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Closing the achievement gap through parent education and quantitative linguistic feedback: The use of LENA Start to improve the home linguistic environment and parental knowledge of child development

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Closing the achievement gap through parent education and quantitative linguistic feedback: The use of LENA Start™ to improve the home linguistic environment and parental knowledge of child development

by

Craig K. Van Pay
(Craig Van Pay)

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Education

Program of Study Committee:
Constance Beecher, Major Professor
Anne Foegen
Ji Young Choi

The student author and the program of study committee are solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University
Ames, Iowa
2017

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I dedicate this thesis to my amazing wife, Kate, and to my loving parents, Holly and Kelly. Kate, thank you for all your encouragement, support, and love throughout the completion of this work and throughout our lives together, you made this thesis better and make me a better person. Mom and Dad, thank you for always believing in me, pushing me to do great things, teaching me to be a good person, and of course, providing a good home environment from which to learn.
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ABSTRACT

This study investigates the use of an eight-week, parent-education program (LENA Start™) to increase the amount of child-directed speech, quantity of conversations, and parental knowledge of child development. For most young children, parents or caregivers primarily provide their language and literacy environment. However, all children do not receive the same early experiences due to differences in socioeconomic status or parent knowledge. Such differences can result in varied quantity and quality of linguistic input to the child, influencing later academic achievement. Therefore, interventions to combat the achievement gap between children of low and high socioeconomic status families are used and researched. To that end, 46 parents of infants and toddlers, about half of whom identified receiving public assistance, completed the LENA Start™ program and were assessed for growth in linguistic behaviors and child development knowledge. Participants received tips and practice to increase the number of words spoken to and the number of conversations engaged in with their child, paired with information about child language and brain development. Each week, participants recorded the number of words spoken to and number of conversational turns taken with their child by use of the LENA Digital Language Processor, receiving quantitative linguistic feedback. Participants completed pre and post SPEAK surveys, a test of parent child development knowledge, as well as the LENA Snapshot, a self-report questionnaire of child language ability. Findings revealed growth in word count and conversational turns, as well as growth in the overall knowledge of child development. No differences were found in growth or number of words and conversational turns based on participant public assistance status, although participants who received public assistance scored significantly lower on child development knowledge. Finally, the participants’
children exhibited greater than expected growth in language ability during the program. These findings provide evidence of a relationship between growth in linguistic behaviors and attending LENA Start™, an association among parent knowledge of child development and linguistic behavior, and the potential impact of increased parent linguistic behaviors on child language ability. The broader implications of these findings, the limitations, and the future directions of this research are discussed.
CHAPTER 1. INTRODUCTION

During a child’s first years, a critical foundation for his or her lifelong brain, social-emotional and cognitive development is laid (Brooks-Gunn, Berlin, & Fuligni, 2000; Fox, Levitt, & Nelson III, 2010; Shonkoff, 2010). This foundation is not only imperative for strong academic achievement, but for a lifetime of good mental and physical health (Duncan, Magnuson, Kalil, & Ziol-Guest, 2011). In particular, areas of a child’s development that have large impacts on later academic achievement and success are language and pre-literacy development (Carter, Chard, & Pool, 2009; Dickinson, Golinkoff, & Hirsh-Pasek, 2010; Schoon, Parsons, Rush, & Law, 2010). These skills are not developed in a vacuum, however; learning language and developing pre-literacy are social endeavors, and much of a child’s socialization and learning takes place in the home and from the parents or caregivers (Brooks-Gunn et al., 2000; Pruden, Hirsh-Pasek, & Golinkoff, 2017). Parental and home environment factors that impact language and literacy development are engagement in literacy activities such as shared book reading (Aram, 2008; Bus, Van Ijzendoorn, & Pellegrini, 1995), maternal knowledge of child development (Rowe, 2008; Suskind et al., 2015), and the quantity and quality of child-directed speech from mothers (Cartmill et al., 2013; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). Families of low socioeconomic status (SES) may lag behind other families of higher SES in many of these activities due to a lack of resources, education, and different life stresses and responses to those stresses (Bradley & Corwyn, 2002; Hoff, 2013; Payne, Whitehurst, & Angell, 1994). Therefore, children from these families tend to have lower vocabularies and pre-literacy skills when entering kindergarten and preschool, often described as the achievement gap between children of low and high SES families (Brooks-Gunn et al., 2000; Carter et al., 2009). This gap often persists
across the academic career of children from low SES households and widens rather than closes, even after remedial support such as special education has occurred (Duncan & Magnuson, 2013; Gettinger & Stoiber, 2008). Rather than remediate the problem after it has appeared, some programs are designed to proactively reduce the gap before it starts through parenting programs or interventions (Reese, Sparks, & Leyva, 2010; Roberts & Kaiser, 2011; Sénéchal & Young, 2008).

To help close the achievement gap, researchers have used parent-education programs to inform parents about the importance of certain parenting activities and increase behaviors which help develop their children’s abilities: linguistic, cognitive or socioemotional (Brooks-Gunn, Berlin, & Fuligni, 2000; see Reese, Sparks, and Leyva, 2010 for a review). Two of the most common parent-education interventions with families of low SES are shared book-reading and conversational interventions (Reese et al., 2010). These are designed to increase engagement in quality literacy activities in the home and increase the quantity and quality of child-directed speech respectively. Shared book-reading interventions provide families and caregivers with books and training about how to read dialogically, a type of reading shown to be particularly powerful for a child’s learning (Bus et al., 1995; Sim, Berthelsen, Walker, Nicholson, & Fielding-Barnsley, 2013). Conversational interventions instruct parents on how to talk with children in such a way that will benefit the children most, how to talk more, and how important and powerful it is for parents to talk with their child (Leffel & Suskind, 2013; Suskind et al., 2015). Due to the large effects seen from both types of interventions on children from low-income households (Bus et al., 1995; Roberts & Kaiser, 2011), some researchers have proposed that an intervention that includes aspects of both would be particularly influential in closing the gap (Reese et al., 2010). Recently, in a study conducted by Suskind and colleagues (2015),
parents of low-income were taught how to converse more with their children using an electronic “language pedometer” alongside information about shared-book reading in a home visitation setting. Although the gains in parent-child talk were modest, a strong mediating effect of the mothers’ knowledge of child development on their ability to increase talk was found. That is, participants who had larger gains in knowledge of child development had larger gains in parent-child talk. However, home visiting programs are expensive to provide for all families in need, and other researchers have called for community-based interventions to address the achievement gap as they are cheaper to provide and can reach more families (Burwick et al., 2014; Greenwood et al., 2017). Therefore, an intervention that is community-based and teaches techniques to alter parental language use and literacy activities, paired with instruction of the major milestones and processes of child development, may be particularly effective for combating the achievement gap.

LENA Start™ is a community-based, parent-education program created by the LENA Research Foundation to increase the amount of talk, conversations, and reading with children under 30 months of age. In this thesis, participants who completed the program were evaluated for individual growth across the program in the number of words spoken to their child, the amount of conversational turns taken with their child, and the change in their knowledge of child development before and after the program. As the program is a community-based intervention, the efficacy of the program for parents who are and are not receiving public assistance was compared, as families who receive public assistance are at greater risk for having children who are behind at school entry. Furthermore, the relationship between the participants’ knowledge of child development and the number of words and conversational turns was analyzed to corroborate its role in changing adult behavior as seen in other research (Rowe, 2008; Suskind et
al., 2015). Finally, as the program is to help combat the achievement gap, the transfer of parent behavior change to child language ability was assessed. Results of the study are utilized to assess the use of the LENA Start™ program as a beneficial tool in helping to close the achievement gap.
CHAPTER 2. LITERATURE REVIEW

How Language is Learned

Young children acquire language by listening to the linguistic input that surrounds them, learning the statistical likelihood of sound groupings in their soon-to-be native language (Saffran, Newport, & Aslin, 1996) and associating words and objects that are frequently paired together in their environments (Smith, Jones, & Landau, 1996). The environments in which children learn language are highly contingent on their caregivers or parents, and many have regarded parents as the child’s first and primary teachers (Brooks-Gunn et al., 2000; Hoff, 2006). Therefore, learning language and pre-literacy skills is highly social, and depends upon input from caregivers and their scaffolding of the use of language and social skills (Pruden et al., 2017). Caregivers do this in many ways, often changing the way they engage and talk with their babies (Newport, Gleitman, & Gleitman, 1977; Tomasello & Farrar, 1986). For example, when mothers are teaching new words to their infants, they engage in joint attention, or switching their own attention and instruction toward an object to which the child is already attentive (Morales et al., 2000; Tomasello & Farrar, 1986). This results in the parent using more words about the object, and keeps the mother-child pair engaged longer (Tomasello & Farrar, 1986). Furthermore, parents who engage in joint attention more frequently have children with larger early vocabularies (Morales et al., 2000). During joint attention and other language teaching moments by the caregivers, parents also frequently change their speech and language, speaking more slowly, using a higher pitch, and using longer pauses between words, called “motherese” (Ma, Golinkoff, Houston, & Hirsh-Pasek, 2011; Newport et al., 1977). In fact, 21 month old infants learn best from this type of infant-directed speech, and do not learn as well from typical
adult-directed speech (Ma et al., 2011). However, later at 27 months, children learn new words equally well from both types of speech. Surprisingly, two year old children can learn new words just from overhearing adult-directed speech, even when they are distracted with other tasks (Akhtar, 2005; Akhtar, Jipson, & Callanan, 2001). Given that infants learn best from hearing words both directed at them and by overhearing, the number of words they are exposed to is crucial during language development.

