Program, all SPSS (version 28) syntax for conducting the statistical procedures has been provided in Appendix I.

Limitations and Future Directions

Recruitment of Low SES Families Across Condition

While SES may be of limited individual value as a clinical risk factor, the evidence does support the conclusion that preventive efforts have a larger impact in low SES families as a group than in mid-high SES families. In a meta-analysis of 37 observational studies examining caregiver behavior and typically-developing infant language, Madigan et al. (2019) found that associations between caregiver responsivity and child language outcomes were larger in samples that included low SES families. Engagement and retention of families with environmental risk factors is a challenge long identified in other preventive initiatives (Beecher & Van Pay, 2020; Ingoldsby, 2010; Snell-Johns et al., 2004). Resources invested in making preventive programming

accessible to families that experience barriers to participation (such as work scheduling, need for childcare to participate, need for transportation, and need for meals during programming) will yield a strong return on investment (García et al., 2017) despite the additional efforts required to include these families. Though the FIRST Program was developed with these families and needs in mind, recruitment of participants who met the economic and educational criteria for low SES status across intervention conditions was very difficult and impacted the conclusions that could be made about the research questions. The low SES families that did participate were recruited through personal invitation by trusted healthcare professionals, offered transportation support, and high value incentives such as iPads. A larger participant pool of low SES families in the 4-session, 1-session, and no-session groups is still needed to definitively answer the research questions about the relative benefit of the FIRST Program to families across the SES spectrum.

Data Set Sample Size

While this study has demonstrated the suitability and strengths of using mixed effects modeling to understand the factors that contributed to the outcomes of the FIRST Program, the analyses would have provided stronger evidence had they been powered by larger sample sizes for each condition. The FIRST Program should continue to be replicated at James Madison University and at other institutions at various levels of intensity without changes to the current content to allow for the growth of the data sets and comparison across intervention intensity conditions. The data analysis plan described in detail in this document, when sufficiently powered, should provide more robust evidence regarding FIRST Program outcomes.

Longitudinal Outcomes

As previously mentioned, how the intensity of the FIRST Program influences short- and long-term outcomes for participants is an important question because it will inform subsequent programming decisions. It is also crucial to understand what the long-term impact of the FIRST Program is for the children who participate. Do the currently observed trends towards an "equalizing" effect of the coaching for families across the SES continuum on infant language development persist past the follow-up assessment period? If not, when do disparities in language development begin to re-emerge for FIRST families with environmental risk factors? It is not uncommon for this to occur in preventive programs (Hoffman et al., 2020; McGillion et al., 2017; Suskind et al., 2016; Zhang et al., 2015). Could the re-emergence of disparities be mediated by offering booster sessions at older ages that build upon previously learned caregiver skills and include developmentally relevant advances to support continued development? For example, a FIRST Program Toddler Follow-up would build upon the turn-taking interactions by coaching caregivers to place more emphasis on decontextualized content in conversation with preschoolers (Wei et al., 2020)

The long-term impact of the FIRST Program on graduate clinicians who participate is also of great interest. The data collected in this study was self-reported perception of increased confidence working with infants and coaching caregivers. Do student experiences in the FIRST Program encourage and equip graduate students to enter early intervention settings? Are FIRST Program clinicians positioned to offer high quality services that meaningfully and effectively engage caregivers in family-centered early intervention as early-stage professionals? To answer these questions, future efforts

to follow FIRST Program clinicians as they enter the workforce should be relatively easy with accreditation requirements from the Council of Academic Programs in Communication Sciences and Disorders. Additionally, measures of intervention fidelity (beyond self-report and clinical educator oversight) should be incorporated into the FIRST Program assessment schedule. Intervention fidelity describes the degree to which a coach or caregiver delivers or enacts an intervention as intended (Barton & Fettig, 2013). An operationalized key indicators fidelity measure, like that used in the Family Guided Routines Based Intervention (Romano & Schnurr, 2020), could be adapted to the FIRST Program and used by clinical educators and graduate clinicians to assess their adherence to the intended targets of the FIRST Program and become a routine clinical education tool to provide feedback to graduate clinicians.

Qualitative data collection and feedback mechanisms

While participant feedback was sought in survey form, other forms of qualitative data collection that could be made anonymous to the researchers, such as focus groups conducted by an outside party or anonymous computerized survey mechanisms, may better inform FIRST Program efforts to be culturally sensitive and relevant. Caregivers undoubtedly have important perspectives about the cultural relevance of FIRST Program targets but sharing these may feel uncomfortable outside of an anonymous context.

Conclusion

The contexts in which children develop language can be described at the macro-level which includes social, political, economic, cultural, and belief systems that surround the individual child. Children also develop within micro-level contexts which include the language environments they are exposed to on a daily basis at home and in the

community, as well as individual cognitive and sensory factors within the children themselves that influence learning. Each of these contexts in which children develop contribute to language development. The preventive intervention described here offers support for infant language development by focusing on support for caregivers at the micro-level context, with sensitivity to group membership and social connections. Based on growing evidence that changes within micro-contexts to malleable elements such as caregiver knowledge and self-efficacy can have a cascade of effects on language development (Alper et al., 2021; List et al., 2021; Rowe & Weisleder, 2020), the FIRST Program addressed both caregiver knowledge and caregiver-infant interaction with results that suggest a positive influence on infant developmental trajectories. As the first preventive caregiver-infant initiative conducted with graduate student clinicians in speech-language pathology, the FIRST Program provided both an important experience to graduate clinicians in early intervention, infant assessment, and caregiver coaching; and it demonstrated successful implementation of a clinical-research project that should be replicable in other university programs.

Appendix A

Prevention Program Coding Form - Harbick et al., 2021

Do prevention programs designed to facilitate caregiver-infant interactions promote positive spoken language outcomes in young children from environmentally at-risk samples?

1. Coder Initials

2. First Author

3. Primary discipline of First Author

4. Year of Publication

5. Year of Publication Summary: Please indicate the exact year above as well as the year range below

6. Article Title

7. Source or Publication Type:

Check all that apply.

- [ ] Journal
- [ ] Technical Report
- [ ] Unpublished data
- [ ] Doctoral Dissertation
- [ ] Master Thesis
- [ ] Presentation

8. Language

Check all that apply.

- [ ] English
- [ ] Translated to English

9. Country in which study conducted

_____

10. State(s) in which study conducted

_____

11. Study objective

_____

12. Do interventions designed to facilitate infant-caregiver interactions promote spoken language outcomes in young children? How would the authors of this study answer this question about their intervention?

Check all that apply.

- [ ] Yes
- [ ] No
- [ ] Other: _____

Sample Characteristics

13. Initial study Sample Size:

_____

14. Mean age of infants at first program encounter (months)

_____

15. Age range of infants in the sample at first program encounter (ex. 1-7 months)

_____

16. Genders of Infants: percentage or numbers of each

_____

17. Genders of Caregivers: percentage or numbers of each

_____

18. First Language of Infant-Caregiver Dyad

_____

19. Race and Ethnicity of Infant-Caregiver Dyad

Mark only one oval.

- ◯ Minority
- ◯ Non-Minority
- ◯ Not Reported
- ◯ Other: _____

20. Socioeconomic Status

Check all that apply.

- ☐ Below Poverty Line
- ☐ Low SES
- ☐ Mid SES
- ☐ High SES
- ☐ Not Reported
- Other: ☐ _____

21. Average education of caregiver

Check all that apply.

- ☐ Less than High School
- ☐ More than High School
- ☐ Not Reported
- Other: ☐ _____

22. Medical diagnoses of included infants

Mark only one oval.

- ◯ Yes (if so describe in next item)
- ◯ No
- ◯ Other: _____

23. If answered yes to the last question, describe the medical diagnoses of infants in the study

_____

24. Medical Resources of the Caregiver

Check all that apply.

- [ ] Private Insurance
- [ ] State Insurance
- [ ] Medicaid
- [ ] Not Reported
- [ ] Other: _____

25. At Risk Classification for Caregiver or Infant

Check all that apply.

- [ ] Low SES
- [ ] Single Parent family
- [ ] Low primary caregiver education
- [ ] Rural or underserved area inhabitant
- [ ] Minority
- [ ] Caregiver criminal history
- [ ] Caregiver medical or intellectual impairment
- [ ] Family history of speech-language impairment
- [ ] Immigrant family
- [ ] Prematurity
- [ ] Weight Faltering/Low Birthweight/Failure to Thrive
- [ ] Caregiver depression or mental health concern
- [ ] Other: _____

26. Setting for Sample and Study

Check all that apply.

- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Mixed
- [ ] Not Reported
- [ ] Other: _____

27. Sample Source

Check all that apply.

- [ ] Hospital
- [ ] Clinic
- [ ] Community Agency
- [ ] Other: _____

Prevention Program Characteristics

28. Method of Program Delivery (select all that apply)

Check all that apply.

- [ ] Training of caregivers in groups
- [ ] Training of caregivers individually
- [ ] Coaching with caregivers using videotapes of caregiver-infant interaction
- [ ] Coaching with caregivers over the phone
- [ ] Coaching with caregivers in the home
- [ ] Use of video as instruction method
- [ ] Use of literature/paper-based information as instruction method
- [ ] Use of children's books
- [ ] Anticipatory guidance in conjunction with medical visits
- [ ] Public Awareness Campaigns
- [ ] Other: _____

29. How did the article describe the program strategies/materials used? (Include curriculum name if applicable)

_____

30. Did the article describe the development of program strategies/materials?

Check all that apply.

- [ ] Previously developed program
- [ ] Use of formative/iterative practices
- [ ] Research/theory based
- [ ] Not reported
- [ ] Other: _____

31. Specific caregiver practices targeted

Check all that apply.

- [ ] Eye Gaze
- [ ] Turn Taking
- [ ] Responding to vocalization/parent responsiveness
- [ ] Reading to child responsively (dialogic reading)
- [ ] Gestures
- [ ] Joint Attention
- [ ] Other: _____

32. Hospital or Medical Clinic Program Site?

Check all that apply.

- [ ] Yes
- [ ] No
- [ ] Included this location but other locations as well
- [ ] Other: _____

33. Home-based Program Site?

Check all that apply.

- [ ] Yes
- [ ] No
- [ ] Included this location but other locations as well
- [ ] Other: _____

34. Other Training Sites used in addition to clinic or home?

_____

35. Program implemented by (check all that apply)

Check all that apply.

- [ ] Physician or PA
- [ ] Nurse
- [ ] Home Health Visitor
- [ ] Early Childhood Educator
- [ ] Social Worker
- [ ] SLP
- [ ] Trained community member/mentor/coach
- [ ] Other: _____

36. Number of program encounters (in terms of number of encounters/visits/sessions); include infant ages if this is significant detail (for ex. visits at 4, 8 and 12 mo)

_____

37. Length of an encounter (ex. hours)

_____

38. Total Duration of the program (from first encounter to final encounter, record as reported in the study):

_____

39. Child spoken language outcome measure reported

_____

Design Characteristics

40. Design Type

Mark only one oval.

- ◯ Random/RCT "True Experiment"
- ◯ Quasi-experimental (Pre-Post with Control)
- ◯ Other: _____

41. Type of Control Group

Mark only one oval.

- ◯ Non-treatment Control: group that did not receive any type of intervention regarding infant-caregiver interaction
- ◯ Business as Usual: group that may have received typical types of education regarding infant-caregiver interaction (ex. pamphlet, well check protocol) but NOT the intervention studied
- ◯ Alternate Treatment: group that was offered an alternate experience that would in no way impact the infant-caregiver interactions studied
- ◯ Other: _____

42. Method of Random Assignment

Mark only one oval.

- ◯ Random Number Generation/Table
- ◯ Coin Flip
- ◯ Not Reported
- ◯ Other: _____

43. Was random assignment concealed from the following?

Check all that apply.

	Yes	No	Not reported
Researcher	☐	☐	☐
Participant	☐	☐	☐
Intervener	☐	☐	☐
Assessor	☐	☐	☐

44. Subject Assignment

Mark only one oval.

- ◯ Individual Random
- ◯ Individual Matched-Random
- ◯ Whole Group Random
- ◯ Not Reported
- ◯ Other: _____

45. Were the following blinded from participant status?

Check all that apply.

	Yes	No	Not Reported
Researcher, Participant, Intervener, Assessor	☐	☐	☐
Participant	☐	☐	☐
Intervener	☐	☐	☐
Assessor	☐	☐	☐

46. Level of Blinding:

Mark only one oval.

- ◯ Single blinding
- ◯ Double blinding
- ◯ Triple blinding
- ◯ Not reported

47. Recruitment Pool

Check all that apply.

- ☐ Referral
- ☐ Meeting a criterion
- ☐ Waiting List
- ☐ Existing Group
- ☐ Volunteer

Other: ☐ _____

48. Design Problems Identified by Authors?

Mark only one oval.

- ◯ No or not stated
- ◯ Yes, Favors Control
- ◯ Yes, Favors Treatment
- ◯ Other: _____

49. Treatment Fidelity: If reported, describe fidelity measures

Mark only one oval.

- ◯ No, not reported
- ◯ Yes, describe below:

50. Reported fidelity measures

_____

_____

_____

_____

_____

51. Attrition from enrollment:

Mark only one oval.

- ◯ 0%
- ◯ 1-10%
- ◯ 11-20%
- ◯ >20%
- ◯ Not reported

52. Intention to Treat?

Check all that apply.

- [ ] Yes
- [ ] No
- [ ] Other: _____

53. Treated Participants only?

Check all that apply.

- [ ] Yes
- [ ] No
- [ ] Other: _____

ICROMS Quality Assessment: Use a copy of Table 3 for each coded study

Score 2 points if criterion met
Score 1 point if it's unclear whether or not the criterion is met
Score 0 if the criterion is not met.

*To meet inclusion criteria RCTs must meet mandatory criteria 1A, 2A, 2B and 3A and achieve a minimum score of 22.

54.

Mark only one oval per row.