The Effect of the Quantity of Language Input on Language Development

The number of words young children hear is highly predictive of their later vocabulary and language development (Hart & Risley, 2003; Hurtado, Marchman, & Fernald, 2008; Huttenlocher et al., 1991; Zimmerman et al., 2009). In a seminal study examining early vocabulary growth, Huttenlocher and colleagues (1991) collected data from 22 English-speaking, mother-child dyads for 10 months, from the time children were 14 months of age to the time they were 24 months of age. The amount of words heard by the children from their mothers predicted their vocabulary growth as well as total vocabulary size. In a more recent study by Hurtado, Marchman, and Fernald (2008), these results were replicated with Spanish-speaking mothers and children. In this study, Spanish-speaking mothers who provided more input to their children at 18 months of age had children with higher vocabularies and faster word recognition at 24 months of age. Further evidence is seen in studies investigating the “word gap,” which is a term for the difference in input heard by children in families of low and high SES (Fernald, Marchman, & Weisleder, 2013; Hart & Risley, 1995; Hoff, 2003).

In 1995, Hart and Risley published a landmark study that measured the child-directed speech from parents to their children in households of varying SES. The researchers observed, tape-recorded, and transcribed the natural speech of 42 families with young children across two
and a half years. The researchers analyzed the data from the families based on their SES, dividing them into professional families, working-class families and families receiving welfare. The differences in linguistic input were staggering; from seven months of age to three years of age, children in families receiving welfare heard on average 30 million fewer words than did children from professional families. Even more discouraging, the researchers followed 29 of the studied children until third grade and the number of words heard was a powerful predictor of third grade vocabulary and reading ability. This was not the only major finding from this study however, other analyses of specific speech patterns showed differences in the amount of encouraging words (e.g., “Good job!” or “You can do it!”) and prohibitions (e.g., “Don’t do that!” or “Stop it!”) used across SES. Children in professional families heard on average six encouragements for every prohibition, whereas children in welfare families received two prohibitions for every encouraging word or phrase heard (Hart & Risley, 2003). The quality of caregiver speech is also another powerful predictor of vocabulary and later achievement (Cartmill et al., 2013; Rowe, 2012).

The Effect of Language Quality on Language Development

Not only is the quantity of language input important for a child’s language development, but also the quality of the input they are receiving (Hoff, 2006). For example, Rowe (2012) examined the quality of mothers’ speech to their preschoolers and examined the children’s vocabulary a year later. After controlling for SES, the child’s previous vocabulary skills, and the amount of words heard in the home, mothers who used more language that is decontextualized (e.g., language about events that do not have a visual context immediately available, like narratives, pretend talk or an explanation) or who used a richer vocabulary (e.g., using tier two or three words; saying gigantic instead of big) had children with higher vocabulary skills a year
later. Furthermore, children with larger vocabularies have parents that provide longer inputs to the child and use less directing behavior (Rowe, 2008).

In another study looking at five year old children and the quality of maternal speech, higher quality talk accounted for a third of the variance in a child’s vocabulary in kindergarten and in second grade (Weizman & Snow, 2001). These differences are also seen in younger children, as shown in a recent investigation of 14 to 18 month old children (Cartmill et al., 2013). Undergraduate student participants watched a video of a parent teaching words to their 14 to 18 month old children and were asked to guess 50 of the words the parents in the video were trying to teach. For parents whose words were more easily distinguished by the participants, their children had higher vocabularies three years later. After controlling the quantity of words spoken, the association was still significant and quality accounted for 22% of the children’s vocabularies at four years of age.

Some evidence of the cross-cultural nature of the importance of quality is also seen in Dominican and Mexican American families (Song, Tamis-Lemonda, Yoshikawa, Kahana-Kelman, & Wu, 2012). The quality of the language experiences of the children in these families at 14 months of age and two years old were highly predictive of their vocabulary. Furthermore, the literacy activities these families engaged in predicted vocabulary as well, pointing to a powerful contribution of reading to the vocabulary of a child, which is also shown in other studies (Raikes, et al., 2006; Wasik, Hindman, & Snell, 2016).

The Effect of Home Literacy Practices on Language and Literacy Development

Parent-child shared-book reading provides important interaction for a child and fosters many skills, including vocabulary development and pre-literacy ability, which are important for
later outcomes (Aram, 2008). In research using the Early Childhood Longitudinal Study – Birth (ECLS-B) cohort, Hindman, Skibbe, and Foster (2013) found that parents who use a wider variety of talk during reading have preschoolers who have stronger language ability. Most parents focus primarily on the meaning of a story when reading, but rarely focus on the letter to sound correspondence and grammar, which are important for developing pre-literacy skills (Hindman et al., 2013). Another study that utilized the ECLS-B dataset compared the amount of literacy activities a child experienced at 24 months of age to their outcomes in preschool (Baker, 2013). The children who received more frequent literacy activity involvement at home exhibited better reading, math, and social-emotional outcomes in preschool. In an analysis of Jordan, Snow, and Porche’s (2000) Early Access to Success in Education (Project EASE), a program that worked to connect home literacy and language practice with schools, larger language growth was exhibited by kindergarten students who had experienced more book related activities in the home. More evidence of the importance for book reading on later reading and language outcomes is found from a study by Reese (1995). Mothers were evaluated while talking and reading with their children at ages 40, 46, and 56 months. The engagement of the mothers and their storytelling talk was highly correlated with the children’s achievement on a comprehensive literacy assessment at 70 months of age. Furthermore, four year old children who have greater knowledge of storybooks have greater vocabularies, even after controlling for SES and parent literacy level (Sénéchal, LeFevre, Hudson, & Lawson, 1996).

A review of reading programs in kindergarten through third grade shows great effects of reading at home on a child’s ability to read as well (Sénéchal & Young, 2008). Activities such as dialogic reading or having book-related discussions at home provided strong effects for reading achievement ($r = .65$) (Sénéchal & Young, 2008). However, not all children receive the great
benefits of reading in the home. For example, in a survey of urban, American mothers with newborn babies, 42.2% of mothers had no books for babies in their home (Berkule et al., 2008). Similar to language experiences, literacy activities in the home are heavily influenced by SES and beliefs (Berkule, Dreyer, Huberman, Fierman, & Mendelsohn, 2007; Leseman & Jong, 1998; Payne et al., 1994; Rodriguez et al., 2009)

Theoretical Framework for Parental and Environmental Effects on Language and Pre-Literacy Development

Bronfenbrenner and Ceci’s Bioecological model (1994) provides a lens to view how low-income parents and the environments they provide may influence a child’s development. This model extends Bronfenbrenner’s Ecological systems theory (1989), which asserts that human beings develop through a bidirectional relationship of themselves and their most immediate environments, which are also changed through a complex bidirectional relationship with the environments surrounding them, and so on. For example, a child influences her parents and siblings, who in turn influence her. Her parents and siblings are part of the household environment, but also perhaps within their own extended families, workplaces, and culture, which can influence them. In the Bioecological model, a larger importance of a child’s closest environments and their interaction with these close environments, together called the proximal processes, is placed on their development than in the original Ecological model. Beyond these proximal processes, processes that are more distal also influence the child, but in smaller ways (See Figure 1).
Figure 1. The Bioecological model with the focus on a language-learning infant. This figure shows how the circles of influence are arranged and the bidirectional nature of the systems interacting with one another.