	Yes criteria met (2 pts)	Unclear criteria (1 pt)	No criteria (0 pt)
1A			
2A			
2B			
3A			
3E			
3F			
4A			
4B			
4C			
5A			
6C			
7A			
7B			
7C			
7D			
7E			

55. ICROMS Quality Number Assignment TOTAL

Appendix B

Clinician Coaching Content Schedule, Planning, and Ideas

Schedule Assessment Day 1 May 15	
8:30-9:10	Clinicians Arrive and Set up
9:10-9:30	Parking Lot Greeting
9:30-9:45	Breakfast, Meet & Greet assigned family, Supervisor Intro.
9:45-10:00	Consent and Parent Survey
10:00-10:10	Informal Interaction Assessment
10:10-11:10	Rossetti, PLS-5, MB-CDI
Send home today: Diapers	

*Adjust schedule as needed to accommodate Hearing Screenings which should take 170pprox.. 10 mins.

Components of each coaching session should include:

1. Asking caregiver to reflect on ways they used the 3 Ts since the last session. Asking about any developmental milestones or progress noted.
2. Review of 2-3 video segments from the previous session with caregiver/infant demonstrating targeted skills. Ask the caregiver to identify and explain what happened; provide language support as needed.
3. Show parent a visual of number of turns taken or other data that will be motivational.
4. Activities and Materials related to the focus of the day.
5. Provide some activities to be used at home and record these in **HP Reveal for carryover**.
6. Anticipate and discuss upcoming developmental milestones to be watching for.

DATE	Large Group Content	1:1 Coaching Content Ideas
5/15 Assessment 1	-Breakfast and Meet & Greet Format of the day is different today than Friday or most of the other days will be.	• Consent and Survey • Informal Interaction Assessment with Toys • PLS-5 • Rossetti • MB-CDI Parent Report Measure • Infant Hearing Screenings Send home: Diapers
DAY 1	Language Nutrition & TUNE IN	• Visual for results on assessments • Discuss favorite things to do with their baby (cultural/work based/other)

		• Discuss technology distraction • Make a list of cues the baby uses to communicate • Practice Parentese using non-baby material (like a magazine article) • Model use of repetition in child-directed speech • Model book sharing with today's book to go home • Orient to HP reveal and iPad • Review Zero to Five content on pp. 38, 42, 47, 97, 98, 137, 138 Send Home: Book & iPad
DAY 2	• TALK MORE • DESCRIBE as a Strategy • NARRATION as a Strategy	• Catch up with any previous activities • Make a list of "built-in" times to focus on talking with their baby. • Practice Parallel talk • Practice Labeling • Make a bottle "toy" out of a common household object • Review Zero to Five content on pp. 48, 51, 52 Send Home: Diapers & iPad, bottle toy
DAY 3	The 3 Ts and Attachment	• Continue to focus on Tune In Activities and Talking More • Elicit discussion about caregiver experience of needing someone's attention and not getting it. • 30 second still face experiment with baby; notice and discuss baby's ability to repair and reconnect so quickly (resilience) • Review Zero to Five content on pp. 122

		Send Home: Book & iPad
DAY 4	• TAKE TURNS • BOOK SHARING	• Play baby turn-taking games such as peekaboo • Model and coach for waiting for responses • Practice book sharing • Start or continue to discuss upcoming developmental milestones; what to watch for so it can be reinforced • Review Zero to Five content on pp. 54, 57, Send Home: Book & iPad
DAY 5	The 3 Ts and Music Play	• Rehearse some baby songs • Ask about songs the family sings • Emphasize turn-taking in music play • Review My Music Box Content and activities • Solicit questions about feeding to be addressed next session • Review Zero to Five content on pp. 101, 102 Send Home: Diapers & iPad
DAY 6	The 3 Ts and Feeding	• Discuss Feeding Concerns • Connect the 3Ts to feeding opportunities • Discuss upcoming feeding milestones • Review Zero to Five content on pp. 84, 85, 87, 88, 91 Send Home: Book & iPad
DAY 7	The 3 Ts and Gesture	• Practice Songs and Fingerplays

		• Play "everyday" gesture charades • Send Home: Diapers & iPad
DAY 8	The 3 Ts and Motor Development	• Crossing the midline games • Help mom's set up a VROOM account on their smart phones or print out VROOM ideas for them to use. • Review Zero to Five content on pp. 180-182 • Send LENA home Send Home: Diapers & iPad

Schedule Assessment Day 2 6/14	
8:30-9:30	Clinicians Arrive and Set up
9:30-10:00	FIRST Graduation & Personalized Boxes
10:00-10:10	Informal Interaction Assessment
10:10-11:30	Rossetti, PLS-5, MB-CDI, Parent Survey, Assessment Results
11:30-12:00	Debrief in 1051 with Charlette
Send home today: Personalized Box, Zero to Five Text, Flowers	

- Explain Date to come back for Assessment 3 in September to received iPad.

Be prepared to do some on the spot analysis and summarizing; showing progress with your Assessment 1 visual.

Appendix C

Data Collection Sheet

FIRST Data Collection Sheet

Choose a 10-minute segment from the coaching session portion that you feel represents the most or best data.

Context/Activity/Coaching Focus within the Session:
Time Start: _____ Time End: _____

Turn-Taking		**Mode of Communication**		
Initiated by **Caregiver:** **Turns end when no response for either party after 15 sec of no engagement** Check per Initiation	# turns in exchange	**Non-Verbal** Interactions used by **Caregiver:** (Track total number) **Gestures**	**Vocal** Interactions used by **Caregiver:** (Track total number)	**Verbal** Interactions used by **Caregiver:** (Track total number) *These include signs
		Visual Referencing		
Total:				
Initiated by **Infant:**		**Gestures**	**Vocalization (vocal play)**	**Verbal (includes sign & word approximation)**
		Visual Referencing	Transcribe vocal play if applicable	Transcribe & count total utterances
Total:				

Caregiver: Infant:

____% Non-Verbal ____% Non-Verbal

____% Gesture ____% Gesture
____% Visual Referencing ____% Visual Referencing
____% Vocal ____% Vocal
____% Verbal ____% Verbal

Qualitative Observations of parent or child behaviors and interaction (*especially anything that impacted the data positively or negatively):

Choose 2-3 video segments from this session of responsive interaction between caregiver and infant. Identify the behaviors to be reinforced. Next session show the caregiver and ask them to explain what behavior they are using. Support as needed.

Time on Video	Details of the interaction	Targeted Behavior

Plan for next session (coaching targets):

Appendix D

FIRST Curriculum for Coaches

The FIRST Program Content Overview based on Thirty Million Words: Building a Child's Brain by Dana Suskind, MD

Belief in the Malleability of Intelligence:

- Babies aren't ***born*** smart: they're ***made*** smart by parents talking with them.

Language Nutrition (a term from Arianne Weldon):

- Just as babies need food to grow their bodies, they need language input to grow their brain.

Creating a Language Rich Environment built on Connection with your Baby:

- Tune In
- Talk More
- Take Turns

Tune In

-Intentionally notice what the baby is focused on and then talk with the baby about it
-When the baby's focus of attention changes, you notice and change with it
-Follow and respond to the baby's lead

Coaching Tips for Tune In:

The key purpose of Tune In is **parental responsiveness** which has been linked to a host of child development and life outcomes.

The essence of parental responsiveness/tuning in boils down to a 3-step process:

1. Observation
2. Interpretation
3. Action

Help caregivers to recognize when they have an "agenda" for an interaction, and to be flexible to let that go and notice what the baby is noticing and focused on (Observation & Interpretation). A baby will build more brain connections when an adult doesn't require them to use the energy to switch to another arena of less current interest. If a baby isn't interested, words have little to no effect on the brain development in that moment. Studies show that when a child has to participate in a low interest activity, they are less likely to learn the words being used.

Tuning in is enhanced by a communication partner who is on the same physical level. Joining a baby on the floor or holding them on their lap or being at the same height to allow for eye gaze while feeding.

Tuning in is deterred by digital distractions. *The fourth T should possibly be Turn It Off

Babies who receive consistent Tuning In are more inclined to stay engaged longer, to **initiate** communication and to learn more easily.

Babies use **verbal and non-verbal communication** cues to communicate their needs. Interpretation of these cues isn't always easy especially with crying. Crying can be for any number of reasons but there is one constant underlying infant crying: he or she is feeling *stress*.
Parents should always respond. Responding to a stressed baby helps them to understand that they are safe. It's the first lesson in life with long term effects. Parents are saying essentially, "It's not always going to be easy, but when the times are tough, someone will be there to catch you". While some stress is normal in babies, constant stress has been shown to have long-term negative ramifications known as "toxic stress".

Babies who experience toxic stress have brain connections that are permanently, negatively impacted. They grow up to have more difficulty learning, controlling emotions, controlling behavior and trusting others. They are also more prone to health problems later in life.

Parents who are responsive and Tuned In address babies experiencing stress promptly and positively. These responses build healthy brain pathways and lay the foundation for **attachment**.

Babies learn to Tune In too:

Tuning In will provide the opportunities for child-directed speech (Action). Discuss that **parentese** is something that parents from all cultures across time have used with infants because it helps a baby's brain learn language. Talk to the caregiver about parentese and the qualities that make it stand out: melodic pitch, positive tone, simplified vocabulary, singsong rhythm, a few octaves higher to usual to entice a child into shared attention. Some parents think this is "dumbing" down language for babies so encourage it. Parentese helps babies focus on the words, be engaged and interact…to Tune In.

Research: 11- to 14- month-olds who heard more **child-directed speech** knew at age 2, twice as many words as those who had been exposed to more **adult-directed speech**. When discussing this you may need to define adult and child direct speech in plain terms.

Repetition in child-directed speech also helps a baby to Tune In. Babies learn words they hear more frequently and will listen longer to sounds they've heard before.

Research: 9-month-olds heard the same 3 stories containing words not normally heard in a baby's everyday experience every day for 2 weeks. A control group did not. In a lab the babies who heard the story listened longer to the list of words from the stories than the control group. They learned to Tune In to the familiar.

Talk More

-Increase talking *with* a baby about what they are focused on, not *to* the baby
-The kinds of words used and how the words are said matters more than the amount
-Provide the input that allows for communication to develop and thrive

Coaching Tips for Talk More:

Teach and model **narration**: Narration of what you are doing is a method of surrounding a child with language. It increases vocabulary and shows the relationship between a sound and the act or thing it pertains to. Narration of daily routines with the baby (diaper changes, baths, feeding) is particularly valuable. Narration provides language nutrition to build the brain and attachment between the parent and child. It builds independence by familiarizing a young child with the steps involved in routine activities that they will one day do on their own.

Teach and model **parallel talk**: While narration occurs when parents talk about what *they're* doing, parallel talk is commentary on what the child is doing (requires Tuning In).

Tips for using both narration and parallel talk:

-Use eye contact with both
-Talk about things in the immediate environment
-Prioritize talking about what the baby is focused on

Teach and model **labeling**: He, She, It, That, and This don't mean very much to a baby who doesn't know the names of things yet. Label to build vocabulary. Babies will understand specific words LONG before they can speak them.

Teach and model **expansion, extension,** and **scaffolding:**

These are methods used to stay 1-2 steps ahead of a child's ability to communicate, encouraging more elaborate, detailed communication.

Use the analogy of charades to characterize early child-to-parent communications. Very often they start with gestures, such as raising both arms to signify they want to be picked up. Narrate these gestures (put words to them) and eventually the child will use the language you have provided: "Oh, you want UP!". (Most of our infants will be at this stage.)

As the baby learns to talk, they will use partial words and incomplete sentences, and parents will restate what they say by filling in the blanks. The expansion of "doggie sad" is "Your doggie is sad". It allows kids to learn a better way of saying something without the negative aspect of correction. (The baby is likely not talking yet, but you can mention these things for the near future.)

Scaffolding helps build language skills by adding words onto a child's response. For example, when a child uses one word, parents respond with 2 or 3; for a child who uses 2-3 words, parents use short sentences.

Take Turns

-Even babies can be engaged in a conversational exchange
-The critical components are responding to cues and waiting for responses to cues

Coaching Tips for Take Turns:

Turn-taking is the most valuable of the 3 Ts to brain development because it requires active engagement between parent and child which requires Tuning In to what the child is focused on and Talking More about it.

This can be the most challenging aspect of the 3 Ts with an infant. It can feel one sided, but it sets up an important perspective and expectation for the parent who is watching for responses.

Conversation with a baby means reading communication cues, decoding what those cues mean and responding (the essential elements of tuning in). It may not be considered a typical conversation, but these back-and-forth exchanges are important for building both a baby's brain and the parent-child attachment.

Highlight and model the use of **gestures and facial expressions** which are often used by babies to communicate well before words.

Teach and model **waiting for responses:** Taking Turns with a toddler becomes more varied. Toddlers are starting to use made-up words, approximations of real words and real words. Parents respond to these then wait for a child response…a very critical action! Emergent talkers may take a long time to search for words and a parent's instinct may be to respond for them which then ends the conversation. Allow children extra time to respond to communication opportunities.

Discuss and model the use of **open-ended how and why** questions: Show the caregiver how excessive use of "What?" limits the child's responses to single words and shuts down a conversational exchange. Yes/No questions fall into the same category because they shut down conversation and don't teach anything new.

Appendix E

FIRST Video Coding Manual

Start all sessions in the lab with the FIRST Lab Notebook:

-Add date, who is there and what tasks were accomplished

Opening up a new video to code in ELAN

1. Locate the correct file as indicated by Shiree

2. Copy the original uncoded ELAN file in the drive you are working on and then rename the copy file by adding all coder initials to the file name and saving in the folder of the original file. (Preserve the original that is uncoded.)

3. Set up the video by adding the START and STOP Markers in the Tier labeled Start and stop. Shiree will demonstrate this on your first coding day.