The model is comprised of several circles of influence that surround the developing child. The most immediate environment of influence is the Microsystem, which includes the child’s parents or caregivers and the home environment. In the model, the interactions of the child and his/her Microsystem are the proximal processes and are most important for development. The interaction of the Microsystem and the Exosystem form the Mesosystem, which is how the parents are influenced by outside sources such as their job, or the available resources in the communities. These are all influenced bidirectionally by the Macrosystem, or large circles of
influence like culture and laws. For a young child acquiring language and pre-literacy skills, the proximal processes include the home linguistic and literacy environment and relationship with her caretakers. From these proximal processes the young child learns, among many other things, the ability to talk and the precursors that are needed to later to be literate. The caretakers of the child are the primary agents of forming the home environment and providing developmental opportunities for the child. However, the home environment and the caretakers are simultaneously affected by the proximal processes they are experiencing. The home environment is then changed by the complex interplay of the child, the caretakers, and the caretakers’ environments. In the Bioecological model, although most all caretakers are looking to provide an optimal environment for their children to learn within, that may not be possible due to environmental or experiential constraints put on the caretakers by outside sources (Payne et al., 1994). As would be hypothesized through this framework, there are differences in the home literacy environments between families with varying levels of education, income discrepancies, and different family characteristics (Payne et al., 1994; Rodriguez et al., 2009). Overall, the Bioecological model provides a conceptual framework through which to view the impact of home environment, by way of SES on a child’s individual development.

The Effects of Socioeconomic Status on Language and Literacy Development and Later Achievement

SES has large effects on a child’s outcomes, from early achievement to later health and even criminality (Duncan et al., 2011). Unsurprisingly, and as alluded to in other portions of the literature review, SES also influences language and pre-literacy development, which has long-term effects for academic achievement and success. SES is based on the family’s income, the education level of the parents, and the current occupational status of the members in the family.
(Bradley & Corwyn, 2002). This results in differential access to materials and social resources. Furthermore, due to the nature of stress and the differential fostering of resiliency by children who endure poverty, families of low SES exhibit different reactions to stress and stressful situations (Bradley & Corwyn, 2002). With these differences, as seen with the theoretical model above, the environment and ultimately the trajectory of childhood development are altered. For example, the differences seen between the quantity and quality of language input in Hart and Risley’s (1995) study resulted in a 30 million word gap at age three, and differences in third grade reading ability. The disparities appear even before age three; in a recent study Fernald, Marchman, and Weisleder (2013) found a receptive vocabulary difference in children as early as 18 months of age. At 24 months, the developmental gap between low and high SES children is already six months (Fernald, Marchman, & Weisleder, 2013). In a study of the type of talk parents with low-income engage in, Hoff (2013) found that they use more directive speech that is less conversational, and use a smaller vocabulary with a smaller grammatical range than middle- and high-income parents. There are also many differences of families of low SES in providing literacy activities and materials in the home (Leseman & Jong, 1998; Payne et al., 1994; Rodriguez et al., 2009). For instance, for families enrolled in Head Start, a community-based, federally-funded preschool program for children of low-income families, differences were recorded at 14, 24, and 36 months of age in the number of books in the home, the amount and type of literacy activities engaged in, and the quality of maternal engagement during these activities (Rodriguez et al., 2009). Later, at 36 months of age, these differences predicted their cognitive and language abilities. Another study with Head Start children found that trips to the library, the child’s requests to do shared-book reading, number of books in the home, and the
amount of shared-book reading explained 12 to 18.5% of the variance in preschool children’s language ability (Payne et al., 1994).

However, SES does not always drive these effects directly. Child-directed speech from mothers (maternal speech) predicts a child’s productive vocabulary best, not SES, and even though maternal speech is highly correlated with SES, there are large individual differences in parent talk across income levels (Hoff, 2003). One variable that mediates the relationship between SES and the amount of child-directed speech is parent knowledge of child development (Rowe, 2008; Suskind et al., 2015). That is, parents of low SES can provide a lot of quality child-directed speech if they are aware of its importance in language development. Furthermore, mothers’ knowledge of child development impacts the way mothers play with their children, which has broad implications for children’s cognitive and social development (McMillin et al., 2015).

Taken altogether, these early differences of environment have lasting influences on language and reading achievement (Bleses, Makransky, Dale, HØJen, & Ari, 2016; Schoon et al., 2010; Sénéchal, Ouellette, & Rodney, 2006). Using the 1970’s British Cohort Study, receptive vocabulary as measured by the Peabody Picture Vocabulary Test (PPVT) at age five accurately predicted subsequent literacy skills in adulthood, even after controlling for things such as SES (Schoon et al., 2010). Further evidence is seen from a study of Danish children, where children’s vocabulary at 16 months of age was used to predict their decoding and reading comprehension ability later in sixth grade (Bleses et al., 2016). Furthermore, Kindergarten vocabulary level is also a reliable predictor of reading success in the fourth grade (Sénéchal et al., 2006).
Early Interventions for Closing the Achievement Gap

The systematic difference seen in language skills, socioemotional development or cognitive ability between children of low- and high-income families is known as the “achievement gap” (Duncan & Magnuson, 2013). However families of low SES are not inherently inept at providing strong learning environments for their children, but instead face different challenges than middle and high SES parents do (Pace, Luo, Hirsh-Pasek, & Golinkoff, 2016). Parents of low SES typically have lower educational attainment, access to fewer resources and opportunities, and an increased rate of mental health problems, which all can greatly impact parenting (Shonkoff & Phillips, 2000). Interventions to help close the achievement gap have been used with success. These programs typically involve increasing behaviors conducive to language and literacy development, such as increasing the amount of talk or increasing the amount of shared-book reading, and increasing awareness about the importance of doing those behaviors (Bus et al., 1995; Leffel & Suskind, 2013; Reese et al., 2010; Roberts & Kaiser, 2011; Sénéchal & Young, 2008).

Early language and literacy interventions for low-income parents of young children have shown some promising results for combatting the achievement gap (Leffel & Suskind, 2013). The two primary foci of these interventions are to promote quality shared-book reading and to provide more meaningful talk to children (Reese et al., 2010). Some of these interventions also include considerable instruction about developmental milestones and overall child development (Suskind et al., 2015). Shared-book reading interventions for families of low-income show a wide-variety of results that are beneficial to the child’s long-term language and literacy outcomes. Aram, Fine, and Ziv, (2013) gave low-income families of preschoolers weekly books and provided them with training in how to read dialogically, including how to focus not only on
the book’s plot, but also the book’s socio-cognitive aspects. After the intervention, the families elaborated further when reading the book and used more plot and socio-cognitive talk, which is beneficial for their child’s literacy and even social development. Another intervention, called Play and Learning Strategies, taught low-income mothers in their homes how to improve their shared-book reading behaviors (Landry et al., 2012). After the intervention, the mothers asked more open-ended questions, used more techniques to facilitate discussion and language, and used more verbal support when reading. More importantly, the children of these mothers were more interested in books and reading, and were more likely to engage in shared-book reading.

Some shared-book reading interventions focus on specific skills during reading, like using decontextualized language (Morgan & Goldstein, 2004). After an intervention, low-income mothers were better at using decontextualized language when reading, in other words, language about what is not just on the pages but extended discourse about the book, like connecting it to the child’s life and making predictions (Morgan & Goldstein, 2004). The authors argue that these skills are required for children to succeed when starting school. Evidence supports dialogic reading as being especially helpful for growing a child’s language and literacy (Whitehurst et al., 1994). Parents of low-income preschoolers were taught to do dialogic reading with their children at home, and after only a few weeks of the exposure at home and in their preschool, these students had higher expressive vocabulary skills (Whitehurst et al., 1994). A similar effect in Australian children aged five to six was found; parents were trained in how to do dialogic reading with their children, and after three months, these children were compared to a group of control children. The children with trained parents had higher expressive language scores (Sim et al., 2013). These findings are generally robust; in a meta-analysis of 29 parent-child, shared-
book reading studies, an effect size of $d = .59$ was found for shared-book reading on language growth and early literacy (Bus et al., 1995).

Other interventions for combatting the word gap include training that alters the conversations of parents with their children (Reese et al., 2010). These interventions can use information to increase the amount of talk, and ways to increase the quality of talk, by using richer vocabulary and by narrating and storytelling more. Recently, some broad, community-based interventions have appeared such as Talking is Teaching from Too Small To Fail and Talk, Read, and Sing Together Every Day! from the United States Department of Education. Interventions like these do not have a specific, in-person training component, but highlight for the public the importance of talking and reading more with their child. There is evidence to believe these efforts are working, but in-person interventions for parents may produce more meaningful effects (Greenwood et al., 2017).