Troubleshooting:

-If the video starts to freeze, or you lose audio:

-Save your file

-Exit the file and ELAN

-Reload…so far this always resolves the issue

Adult Verbalizations

- Segment these in Segmentation Mode
- It's good to have some silence/space before and after the verbalization; you don't need tons of precision with the segments as we are working with 100ths of a second on screen and my data will round to the nearest second.
- It may work best to have one person segment and the other do a handwritten preliminary transcription on scrap paper; this will make it quicker when you Transcribe (see Shiree and Brenda demonstrate this in the training video)
- Switch to Transcription Mode for typing in the Transcription

Transcription notes:

- We are attempting to separate utterances into **breath groups** but it's often hard to judge this, especially when caregivers use an "audible intake of breath" (sounds like a loud gasp) that is designed to get the infant's attention and then they precede with words. In most cases like this an [AI] should be followed by the verbalization and coded as one single utterance. However, sometimes a baby takes a "turn" in between the gasp and the words; in this case code the gasp as one instance and then the words as a second utterance.
- Type out what you hear using regular spelling (no IPA needed) and try to match what was actually said; for example many speakers leave out articles, use unique grammar or condense words such as "whatcha" for "what are you"…use these types of spellings to best capture what was said. Other examples: singin'; we're gon see him soon
- Type non-speech sounds or qualities of note in brackets:
    - [AI] = audible intake of breath, usually to gain infant attention
    - [playful sound effects]
    - [whispered]
    - [laughing]
- Unintelligible word but you have a guess: *best guess*
- Really unintelligible word: ***

Infant Vocalizations

- Try to describe in IPA and use slashes
  - Ex. /o/ /ga/ /i/
  - Use these letters for the vowel sounds since we don't have Pepperfont:
    - "ah" = /a/
    - "ee" = /i/
    - "oh" = /o/
    - Vowel in "sit" = /I/
    - Vowel in "as" = /ae/
    - Vowel in "met" = /E/
    - "oo" = /u/
    - Vowel in "mud" (schwa) = /uh/
    - Vowel in "hay" = /e/
  - If you can't decide on a vowel or consonant sound use V and C to mark them, for example: /CVCV/ or /CVCVV/

- If there's any possible adult word form place it in quotes along with why you think this
  - Ex. /juhiuhio/ for "yellow" - imitation attempt

- If it's a non-speech sound describe in brackets
  - Ex. [vocal play]

THEN Add these codes for each instance according to the following:
Speech-like Vocalizations: vocalizations that can be described according to the adult model

Code	Description
L1	Just a vowel sound if [prolonged] add this descriptor
L2	1 consonant sound and 1 vowel sound
L3	Multiple consonants (liquids and glides only - /w/, /j/ usually); may be accompanied by vowels Ex. wawawa
L4	Multiple consonants (stops, fricatives, affricates, etc); may be accompanied by vowels Ex. dadada, ng

Non-Speech Vocalizations: vocalizations that are very difficult to associate with adult models

Code	Description
NS1	Positive - Expressing pleasure (ex. Laugh, giggle)
NS2	Negative - Expressing complaint (ex. Cry, fuss, whine)
NS3	Other - any prolonged vocalization that does not resemble adult-like speech OR Cannot be identified as positive or negative (squeal, growl, yell, non-communicative grunt). (Schoen 2011)
NS4	Reflexive sound including: burp, audible breathing, sounds made while feeding, describe these ex: [feeding sound]
GS	Glottal Stops (not quite a grunt and not quite a vowel)

UNC = Any vocalization listened to a maximum of 5 times and is unidentifiable
Infant Vocalizations based on previous lab SES study levels that were based on Bloom (see Hsu and Fogel ref p. 95)
*See Bloom's definitions 1988

Communication Pattern Coding

Code the entire video for each of these noting the switches between them.

Symmetrical (S):	Caregiver is tuned in to infant, Infant is tuned into caregiver. Turn taking occurs…any type of back and forth communication which may occur via movement, gestures, eye gaze, babble or vocalization.
Asymmetrical (A):	One partner is tuned in to the other (usually caregiver to infant). The other partner is tuned in and paying attention but just watching, not initiating or responding to communication bids.
Unilateral (U):	One partner is *attempting* to tune in effectively and talking more; providing opportunities for communication. Second partner is not attending to the first partner and may be focused on something else.
Disruptive (D):	One partner tries to be tuned in and force an interaction but the second partner rejects the communication attempts, showing active avoidance or resistance
Unengaged (UNEN):	No tuning in or engagement in either partner

*When in doubt or if something occurs in the session that you can't see, code for a "lower level" pattern.

Based on: Hsu, H. C., & Fogel, A. (2001). Infant vocal development in a dynamic mother-infant communication system. *Infancy*, *2*(1), 87-109.
p. 94 table

Expansion on the Relational Coding System as it applies to FIRST:
Unilateral:
Caregiver is *Talking more* and trying to engage and focus baby but the baby not engaged in that activity but other activities

Asymmetrical:
Caregiver and infant are focused and interested in the same activity but one isn't actively participating; just observing. (Ex. Baby observing a finger play, or observing a book during book sharing). The caregiver is *Tuning in and Talking more*.

Symmetrical: Caregiver and infant are actively involved in an interaction and novel actions occur because of the engagement of the other. These are true Take Turns interactions and novel actions can be verbal, vocal, gestural, or motoric (ex. Baby shows excitement during booksharing activity and waves arms or kicks legs; mother notes this

and continues. Ex. Game of peek a boo) There needs to be at least one back and forth "volley" between initiator, responder, intiator continues or adds novelty/modifies interaction. For this type of interaction we won't count turns but rather amount of time engaged in a symmetrical pattern. To achieve a symmetrical communication pattern a caregiver must be *Tuned In, Talking More and Taking Turns.*

Appendix F

Participant Intake Questionnaire

FIRST Participant Contact Information and Inclusion Criteria Questionnaire

Name of Caregiver: _____ Name of Infant: _____

Age of Caregiver: _____ years _____mo.

Age of Infant as of 5/18/21:

Infant DOB:

_____

Diaper Size: _____

Address: _____
_____

Phone number(s): _____
_____

Email contact: _____

Preferred and most reliable method of contact? _____
Is text messaging ok? _____

INCLUSION CRITERIA (bolded must be met to be included):

- **Yes** No Infant age between 6 and 12 months as of 5/18-20/21
- Yes **No** Does the infant currently have any medical diagnosis which may impact acquisition of developmental milestones? If so, describe: _____
- **Yes** No Does the caregiver or infant receive any type of public assistance? (Examples include Medicaid, WIC, FAMIS) If so, describe: _____
- **Yes** No Is the caregiver proficient in English?
- **Yes** No Did the infant pass the newborn hearing screening?

- **Yes** No Is the caregiver the infant's *primary* caregiver?

Groups Available: (all 5:00 - 6:30)

- JMU Group: Tuesdays for 6 weeks, 5/18-6/22
- New Market Group 1: Wednesdays for 6 weeks, 5/19-6/23
- New Market Group 2: Thursdays for 6 weeks, 5/20-6/24

Appendix G

Example Clinician Evaluation Checklist

FIRST 2021 Evaluation 1 Clinician Check-List

Participant Code: _____
Date of Eval 1: _____
Age in Months of Infant at Eval 1: _____

Initial each item when completed.