One exciting intervention for increasing parent talk involves use of the LENA Digital Language Processor (DLP). Caregivers of children aged 10 to 40 months set talking goals and attended a single session on the importance of talking to children and then wore a device which quantified the number of words and conversations they took part in with the child (Suskind et al., 2013). After receiving feedback on the amount of words and conversations they had, they were able to significantly increase the amount of conversations and the amount of talk they provided to the children on successive recordings using the LENA DLP. Using the same DLP technology, Suskind and colleagues (2015) created a home-visiting intervention for families with low-income. Throughout eight weekly, 60 minute sessions, parents received instruction about development and tips to talk more, time to practice those tips, received feedback on their previous recordings of talk, and set goals. After the eight-week intervention, parents had
significantly larger knowledge of their role in their child’s language development than did a control group, and talked significantly more with their children as measured by the device and an observation. Critically, the parent’s knowledge of child development also mediated the increase in talk with their child relative to the intervention effects. Across these interventions, the provision of books, better shared-reading techniques, linguistic feedback, and instruction of child development information seem to be techniques that can help parents provide a better linguistic and literacy environment for their young children. An intervention that includes all of these practices might be particularly beneficial in helping all parents, low- or high-income, to prepare their child for future academic success.

Purpose Statement, Research Questions, and Hypotheses

The purpose of the current study is to investigate the use of an eight-week, in-person, community-based, parent-education class called LENA Start™. LENA Start™ is a curriculum designed to increase the quantity of child-directed speech and the amount of conversational turns parents take with their children through providing quantitative feedback and information about child development. Forty-six parents with children under 30 months of age completed the program and were evaluated for their ability to increase the frequency of their child-directed speech and conversational turns, and their increase in overall knowledge of child development. Currently the program is in iterative development, so there is no control group to assess against, but rather participants were assessed for individual growth across the eight-week program.

Furthermore, as the intervention is designed to close the achievement gap for children of families with low or high SES, the programs effect on growth for both families that are and are not receiving public assistance (Women, Infants, & Children) was investigated. Finally, because the ultimate goal of this parent-directed intervention is an increase in child language and literacy
ability, growth in the language development of the child throughout participation in the program was examined. Therefore, the following research questions are investigated in this study:

1. Can completion of the LENA Start™ program result in increases in the quantity of words used and conversational turns participants have with their child?

2. How is parents’ knowledge of child development related to the number of words and conversational turns with their child, and can the LENA Start™ program increase their overall knowledge of child development?

3. Does the LENA Start™ program have a differential impact on higher risk families versus lower risk families, as determined by receiving public assistance?

4. Does the LENA Start™ program result in greater growth of a child’s language ability than is expected over the course of the program as measured by the LENA Snapshot?

With regard to research question one, it is hypothesized that the LENA Start™ curriculum will result in individual growth of the participants’ number of words spoken to their child and the number of conversational turns engaged in with them. For research question two, in corroboration of prior research (Suskind et al., 2015), I hypothesize that the participants’ growth in their words and conversational turns will be related to their knowledge of child development, and that participants’ knowledge of child development will grow as a result of completing the program. For research question three, due to the nature of low-income families typically speaking fewer words (Rowe, 2008), I hypothesize that families receiving public assistance will have larger growth in child-directed speech and the number of conversational turns with children across the LENA Start™ curriculum than do families who are not receiving public assistance. Finally, for research question four, due to increased language input and quality from the participants in the program, it is hypothesized that children of the participants will have language
growth that is greater than is expected by developmental norms as measured by the LENA Snapshot.
CHAPTER 3. METHOD

Participants and Setting

Forty-six parents of children aged one to thirty months were recruited for participation in the present study. In the case of families with multiple children in the specified age range, the youngest child within the range was designated as the primary child for focus in the study. The mean age of the children of focus was 13.82 months ($S.D. = 8.28$ months) with a range from 1.10 to 29.80 months of age. Parents identified the gender of their children, resulting in 28 females and 18 males.

Demographic information was incomplete for five participants in the study, due to opting out (three participants) or recording errors (two participants). The mean age of the parents was 33.27 years ($S.D. = 5.17$ years) with the youngest parent being 21 and the oldest 44. Parents ($n = 41$) reported their self-identified gender, resulting in thirty-six females and five males. All participants had basic proficiency in English, the language used in the sessions and in the LENA Start™ curriculum. Participants reported their primary language used in the home; 18 used English, one used Spanish, one used Polish, 14 used Chinese, and seven families selected “Other.” Most participants reported being married ($n = 38$) with one family reporting living with their partner unmarried and two participants reporting being single parents. The racial/ethnic breakdown of the participants was as follows: 18 White or Caucasian, 21 Asian or Pacific Islander, and two participants who preferred not to answer. Four of these participants additionally reported being Hispanic or Latino. Twenty-three of the participants reported having only one child under 18 in their household, 13 reported two children, four reported three children, and one participant reported four children under the age of 18 in the household.
Overall, participants reported having high educational attainment, with 16 reporting having at least a bachelor’s degree and 18 having a graduate or professional degree (see Table 1 below). This is in-part due to the city in which the study occurred, which houses a large, research one institution. Therefore, many of the participants are also international graduate students as evidenced by the large variety of languages spoken in the home.

Table 1

<table>
<thead>
<tr>
<th>Highest Level of Education</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some college, but no degree</td>
<td>4</td>
<td>9.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Associates Degree - AA, AS</td>
<td>3</td>
<td>7.3</td>
<td>17.1</td>
</tr>
<tr>
<td>Bachelors Degree - BA, BS</td>
<td>16</td>
<td>39.0</td>
<td>56.1</td>
</tr>
<tr>
<td>Graduate or professional degree - MA, MS, MD, JD, PhD</td>
<td>18</td>
<td>43.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>

See Table 2 below for reported monthly income of the participants. Over half of the participants (58.5%) reported making $3,349 - $4,402 or fewer dollars per month. Participants were also asked if they received Women, Infant, and Children (WIC) supplements or Supplemental Nutrition Assistance Program (SNAP). Eighteen of the 41 respondent participants reported that their family received WIC and five reported receiving SNAP.
Table 2

Participants' Self-Reported Monthly Income

<table>
<thead>
<tr>
<th>Income</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $2,655</td>
<td>11</td>
<td>26.8</td>
<td>26.8</td>
</tr>
<tr>
<td>$2,656-$3,348</td>
<td>5</td>
<td>12.2</td>
<td>39.0</td>
</tr>
<tr>
<td>$3,349-$4,402</td>
<td>8</td>
<td>19.5</td>
<td>58.5</td>
</tr>
<tr>
<td>$4,736-$5,428</td>
<td>1</td>
<td>2.4</td>
<td>61.0</td>
</tr>
<tr>
<td>$5,429-$6,122</td>
<td>1</td>
<td>2.4</td>
<td>63.4</td>
</tr>
<tr>
<td>$6,123-$6,815</td>
<td>4</td>
<td>9.8</td>
<td>73.2</td>
</tr>
<tr>
<td>$6,816-$7,508</td>
<td>2</td>
<td>4.9</td>
<td>78.0</td>
</tr>
<tr>
<td>$7,509-$8,202</td>
<td>1</td>
<td>2.4</td>
<td>80.5</td>
</tr>
<tr>
<td>$8,203-$9,469</td>
<td>2</td>
<td>4.9</td>
<td>85.4</td>
</tr>
<tr>
<td>$9,470-$10,856</td>
<td>2</td>
<td>4.9</td>
<td>90.2</td>
</tr>
<tr>
<td>Over $16,402</td>
<td>4</td>
<td>9.8</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The 46 families in this study were recruited through means of convenience sampling. Although convenience sampling is not ideal in terms of generalizability and not always representative of the general population, it is commonly used in developmental science for its affordances on cost and due to the difficulty of obtaining samples in this field (Bornstein, Jager, & Putnick, 2013). Participants were recruited through promotional materials displayed at the local public library (e.g., flyers, posters, and brochures), a local WIC clinic (i.e., in-person recruitment, posters, and flyers), a partnership with a local early literacy agency (e.g., sharing of family information, sharing of materials with partners, posts on social media), and through postings on social media (e.g., library and program Facebook page). In-person recruitment was done at the WIC clinic to ensure recruitment of participants who received public assistance. WIC is available to parents who make up to 185% of the federal poverty limit, the same guidelines for programs such as Free and Reduced Lunch and Head Start. After the first few cohorts completed the program, word of mouth from those participants was also a significant contribution to
recruitment. The four cohorts of participants engaged in the program at different times. The first cohort started in April 2016 and ended in June, 2016. The second cohort started in June 2016 and ended in August 2016. The third and fourth cohorts ran concurrently on different days, running from September 2016 to November 2016.