Prior to Evaluation session:

Equip treatment area with:
- Tripod(s) for iPad recording _____
- Set up iPad(s) with wide angle clip lens _____
- Floor blanket/baby space as needed _____
- Set up a B-Line Computer in Observation room _____

Familiarize yourself with:
- Location of standardized toy box _____
- Caregiver Questionnaire & CDI _____
- Test protocol & items for infant's current age on Rossetti _____
- Test protocol & items for infant's current age on PLS-5 _____

At the Evaluation Session Start:
- Collect Consent forms and Clinic forms _____
- Set up and press **record** on the B-Line _____
- Ensure angle of the iPad(s) and press **record** _____
  (Use forward facing cameras; not "selfie" camera)

1. Informal Interaction Assessment: 5 mins free play/5 mins with toys
   Start time: _____
   End time: _____

2. Administer Rossetti & PLS-5 concurrently as a team noting overlap of information
   - Rossetti: Start at appropriate age; find age of mastery per area _____
     Mastery for FIRST = only *one* item may be unchecked in an area
   - PLS-5: Administer at appropriate start point for age _____

3. Ask caregiver to fill out survey/questionnaire _____
   (Assist with infant as necessary)

4. Explain the CDI instructions, then ask caregiver to fill it out _____
   (Assist with infant as necessary)

5. Review information from the Assessments with parent _____
   (At minimum use a marker to show Rosetti outcomes)

6. Stop recordings, give family diapers, reminder next visit, walk to car _____

7. Plan with your partner and Debrief with your CE and include the following:
   Notes regarding parent concerns
   Your observations of the 3Ts during interactions thus far
   Review and Check assessment scoring together
   Review interaction video and choose a segment demonstrating the 3Ts to discuss with family
   Plan activities for the next session _____

8. Clean up your area, wipe surfaces and toys, linens to wash tub, _____
   iPad and Tripod turned off and placed in bins

9. File protocols and forms (including this one) in participant folder _____
   and place in marked file box
   *take any personal notes you need for the next session with you

Appendix H

Graduate Clinician Survey Questions

Pre-Test items:

Responses to this Survey will remain confidential and will have no impact on your course grade or evaluation.

Do you have any of your own children? Yes No
Describe any experiences or opportunities you have had to care for an infant:

Have you had any experience with infants in your clinical experiences to date? Yes No
If so, please describe:

For the questions below, use the following rating scale:

---------1---------2---------3---------4---------5---------
Strongly Disagree Disagree Unsure Agree Strongly Agree

	Rating Number
I feel comfortable with interaction with an infant and caregiver.	
I feel confident in my ability to accurately assess the language development of an infant.	
I feel confident in my ability to interview the caregiver of an infant to gain information needed to make an accurate assessment of infant language development.	
I feel confident interacting with the caregiver of an infant and providing and modeling suggestions for how to improve caregiver interactions with their infant.	
I feel like my coursework has prepared me to assess a variety of developmental milestones in an infant under 12 months (including language, feeding, and motor milestones).	
I feel that my clinical experiences have prepared me to confidently and competently assess the language development of an infant.	
I feel comfortable in my ability to explain my assessment of an infant's development to a caregiver.	

Post-Test Items:

Responses to this Survey will remain confidential and will have no impact on your course grade or evaluation.

How do you feel the FIRST program was beneficial in your development as an SLP?

What would you have changed about the FIRST program?

For the questions below, use the following rating scale:

---------1---------2---------3---------4---------5---------
Strongly Disagree Disagree Unsure Agree Strongly Agree

	Rating Number
I feel comfortable with interaction with an infant and caregiver.	
I feel confident in my ability to accurately assess the language development of an infant.	
I feel confident in my ability to interview the caregiver of an infant to gain information needed to make an accurate assessment of infant language development.	
I feel confident interacting with the caregiver of an infant and providing and modeling suggestions for how to improve caregiver interactions with their infant.	
I feel like my coursework has prepared me to assess a variety of developmental milestones in an infant under 12 months (including language, feeding, and motor milestones).	
I feel that my clinical experiences have prepared me to confidently and competently assess the language development of an infant.	
I feel comfortable in my ability to explain my assessment of an infant's development to a caregiver.	