Participants and their child received one children’s book weekly for eight weeks during the study, as well as a monetary gift of $100 for completing the assessments and recordings. The families who attended also received a meal at each session. Participants could choose to opt out of any assessments or leave the program at any time and still received prorated compensation. To graduate from the LENA Start™ program and receive full compensation, families must attend or make-up six of the eight sessions of the program and complete the pre- and post- assessment of parent knowledge of child development.

The eight-week parent education intervention was held at a public library in a mid-sized, Midwestern college city. The public library was selected for its central location, offering of services and space, and because the library sought to expand early literacy programming in their latest strategic plan. Also, according to surveys done by the Pew Research Center, 94% of parents say that libraries are important for their children and 46% of American families with children have attended a library event in the past year (Miller, Zickuhr, Rainie, & Purcell, 2013). A room with group seating at tables to foster communication and sharing was provided for the class. Audio and visual equipment was provided by the library to project the presentations in the room. Participants also received complementary childcare during the class, which was provided in a room nearby for ease of the parents. A healthy meal/snack was given to the participants and children during the class time, offered in both the childcare room and the classroom.
Procedure

The four cohorts of participants completed an eight-week parent-education class with eight additional, optional sessions (graduate sessions) called LENA Start™ (see Parent Education Curriculum – LENA Start™ for more information). Due to decreased attendance of participants in the optional graduate sessions, data from those sessions were removed for analysis in the current study. Families in all cohorts received an orientation before the intervention started where they completed informed consent documents and basic demographic information. Participants also completed the pretest of the Survey of Parental Expectations and Knowledge About Language Learning (SPEAK) – a test of parent knowledge of child development, at

Table 3

<table>
<thead>
<tr>
<th>Week</th>
<th>Measure</th>
<th>Orientation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SPEAK</td>
<td></td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Demographics</td>
<td></td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>SPEAK</td>
</tr>
</tbody>
</table>

orientation (see Table 3 for timeline of study and data collection).

Notes. S = Snapshot; R = Recording.

After orientation, participants attended weekly sessions that lasted about 60 minutes, completing in-class activities, practicing newly learned techniques, and receiving parent educator guided instruction. After each week of class, parents completed weekly recordings of their language with their child at home using the LENA DLP (see LENA Language Environment Analysis). The following week, after the LENA DLP data was uploaded and analyzed using specialized software, participants received a parent-friendly report of the number of words they spoke to their child, the number of conversations they had, and the amount of TV or electronic
time to which their child was exposed. The reports included stars as a way of reinforcing desired behaviors. Participants received stars weekly if they increased the amount of words or conversational turns by 10% or if they were above the 75th percentile (as compared to a normative sample of parents; see LENA Language Environment Analysis). They also received stars if they reported that they completed the suggested amount of daily reading with their child during the past week. This quantitative feedback is a major motivational tool of the curriculum, and prior research shows it as an effective tool for raising adult talk (Suskind et al., 2013). As a group, each cohort tried to achieve their group stars goal, which was one star, per family, per week. If the group succeeded, the educator praised the group for helping to change their babies’ language development. These weekly recordings were used to see growth in adult word count and conversational turns with the child over the course of the program. At monthly intervals during the class, participants completed the LENA Snapshot (see LENA Snapshot), a self-report measure of child language development. After the end of the eight weeks, participants completed the post-test of the SPEAK to be used in an analysis of growth and to see its relationship with words and conversational turns. Finally, participants graduated from the program in a small graduation ceremony and provided feedback via a satisfaction survey.

Materials and Measures

**Parent Education Curriculum – LENA Start™.**

Participants received eight, one-hour, weekly sessions designed to teach parents the importance of talking to and with their child. The curriculum used was the LENA Start™ program, a trademarked parent-education program from the LENA Research Foundation. This program includes everything needed to provide the intervention, including laptop computers, presentation materials, tote bags, guidebooks, and specially designed vests for holding the LENA
DLP. Alongside the curriculum are measures such as the LENA Snapshot and LENA Mobile, a dashboard website that allows researchers and educators to see each participant’s progress and help them prepare for each session. Also included is the LENA Hub, which transmits the recording information to the Cloud to be analyzed and turned into meaningful numbers for research purposes and for giving feedback to the participants. Parents receive the core message throughout the program that they are the primary agents of their child’s development and that they have the ability to help their child’s brain grow. The curriculum is designed to help change beliefs and knowledge, and through Ajzen’s (1995) Theory of Planned Behavior, increase behaviors that will help children learn language at home. The curriculum provides 14 Talking Tips that parents use throughout the class, which are designed to make it easy to increase the amount of meaningful talk with their child (see Table 4).

Table 4

LENA Start™ - 14 Talking Tips
1. Talk about what you’re doing and thinking.
2. Comment on what they’re doing or looking at.
3. Name things they’re interested in.
4. Get down to their level: face to face.
5. Touch, hug, and hold.
6. Tune in, respond to what they look at, do, say.
7. Wait for their response.
8. Imitate them, and add words.
9. Make faces, use gestures.
10. Take turns – don’t do all the talking.
11. Repeat and add to what they say and do.
12. Follow their lead, do what interests them.
13. Encourage them, be positive.
14. Be silly! Relax and have fun!

The curriculum involves a parent guidebook, as well as a teacher-coordinated presentation each week that includes tips, information and videos about child development and
increasing talk in the home. All materials are available in English and Spanish, and materials are written at a fifth grade level, so most adults can understand them. Participants practice with one another and ask questions freely, offering an interactive, engaging program. Another core aspect of the curriculum is the importance placed upon shared-book reading; the curriculum teaches parents how to do this with even the youngest babies. Every week, participants in the program text the number of minutes they read daily with their baby to a LENA number; this process entered the data into the online database. Participants are encouraged to aim for 10 minutes daily if their child is under 11 months of age, 20 minutes daily if their child is between 12 and 23 months of age, and 30 minutes daily if their child is above 24 months of age. Participants also get to take a book home each week that pertains to the lesson discussed during that particular class. After each class, participants complete a recording of their language environment for one, 16-hour day during the following week and receive a report during the next class that details the exact number of words they said to their child and the number of conversational turns they engaged in with their child on that day. The families earned stars if they increased the amount of talk and conversations they have, while limiting the amount of television and electronic time. Although all television time is not bad for children, research has shown that television time impedes interaction and talk with children, which is the core message of this curriculum (Christakis et al., 2009). Each of the eight classes covers a different topic (see Table 5 for a list of the topics).
Table 5

LENA Start™ - Class Topics

| Class 1: Introduction to LENA Start |
| Class 2: LENA Reports & the 14 Talking Tips |
| Class 3: Shared Reading |
| Class 4: Songs and Rhymes |
| Class 5: Talking Tips Practice and Group Report |
| Class 6: More About Your Baby’s Brain |
| Class 7: Midpoint Reflections |
| Class 8: Math Talk: Movement |

Survey of Parental Expectations And Knowledge About Language Learning (SPEAK).

For this study I used the Survey of Parental Expectations And Knowledge About Language Learning (SPEAK) from Suskind, Leung, Zimowski, and Hernandez (2017) with a data-sharing contract with the creators. The SPEAK is a 30-question test of parent knowledge of child language development administered via a computer. Six of the thirty questions ask parents when they think their children should be exposed to certain things such as words, books, reading and math. For these questions, participants can respond with “as an infant” (0 to 6 months) to “in elementary school” (6 years and up), with four other choices in-between. For the other 24 questions, participants respond using a five-point Likert scale from Strongly Disagree to Strongly Agree, with Neither Agree Nor Disagree at the center point. Each question is scored either incorrect or correct based on findings from recent research in the field of child language development. Therefore, if a parent or caregiver marks either Strongly Disagree or Disagree for the question “Infants learn little about language in the first six months of their life,” they would receive a point for answering in-line with current research on child development. The total score is computed based on the total number of correct responses, and when participants believe their children should be exposed to math and language. Participants receive a score out of 100. The
measure is still being evaluated at present, but initial psychometric analyses show a test-retest reliability of \( r = .75 \), indicating it is a reliable measure (Suskind et al., 2015).