Appendix I

SPSS Syntax for Replication of Data Analysis

```
* Encoding: UTF-8.
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DATASET NAME SpeakIIDataSet WINDOW=FRONT.
DATASET ACTIVATE SpeakIIDataSet.

****************************************** RQ1 ********************************************************************** Random
Intercept Mixed Model.
* Random Intercept Mixed Models

* Models considered with statistician:
MIXED SPK BY time session ses
  /FIXED = time session time*session ses
  /METHOD = REML
  /PRINT=SOLUTION
  /RANDOM Intercept |Subjects(id) COVTYPE(VC).

*
MIXED SPK BY time   ses
  /FIXED = time ses time*ses
  /METHOD = REML
  /PRINT=SOLUTION
  /EMMEANS=TABLES(time*ses)  ADJ(BONFERRONI)
  /EMMEANS=TABLES(time*ses) COMPARE (time)
  /RANDOM Intercept |Subjects(id) COVTYPE(VC).


* Final Model written up in dissertation.
MIXED SPK BY time session
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  /METHOD = REML
  /PRINT=SOLUTION
  /EMMEANS=TABLES(time*session) COMPARE (time) REFCAT(LAST) ADJ(BONFERRONI)
  /RANDOM Intercept |Subjects(id) COVTYPE(VC).

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  GUIDE: axis(dim(2), label("SPEAK-II Score"))
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  SCALE: cat(dim(1), include("1", "2", "3"), reverse())
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****************************************** RQ2  symmetry**********************************
Aggregated group data, Generalized Linear Mixed Model (GLMM) logistic regression .

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DATASET ACTIVATE DataSet1.
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```
*RQ2 symmetry.
*no interaction.
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  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=Dyad_Code COVARIANCE_TYPE=VARIANCE_COMPONENTS
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*interaction with sessions.
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****************************************** RQ3  AC EC TL ********************************************************************

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USE ALL.
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VARIABLE LABELS filter_$ 'time = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
SPLIT FILE LAYERED BY Session.
DESCRIPTIVES VARIABLES=AC EC TL
  /STATISTICS=MEAN STDDEV RANGE MIN MAX.

*To Sort Cases, Select cases to look at time 2 (Post-test) and Run Descriptives for tables and plots.
DATASET ACTIVATE DataSet3.
SORT CASES  BY Session.
USE ALL.
COMPUTE filter_$=(time = 2).
VARIABLE LABELS filter_$ 'time = 2 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
SPLIT FILE LAYERED BY Session.
DESCRIPTIVES VARIABLES=AC EC TL
  /STATISTICS=MEAN STDDEV RANGE MIN MAX.

*To Sort Cases, Select cases to look at time 3 (Follow-up) and Run Descriptives for tables and plots.
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*Then reset to make graphs.
FILTER OFF.
USE ALL.
EXECUTE.

SPLIT FILE OFF.

*Chart Builder for AC.

* Chart Builder.
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* Chart Builder.
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  GUIDE: axis(dim(2), label("PLS-5 EC Standard Score Mean"))
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"1", "2", "3", "4"))
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  GUIDE: legend(aesthetic(aesthetic.color.interior), label("Session"))
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*Paired samples t-tests
   Splite file for session group, run compare means by group...need to use my original file for PLS.

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  /FIXED  EFFECTS =  time Session  age_weeks_pre USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=id COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
  CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL  COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
  SINGULAR=0.000000000001.

*Language, interaction time with age.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=id
  /FIELDS TARGET=Language  TRIALS =FIELD(Lang_total) OFFSET=NONE
  /TARGET_OPTIONS  REFERENCE=0 DISTRIBUTION=BINOMIAL LINK=LOGIT
  /FIXED  EFFECTS =  time Session  age_weeks_pre time*age_weeks_pre USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=id COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
  CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL  COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
  SINGULAR=0.000000000001.

*Lang_expression, interaction time with age.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=id
  /FIELDS TARGET=Lang_expression  TRIALS =FIELD(Lang_expr_total) OFFSET=NONE
  /TARGET_OPTIONS  REFERENCE=0 DISTRIBUTION=BINOMIAL LINK=LOGIT
  /FIXED  EFFECTS =  time Session  age_weeks_pre time*age_weeks_pre USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=id COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
  CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL  COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
  SINGULAR=0.000000000001.
****************************************  CDI  ************************************************************Generalized
Linear Mixed Model (GLMM) negative binomial regression ..

GET
  FILE="/Users/shiree/Desktop/Dissertation/Data-Analysis Factor/Jeff Meyer's Analyses/CDI_data_long_nomissing.sav".
DATASET NAME CDIDataSet WINDOW=FRONT.
DATASET ACTIVATE CDIDataSet.

*Descriptives of Session by Time 1, 2, 3

SORT CASES  BY Session Time.
SPLIT FILE LAYERED BY Session Time.

DESCRIPTIVES VARIABLES=Words
  /STATISTICS=MEAN STDDEV MIN MAX.
DESCRIPTIVES VARIABLES=UnderstandAndSays
  /STATISTICS=MEAN STDDEV MIN MAX.
DESCRIPTIVES VARIABLES=Phrases
  /STATISTICS=MEAN STDDEV MIN MAX.
DESCRIPTIVES VARIABLES=Gestures
  /STATISTICS=MEAN STDDEV MIN MAX.

SPLIT FILE OFF.

*Words, UnderstandAndSays, and Gestures with no interaction.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Subject
  /FIELDS TARGET=Words TRIALS=NONE OFFSET=NONE
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
```

```
  CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL  COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
  SINGULAR=0.000000000001.


*Play.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=id
  /FIELDS TARGET=Play  TRIALS =FIELD(Play_total) OFFSET=NONE
  /TARGET_OPTIONS  REFERENCE=0 DISTRIBUTION=BINOMIAL LINK=LOGIT
  /FIXED  EFFECTS =  time Session  age_weeks_pre USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=id COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
    CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL  COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
    SINGULAR=0.000000000001.

*Language, interaction time with age.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=id
  /FIELDS TARGET=Language  TRIALS =FIELD(Lang_total) OFFSET=NONE
  /TARGET_OPTIONS  REFERENCE=0 DISTRIBUTION=BINOMIAL LINK=LOGIT
  /FIXED  EFFECTS =  time Session  age_weeks_pre time*age_weeks_pre USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=id COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
    CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL  COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
    SINGULAR=0.000000000001.

*Lang_expression, interaction time with age.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=id
  /FIELDS TARGET=Lang_expression  TRIALS =FIELD(Lang_expr_total) OFFSET=NONE
  /TARGET_OPTIONS  REFERENCE=0 DISTRIBUTION=BINOMIAL LINK=LOGIT
  /FIXED  EFFECTS =  time Session  age_weeks_pre time*age_weeks_pre USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=id COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
    CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL  COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
    SINGULAR=0.000000000001.
****************************************  CDI  ************************************************************Generalized
Linear Mixed Model (GLMM) negative binomial regression ..

GET
  FILE="/Users/shiree/Desktop/Dissertation/Data-Analysis Factor/Jeff Meyer's Analyses/CDI_data_long_nomissing.sav".
DATASET NAME CDIDataSet WINDOW=FRONT.
DATASET ACTIVATE CDIDataSet.

*Descriptives of Session by Time 1, 2, 3

SORT CASES  BY Session Time.
SPLIT FILE LAYERED BY Session Time.

DESCRIPTIVES VARIABLES=Words
  /STATISTICS=MEAN STDDEV MIN MAX.
DESCRIPTIVES VARIABLES=UnderstandAndSays
  /STATISTICS=MEAN STDDEV MIN MAX.
DESCRIPTIVES VARIABLES=Phrases
  /STATISTICS=MEAN STDDEV MIN MAX.
DESCRIPTIVES VARIABLES=Gestures
  /STATISTICS=MEAN STDDEV MIN MAX.

SPLIT FILE OFF.

*Words, UnderstandAndSays, and Gestures with no interaction.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Subject
  /FIELDS TARGET=Words TRIALS=NONE OFFSET=NONE
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
```

```
  /FIXED EFFECTS =time Session  age_weeks_pre   USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=Subject COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
    CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
    SINGULAR=0.000000000001.

GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Subject
  /FIELDS TARGET=UnderstandAndSays TRIALS=NONE OFFSET=NONE
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
  /FIXED EFFECTS =time Session  age_weeks_pre   USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=Subject COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
    CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
    SINGULAR=0.000000000001.

GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Subject
  /FIELDS TARGET=Gestures TRIALS=NONE OFFSET=NONE
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
  /FIXED EFFECTS =time Session  age_weeks_pre   USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=Subject COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
    CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
    SINGULAR=0.000000000001.

*Words interaction time with age.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Subject
  /FIELDS TARGET=Words TRIALS=NONE OFFSET=NONE
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
  /FIXED  EFFECTS =  Time Session  age_weeks_pre time*age_weeks_pre USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=Subject COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
    CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL  COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
    SINGULAR=0.000000000001
  /EMMEANS TABLES=time COMPARE=time CONTRAST=PAIRWISE
  /EMMEANS_OPTIONS SCALE=ORIGINAL PADJUST=LSD.

*Took out Session and looked at SES...SES doesn't contribute to word predictions

GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Subject
  /FIELDS TARGET=Words TRIALS=NONE OFFSET=NONE
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
  /FIXED EFFECTS =time SES age_weeks_pre   USE_INTERCEPT=TRUE
  /RANDOM USE_INTERCEPT=TRUE SUBJECTS=Subject COVARIANCE_TYPE=VARIANCE_COMPONENTS
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100
    CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
    SINGULAR=0.000000000001.

DATASET ACTIVATE CDIDataSet.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=Time MEAN(Words)[name="MEAN_Words"] Session
    MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE
  /COLORCYCLE COLOR1(119,55,143), COLOR2(41,134,38), COLOR3(227,215,16), COLOR4(155,0,0)
  /FRAME OUTER=NO INNER=YES
  /GRIDLINES XAXIS=NO YAXIS=YES
  /STYLE GRADIENT=NO.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: time=col(source(s), name("Time"), unit.category())
  DATA: MEAN_Words=col(source(s), name("MEAN_Words"))
  DATA: Session=col(source(s), name("Session"), unit.category())
```

```
  GUIDE: axis(dim(1), label("Assessment"))
  GUIDE: axis(dim(2), label("Mean Words Produced"))
  GUIDE: legend(aesthetic(aesthetic.color.interior), label("Session"))
  SCALE: cat(dim(1), include("1", "2", "3"))
  SCALE: linear(dim(2), min(0), max(15))
  SCALE: cat(aesthetic(aesthetic.color.interior), include(
"1", "2", "3", "4"))
  ELEMENT: line(position(time*MEAN_Words), color.interior(Session), missing.wings(), label(MEAN_Words))
END GPL.

GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=Time MEAN(UnderstandAndSays)[name="MEAN_UandS"] Session
    MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE
  /COLORCYCLE COLOR1(119,55,143), COLOR2(41,134,38), COLOR3(227,215,16), COLOR4(155,0,0)
  /FRAME OUTER=NO INNER=YES
  /GRIDLINES XAXIS=NO YAXIS=YES
  /STYLE GRADIENT=NO.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: time=col(source(s), name("Time"), unit.category())
  DATA: MEAN_UandS=col(source(s), name("MEAN_UandS"))
  DATA: Session=col(source(s), name("Session"), unit.category())
  GUIDE: axis(dim(1), label("Assessment"))
  GUIDE: axis(dim(2), label("Mean Words Understood"))
  GUIDE: legend(aesthetic(aesthetic.color.interior), label("Session"))
  SCALE: cat(dim(1), include("1", "2", "3"))
  SCALE: linear(dim(2), min(0), max(150))
  SCALE: cat(aesthetic(aesthetic.color.interior), include(
"1", "2", "3", "4"))
  ELEMENT: line(position(time*MEAN_UandS), color.interior(Session), missing.wings(), label(MEAN_UandS))
END GPL.

GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=Time MEAN(Phrases)[name="MEAN_Phrases"] Session
    MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE
  /COLORCYCLE COLOR1(119,55,143), COLOR2(41,134,38), COLOR3(227,215,16), COLOR4(155,0,0)
  /FRAME OUTER=NO INNER=YES
  /GRIDLINES XAXIS=NO YAXIS=YES
  /STYLE GRADIENT=NO.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: time=col(source(s), name("Time"), unit.category())
  DATA: MEAN_Phrases=col(source(s), name("MEAN_Phrases"))
  DATA: Session=col(source(s), name("Session"), unit.category())
  GUIDE: axis(dim(1), label("Assessment"))
  GUIDE: axis(dim(2), label("Mean Phrases Understood"))
  GUIDE: legend(aesthetic(aesthetic.color.interior), label("Session"))
  SCALE: cat(dim(1), include("1", "2", "3"))
  SCALE: linear(dim(2), min(0), max(20))
  SCALE: cat(aesthetic(aesthetic.color.interior), include(
"1", "2", "3", "4"))
  ELEMENT: line(position(time*MEAN_Phrases), color.interior(Session), missing.wings(), label(MEAN_Phrases))
END GPL.

GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=Time MEAN(Gestures)[name="MEAN_Gestures"] Session
    MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE
  /COLORCYCLE COLOR1(119,55,143), COLOR2(41,134,38), COLOR3(227,215,16), COLOR4(155,0,0)
  /FRAME OUTER=NO INNER=YES
  /GRIDLINES XAXIS=NO YAXIS=YES
  /STYLE GRADIENT=NO.
BEGIN GPL
```

```
  SOURCE: s=userSource(id("graphdataset"))
  DATA: time=col(source(s), name("Time"), unit.category())
  DATA: MEAN_Gestures=col(source(s), name("MEAN_Gestures"))
  DATA: Session=col(source(s), name("Session"), unit.category())
  GUIDE: axis(dim(1), label("Assessment"))
  GUIDE: axis(dim(2), label("Mean Gestures Produced"))
  GUIDE: legend(aesthetic(aesthetic.color.interior), label("Session"))
  SCALE: cat(dim(1), include("1", "2", "3"))
  SCALE: linear(dim(2), min(0), max(30))
  SCALE: cat(aesthetic(aesthetic.color.interior), include(
"1", "2", "3", "4"))
  ELEMENT: line(position(time*MEAN_Gestures), color.interior(Session), missing.wings(), label(MEAN_Gestures))
END GPL.

*To look at t-tests of words produced by session use this syntax.

GET
  FILE="/Users/shiree/Desktop/Dissertation/Data-Analysis Factor/Jeff Meyer's Analyses/CDI_data_short.sav".
DATASET NAME CDIShortDataSet WINDOW=FRONT.
DATASET ACTIVATE CDIShortDataSet.

SORT CASES  BY Session.
SPLIT FILE LAYERED BY Session.

DATASET ACTIVATE CDIShortDataSet.
T-TEST PAIRS=Words1 Words2 Words1 WITH Words2 Words3 Words3 (PAIRED)
  /ES DISPLAY(TRUE) STANDARDIZER(SD)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.

************************************************** Student Clinician
*****************************************************************

GET
  FILE="/Users/shiree/Desktop/Dissertation/Data-Analysis Factor/Jeff Meyer's Analyses/Student_Clinician_Data_long.sav".
DATASET NAME ClinicianDataSet WINDOW=FRONT.
DATASET ACTIVATE ClinicianDataSet.

*Descriptives of Session by Time 1, 2, 3.
SORT CASES  BY session time.
SPLIT FILE LAYERED BY session time.

DESCRIPTIVES VARIABLES=Score
  /STATISTICS=MEAN STDDEV MIN MAX.
SPLIT FILE OFF.

MIXED Score BY time session
  /FIXED = time session  time*session
  /PRINT=SOLUTION
  /EMMEANS=TABLES(time*session)  ADJ(BONFERRONI) COMPARE (time)
  /RANDOM Intercept |Subjects(id) COVTYPE(VC).

GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=time MEAN(Score)[name="MEAN_Score"] session
    MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE
  /COLORCYCLE COLOR1(119,55,143), COLOR2(41,134,38), COLOR3(227,215,16), COLOR4(155,0,0)
  /FRAME OUTER=NO INNER=YES
  /GRIDLINES XAXIS=NO YAXIS=YES
  /STYLE GRADIENT=NO.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: time=col(source(s), name("time"), unit.category())
  DATA: MEAN_Score=col(source(s), name("MEAN_Score"))
  DATA: session=col(source(s), name("session"), unit.category())
```

```
  GUIDE: axis(dim(1), label("Assessment"))
  GUIDE: axis(dim(2), label("Clinician Confidence Score"))
  GUIDE: legend(aesthetic(aesthetic.color.interior), label("Session"))
  SCALE: cat(dim(1), include("1", "2"))
  SCALE: linear(dim(2), min(10), max(40))
  SCALE: cat(aesthetic(aesthetic.color.interior), include(
'1", "2", "3", "4"))
  ELEMENT: line(position(time*MEAN_Score), color.interior(session), missing.wings(), label(MEAN_Score))
END GPL.
```

Appendix J

Participant Post-Survey Questions

1. What do you think are the most important things you have learned in the FIRST Program?

2. How has your baby changed during your time in the FIRST Program?

3. What did you like about the FIRST Program?

4. What do you wish we had done differently in the FIRST Program?

5. Have you told other people about what you have learned in the FIRST Program? If so, who did you tell?

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