**LENA Snapshot.**

To assess the cognitive and language growth of the child during the program, the participants completed the LENA Snapshot via a paper survey (Gilkerson & Richards, 2008a). Participants completed the LENA Snapshot up to three times during the eight-week program, although some only completed two, at the beginning and end of the program due to absences. The LENA Snapshot is a 52-item survey for caregivers of children two months to thirty-six months of age. Caregivers complete the survey for their child, marking yes or no to whether their child can do the task given; examples of assessment questions include whether the child points to things the caregiver names or if the child says ‘mama’ or ‘dada’. When a caregiver checks five successive no boxes, the assessment is complete. The number of yes answers is compared to a normative sample of children of the same chronological age and a standard score is given. The norms were created from a sample of 308 children of various ages to create standards for each developmental and chronological age (Gilkerson & Richards, 2008a). A standard score of 100 is average, and can be compared to the 50\(^{th}\) percentile. Standard scores above 100 denote a child who has a developmental age equal to or greater than 50% of their same-aged peers, whereas a standard score below 100 denotes a child who has a developmental age equal to or less than 50% of their same-aged peers. The LENA Snapshot has high correlations with other measures used for expressive and receptive language ranging from \( r = .81 \) to \( .97 \); overall it is correlated on average at \( r = .93 \) across ten widely used measures like the Child Development Inventory Receptive Language and Expressive Language tests, and the PLS-4 Receptive and Expressive Language tests. (Gilkerson & Richards, 2008a). Test-retest reliability is also excellent, with an
average correlation of \( r = .96 \) after a three month interval when using the estimated developmental age. The Snapshot also has an 87% detection rate of language delay with children (Gilkerson, Richards, Greenwood, & Montgomery, 2016). Snapshot results for children with a known speech delay due to Autism Spectrum Disorder were compared to results of tests administered by Speech Language Pathologists and criterion validity was \( r = .67 - .97 \) with those tests (Gilkerson et al., 2016).

**LENA Language Environment Analysis.**

Participants received quantitative feedback about the amount of child-directed speech and the number of conversational turns they had with their children with use of the LENA Digital Language Processor (DLP) and LENA Language Environment Analysis. The DLP is placed in a specially designed vest to be worn by the focus child, records 16 hours of audio and stores it. Later, with use of LENA software, the audio file is interpreted into quantitative information. Through the use of algorithms and data mining, computer software computes the amount of adult word talk (both directed toward and away from the child), the amount of conversational turns (switches between an adult and child vocalization) and the amount of electronic time in that 16 hour span (Richards, Gilkerson, Paul, & Xu, 2008). For the purposes of the current study, only the talk that is directed toward the child was counted in the adult word count variable that is analyzed. Conversational turns are when the child makes a vocalization and the parent responds or the child makes a vocalization and the parent responds within five seconds (Ford, Baer, Xu, Yapanal, & Gray, 2008). If more than five seconds pass without another vocalization from either, the next back and forth interaction will be counted as a different conversational turn. The reliability of the algorithms when analyzing the same audio file approaches 100%, and the
validity is 95% when compared to audio transcribed by a human coder (Xu, Yapanel, & Gray, 2009).

After each successful recording, the quantitative language data are provided to the participants at the next session through colorful, easy-to-read charts, where they can earn stars for increasing their child-directed speech by 10% or being over the 75th percentile, or increasing their conversational turns by 10% or being over the 75th percentile. These goals have been shown to increase parent talk in other studies (Suskind et al., 2013). The percentiles and standard scores of adult word count and conversational turns are computed automatically by LENA Mobile, comparing the numbers to a normative sample of recordings from 329 typically developing children and their parents from monolingual English households (Gilkerson & Richards, 2008b). The counts are compared to children of similar chronological age and a standard score is computed. A standard score of 100 is average, a score below 100 indicates performance that below average for a parent-child pair of that age, and a score above 100 indicates a performance that is greater than average when compared to the normative sample.

Data Analysis

Due to missing data for some participants on some measures, not all analyses include all 46 participants. Cases with any missing data for time points from the weekly recordings of adult word count and conversational turns were removed from ANOVA analyses. This is necessary for the analysis in this study, as repeated-measures ANOVAs cannot account for missing data. Thirty-seven participants had seven recordings, of which all of them had the seventh recording dropped from analysis. This was done to include nine participants who only had six recordings. Removing the final time point for 37 participants resulted in a loss of 37 points of data but allowed me to keep 54 points of data from the nine participants. In the discussion, I offer future
directions that would allow for the use of all data points. For the LENA Snapshot, 30 participants completed three Snapshots, and 16 completed two Snapshots. To use all available data, two separate analyses were conducted, a repeated-measures ANOVA for the participants that completed three Snapshots, and a dependent-samples t-test for those that completed only two.

For research question one I completed two repeated-measures ANOVAs, one on weekly adult word count across six recordings and one on conversational standard scores across six recordings to assess for growth through the program. I am using standard scores for conversational turns since children age during the intervention, which might naturally raise the amount of conversations they are engaging in because they are talking more. I tested the data for normality and sphericity, and neither assumption was violated. I fit polynomial contrasts to these data as prior research shows growth in talk that may be explained by a linear or quadratic trend.

For research question two, I used a dependent-samples t-test to see if there was a meaningful change from pre- to post-test on the SPEAK score of parent knowledge of child development. Furthermore, I created a Pearson bivariate correlation matrix with the SPEAK pre- and post-test scores, the adult word count at week one and six and the conversational turns standard score week at one and six.

For research question three, I conducted two, 2x6 mixed-factorial ANOVAs. Participants who reported receiving public assistance (WIC) and those who did not will be the between-subjects comparison, and growth across six recordings will be the within-subjects comparison. One ANOVA was completed for conversational turns standard score and one for adult word count. Using this design, I also checked for an interaction of receiving WIC and growth over time. Furthermore, I conducted a 2x2 mixed-factorial ANOVA of receiving WIC and time (pre-
and post-test) of the SPEAK to check for the interaction of receiving WIC and time on parent knowledge of child development.

Finally, to investigate research question four, I conducted a repeated-measures ANOVA for the participants who completed three Snapshots, along with a polynomial contrast. To analyze the participants with two Snapshots, I used a dependent-samples t-test.
CHAPTER 4. RESULTS

Research Question One

Can completion of the LENA Start™ program result in increases of the quantity of words used and conversational turns participants have with their child?

A repeated-measures ANOVA was conducted to test whether the LENA Start™ curriculum results in an increase in the number of words spoken to the child (henceforth, called adult word count) across the eight-week program. The means of adult word count were compared across time for all 46 participants (see Table 6 for means and standard deviations).

Table 6

Means and Standard Deviations for Adult Word Count and Conversational Turns Standard Score (Standard Deviations shown in parentheses)

<table>
<thead>
<tr>
<th>Time</th>
<th>Adult Word Count</th>
<th>Conversational Turns Standard Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13785.07</td>
<td>107.75</td>
</tr>
<tr>
<td></td>
<td>(5412.27)</td>
<td>(13.68)</td>
</tr>
<tr>
<td>2</td>
<td>17980.43</td>
<td>113.06</td>
</tr>
<tr>
<td></td>
<td>(8209.40)</td>
<td>(18.34)</td>
</tr>
<tr>
<td>3</td>
<td>18646.48</td>
<td>116.33</td>
</tr>
<tr>
<td></td>
<td>(7230.29)</td>
<td>(14.42)</td>
</tr>
<tr>
<td>4</td>
<td>17921.30</td>
<td>113.73</td>
</tr>
<tr>
<td></td>
<td>(7042.50)</td>
<td>(15.82)</td>
</tr>
<tr>
<td>5</td>
<td>18080.87</td>
<td>114.32</td>
</tr>
<tr>
<td></td>
<td>(7991.07)</td>
<td>(16.36)</td>
</tr>
<tr>
<td>6</td>
<td>18382.41</td>
<td>114.66</td>
</tr>
<tr>
<td></td>
<td>(6606.42)</td>
<td>(14.26)</td>
</tr>
</tbody>
</table>

Mauchly’s test indicated that the assumption of sphericity had not been violated ($\chi^2(14) = 22.85, p > .05$), therefore no change was made to the degrees of freedom. There was a significant main effect of time across the six recordings of adult word count, $F(5, 225) = 6.93, p < .001, \eta^2_p$.
= .133. Planned polynomial contrasts demonstrated a significant linear trend in adult word count as time in the program progressed, $F(1, 45) = 11.11, p < .01, \eta_p^2 = .198$, a significant quadratic trend of adult word count, $F(1, 45) = 15.94, p < .001, \eta_p^2 = .262$, and a significant cubic trend of adult word count, $F(1, 45) = 7.89, p < .01, \eta_p^2 = .149$. These results suggest that as participants progressed through the program there was a significant increase in the number of adult words they spoke to their child. Three polynomial contrasts are significant, but the quadratic trend explains the most variance in the change of adult word count across time, accounting for approximately 26% of the variance. This suggests that participants drastically increased the number of adult words spoken after time one, and that this increase continued for several sessions before tapering off and reaching an asymptote at around 18,000 words spoken (see Figure 2).

![Figure 2](image-url)

*Figure 2. Mean number of words spoken by participants in the LENA Start™ program to the focus child across time.*
A second repeated-measures ANOVA was conducted to investigate the difference across time points one through six in the number of conversational turns the participants engaged in with their children (see Table 6 for means and standard deviations). Since the child can also drive conversational turns, and children rapidly acquire language skills in the first years of life, I opted to use standard scores of the conversational turns rather than raw counts. These standard scores are computed against a representative data sample of 329 children from monolingual English speaking homes that were normed in use of the LENA DLP (Gilkerson & Richards, 2008b). Mauchly’s test indicated that the assumption of sphericity had not been violated ($\chi^2(14) = 16.635, p > .05$), therefore no change was made to the degrees of freedom. There was a significant main effect of time across the six recordings of conversational turns, $F(5, 225) = 4.67$, $p < .001$, $\eta_p^2 = .094$. Planned polynomial contrasts demonstrated a significant linear trend in conversational turn standard score as time in the program progressed, $F(1, 45) = 8.13, p < .01$, $\eta_p^2 = .153$, and a significant quadratic trend of conversational turn standard score across the program, $F(1, 45) = 9.90, p < .01, \eta_p^2 = .180$. These results suggest that participants had more conversational turns with their children as they attended more classes in the program, regardless of the child aging and inherently vocalizing more. The linear and quadratic polynomial contrasts are both significant, but similarly to adult word count, the quadratic trend explains more variance in conversational turn standard score over time, with 18% of the variance. This means that the increase in the number of conversational turns increases rapidly at first, then slowed and tapered off to an asymptote at about 114 conversational turns standard score (see Figure 3). In line with my hypotheses for research question one, the data suggest that participants increase the number of adult words spoken to their children and the number of conversational turns they engage in with them while attending the LENA Start™ program. Participants’ growth in adult word count
and conversational turns is quadratic in nature, suggesting they increase drastically at first but approach an asymptote at the end of the program that is typically higher than where they started.

![Graph showing conversational turns standard score across time](image)

**Figure 3.** Mean conversational turns standard score across time for participants in the LENA Start™ program.

### Research Question Two

How is parents’ knowledge of child development related to the number of words and conversational turns with their child, and can the LENA Start™ program increase their overall knowledge of child development?

An analysis to see if parents’ knowledge of child language development changed after completing the LENA Start™ program was conducted. Six of the participants who had completed at least six recordings did not complete either the pre- or post-test of the SPEAK, leaving 40 participants for analysis. A dependent-samples t-test was conducted on the pre-test (M
= 73.38, SD = 15.38) and the post-test score (M = 83.55, SD = 12.41) on the SPEAK survey. There was a significant difference between the pre- and post-test, \( t(40) = -6.00, p < .001 \), with the pre-test scores being significantly lower. A corrected Cohen’s \( d \) of -.99 was found using equation eight from Morris and DeShon (2002). The corrected \( d \) is a better measure due to dependence between means in repeated-measures tests. A \( d \) of -.99 indicated a large effect of the program on parent knowledge of child development (Cohen, 1988). These results show that the LENA Start™ program was effective at significantly raising parents’ knowledge of child development.

To better understand the relationship of parent knowledge between child development and quantity of adult words and conversational turns, a bivariate pearson correlation matrix was created with six measurements for a total of 36 cells (see Table 7). A Bonferroni correction due to multiple comparisons was computed, resulting in a new critical \( p \)-value of .0014 \((0.05 / (6^2))\). The correlation between the SPEAK Pre-test score and adult word count time one was significant, \( r = .496, p < .001 \). However, SPEAK pre-test score did not correlate with conversational turns standard score time one, \( r = .387, p > .0014 \). These data suggest that at time one of the LENA Start™ program, the greater the parent knowledge of child development, the greater the adult word count. However, there was no relation between time one parent knowledge of child development and conversational turns standard score. The SPEAK post-test score was not correlated with either time six for conversational turns standard score, \( r = .133, p > .0014 \) or time six adult word count, \( r = .262, p > .0014 \). Unsurprisingly, the SPEAK pre- and post-test scores were significantly correlated, \( r = .778, p < .001 \). Adult word count times one and six, and conversational turns standard score times one and six were related in several ways (see Table 7 for review), but not in any way that provide support for research question two. In line with my
hypothesis, the LENA Start™ program increased parent knowledge of child development from pre-test to post-test. In addition, although a mediation analysis could not be conducted due to having no control group, a significant relationship between the pre-test SPEAK score and adult word count at time one was found. That is, participants who had greater knowledge of child development at the beginning of the program talked more to their child at time one. However, contrary to my hypothesis, the pre-test or post-test SPEAK score was not related to adult word count at time six or conversational turns standard score at time one or six.

Table 7

*bivariate Pearson Correlation Matrix of Adult Word Count Time 1, Adult Word Count Time 6, CT Standard Score Time 1, CT Standard Score Time 6, SPEAK Pre, and SPEAK Post.*

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adult Word Count Time 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2. Adult Word Count Time 6</td>
<td>.446</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3. CT Standard Score Time 1</td>
<td>.723*</td>
<td>.368</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4. CT Standard Score Time 6</td>
<td>.341</td>
<td>.706*</td>
<td>.556*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5. SPEAK Pre-test</td>
<td>.496*</td>
<td>.120</td>
<td>.387</td>
<td>-.011</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6. SPEAK Post-test</td>
<td>.310</td>
<td>.262</td>
<td>.235</td>
<td>.133</td>
<td>.778*</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note. * = Correlation is significant at the Bonferroni corrected p < 0.0014 level (2-tailed).
Research Question Three

Does the LENA Start™ program have a differential impact on higher risk families versus lower risk families, as determined by receiving public assistance?

To test research question three, I conducted three separate mixed-factorial ANOVAs with both between- and within-subjects effects. The first was a 2 (between-subjects; receiving WIC or not) by 6 (within-subjects; time) mixed-factorial ANOVA to see if there was a difference in adult word count across time for those receiving public assistance (see Table 8 for means and standard deviations).

Table 8

<table>
<thead>
<tr>
<th>Receiving WIC?</th>
<th>Adult Word Count</th>
<th>Conversational Turns Standard Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>15047.04 (6145.75)</td>
<td>108.84 (15.33)</td>
</tr>
<tr>
<td>Yes</td>
<td>12037.67 (4140.19)</td>
<td>105.42 (12.17)</td>
</tr>
<tr>
<td>No</td>
<td>18590.58 (9629.33)</td>
<td>113.71 (17.50)</td>
</tr>
<tr>
<td>Yes</td>
<td>16881.61 (6801.30)</td>
<td>111.77 (19.27)</td>
</tr>
<tr>
<td>No</td>
<td>19776.83 (8384.28)</td>
<td>116.33 (13.93)</td>
</tr>
<tr>
<td>Yes</td>
<td>17022.33 (5952.06)</td>
<td>116.70 (15.18)</td>
</tr>
<tr>
<td>No</td>
<td>18664.92 (6314.68)</td>
<td>114.32 (15.69)</td>
</tr>
<tr>
<td>Yes</td>
<td>17272.22 (8073.85)</td>
<td>113.04 (16.76)</td>
</tr>
<tr>
<td>No</td>
<td>18035.92 (6275.37)</td>
<td>114.62 (14.43)</td>
</tr>
<tr>
<td>Yes</td>
<td>17953.17 (8440.47)</td>
<td>114.39 (19.14)</td>
</tr>
<tr>
<td>No</td>
<td>18555.25 (6052.00)</td>
<td>114.77 (13.52)</td>
</tr>
<tr>
<td>Yes</td>
<td>17830.44 (7511.34)</td>
<td>114.65 (16.97)</td>
</tr>
</tbody>
</table>

Mauchly’s test indicated that the assumption of sphericity had not been violated ($\chi^2(14) = 21.74, p > .05$), therefore no change was made to the degrees of freedom. There was no significant main between-subject effect of receiving public assistance on adult word count, $F(1,$
40) = 0.824, \( p > .05 \), \( \eta_p^2 = .020 \), but there was a significant within-subjects effect of time on adult word count, \( F(5, 40) = 6.37, p < .001, \eta_p^2 = .137 \). There was no significant interaction of receiving public assistance and time on adult word count, \( F(5, 200) = .595, p > .05, \eta_p^2 = .015 \). Planned contrasts of time were conducted due to the nature of growth in parenting practices due to an intervention. The linear trend was significant across the six time points, \( F(1, 40) = 11.18, p < .01, \eta_p^2 = .218 \), the quadratic trend was significant, \( F(1, 40) = 14.70, p < .001, \eta_p^2 = .269 \), and the cubic trend was significant as well, \( F(1, 40) = 6.43, p < .05, \eta_p^2 = .138 \). This means the growth in adult word count across the six time points for both those who did and did not receive public assistance was similar and both followed the general pattern found in the analysis for research question one (see Figure 4).

![Figure 4](image_url)

**Figure 4.** The mean number of words spoken to the children of participants who are and are not receiving WIC throughout the LENA Start™ program. Participants who receive WIC are represented with the green line and the participants who do not with the blue line.
There is no difference in the growth of adult word count across time for participants whose families received WIC or those that did not, despite a visibly lower count at time one for those who received WIC and similar count at time six for both groups as seen in Figure 4.

A second 2 (between-subjects; receiving WIC or not) by 6 (within-subjects; time) mixed-factorial ANOVA was conducted to see if there was a difference in conversational turn standard score across time for those receiving public assistance versus those not receiving public assistance (see Table 8 for means and standard deviations). Standard scores were used because conversational turns naturally go up across the eight-week class due to children verbalizing more as they age. Mauchly’s test indicated that the assumption of sphericity had not been violated ($\chi^2(14) = 15.80, p > .05$), therefore no change was made to the degrees of freedom. There was no significant main between-subject effect of receiving public assistance on conversational turns standard scores, $F(1, 40) = 0.070, p > .05, \eta_p^2 = .002$, but there was a significant within-subject effect of time on conversational turns standard scores, $F(5, 40) = 4.90, p < .001, \eta_p^2 = .109$. There was no significant interaction of receiving public assistance and time on conversational turn standard scores, $F(5, 200) = .234, p > .05, \eta_p^2 = .006$. Planned contrasts of the within-subjects effect were conducted. The linear, $F(1, 40) = 8.73, p < .01, \eta_p^2 = .179$, and quadratic trends, $F(1, 40) = 11.70 p < .01, \eta_p^2 = .226$, were significant. The growth in conversational turns standard scores is best explained by the quadratic trend, precisely what was seen in research question one (see Figure 5). Similar to adult word count, there is no difference in participant growth of conversational turns standard scores across the six time points between those who did and did not receive WIC.
Figure 5. The mean conversational turns standard score of participants who are and are not receiving WIC throughout the LENA Start™ program. Participants who receive WIC are represented with the green line and the participants who do not with the blue line.

To help answer the final part of research question three, whether parental knowledge of child development changes differentially from pre- to post- in participants who do and do not receive public assistance, a 2 (between-subjects; receiving WIC or not) by 2 (within-subjects; time) mixed-factorial ANOVA was done on the pre- and post-test SPEAK scores. Due to some participants not completing the pre- or post-test, there was a smaller group of participants for analysis, 18 participants reported receiving WIC and 21 reported they did not (see Table 9 for Ns, means, and standard deviations). There was a significant main between-subjects effect of receiving WIC or not on SPEAK score, $F(1, 37) = 5.47, p < .05, \eta_p^2 = .129$, and a significant main within-subjects effect of time on SPEAK score, $F(1,37) = 37.42, p < .001, \eta_p^2 = .503$. There was no significant WIC qualification by time interaction on the SPEAK score, $F(1, 37) =$
3.56, $p > .05$, $\eta_p^2 = .088$. Pairwise comparisons with a Bonferroni correction completed on the between-subjects effect of receiving WIC, show that participants who received WIC scored lower on SPEAK than did participants who did not receive WIC, $p < .05$. Pairwise comparisons with a Bonferroni correction of the within-subjects effect, pre- and post-test, showed a significant increase from pre- to post-test SPEAK score, $p < .001$. No significant interaction suggests that participants who did and did not receive WIC grow similarly in their knowledge of child development from completing the LENA Start™ program (see Figure 6).

It was hypothesized that there would be differences between participants who did and did not receive public assistance on adult word count, conversational turns, and parent knowledge of child development, but a difference was only found for parent knowledge of child development. There was no effect of receiving public assistance on either adult word count or conversational turns, nor was there an interaction over time. Therefore, in opposition to my hypothesis, it seems that these participants grew similarly over the course of the LENA Start™ program. In line with my hypothesis, participants who received public assistance scored lower than those who did not receive assistance on the pre-test and post-test measure of knowledge of child development.

Table 9

<table>
<thead>
<tr>
<th>Time</th>
<th>Receiving WIC?</th>
<th>SPEAK Score</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>No</td>
<td>79.95 (15.23)</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>67.67 (13.53)</td>
<td>18</td>
</tr>
<tr>
<td>Post-test</td>
<td>No</td>
<td>86.38 (11.43)</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>79.83 (13.11)</td>
<td>18</td>
</tr>
</tbody>
</table>
Figure 6. The mean SPEAK scores of participants who are and are not receiving WIC from pre-test to post-test of the LENA Start™ program. Participants who receive WIC are represented with the green line and the participants who do not with the blue line.

Research Question Four

Does the LENA Start™ program result in greater growth of a child’s language ability than is expected over the course of the program as measured by the LENA Snapshot?

To test if child language ability grew faster than expected over the course of the eight-week program, the children’s Snapshot standard scores were compared across the LENA Start™ program. The standard scores are devised based on the normative sample of 308 children from monolingual English speaking homes that were normed in use of the LENA Snapshot (Gilkerson & Richards, 2008a). As discussed above, participants were split into two groups for analysis, one
group of 30 participants who completed three Snapshots and one group of 16 participants that
completed only two Snapshots.

The data from participants who completed only two Snapshots were analyzed using a
dependent-samples t-test. Snapshot standard score time one \((M = 97.19, \, SD = 13.52)\) was not
significantly different from Snapshot standard score time two \((M = 101.21, \, SD = 16.89), \, t(15) =
-1.31, \, p > .05\). This indicates that for participants who completed only two Snapshots, child
language ability only grew at levels that were expected across participation in the LENA Start™
program. A corrected Cohen’s \(d\) was conducted using equation eight from Morris and DeShon
(2002) due to dependence between means, \(d = -.34\), indicating a small to medium effect.

The data from participants who completed three Snapshots were analyzed using a
repeated-measures ANOVA. The means of the Snapshot standard scores were compared across
the three time points (see Table 10 for means and standard deviations).

Table 10

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>97.57</td>
<td>17.41</td>
</tr>
<tr>
<td>2</td>
<td>101.06</td>
<td>14.82</td>
</tr>
<tr>
<td>3</td>
<td>104.41</td>
<td>16.05</td>
</tr>
</tbody>
</table>

Mauchly’s test indicated that the assumption of sphericity had been violated \((\chi^2(2) =
213.83, \, p > .01\), therefore the degrees of freedom were changed using the Greenhouse-Geisser
adjustment to 1.44 and 41.73 respectively. There was a significant main effect of time on the
Snapshot standard scores, \(F(1.44, \, 41.73) = 4.15, \, p < .05, \, \eta_p^2 = .125\). Planned polynomial
contrasts showed a significant linear trend to the data, $F(1, 29) = 5.36, p < .05, \eta_p^2 = .156$. These results suggest that as participants progressed through the LENA Start™ program their child’s language ability grew in a linear fashion that was greater than expected over the course of the program (see Figure 7). Due to standard scores taking into account the children’s chronological age, the Snapshot standard scores across three time points should be a flat, horizontal line, but the positive slope of the line in Figure 7 indicates growth above what is expected.

It was hypothesized that children whose parents participated in the LENA Start™ program would have greater development in language ability than is expected over those eight weeks. Results from the analysis of participants who completed three Snapshots confirmed this hypothesis, with significant growth of their standard scores, which take age into account. Results from the participants who only completed two Snapshots did not confirm my hypothesis, but there was a limited amount of data to analyze (only 16 participants).

![Figure 7. Mean Snapshot standard score across three time points.](Image)
CHAPTER 5. DISCUSSION

The achievement gap between children of low and high SES families is due in part to differences of their early linguistic experiences and early literacy exposure. To that end, interventions that work to increase linguistic behaviors and literacy practices in the home are used with low-income families to prevent the achievement gap rather than remediate it. One such intervention is the LENA Start™ program with quantitative linguistic feedback, exposure to child development research, and practice with beneficial linguistic and literacy techniques. I investigated the relationship of completing the LENA Start™ program and the participants’ growth in the amount of talk to and with their child, the enhancement of their child development knowledge, and the change of child language development trajectory over the program. Furthermore, the participants who received public assistance were compared to participants who did not on the measures of adult behavior, adult word count, conversational turns and knowledge of child development, for differences across time and at each time point. The results of this study provide evidence for the efficacy of the program to improve the language environment of the participants, raise their knowledge of child development, and increase the children’s language ability over normative development. There were no differences found when participants who received public assistance were compared to participants who did not on adult word count or conversational turns standard score, across time or at individual time points. There was, however, a difference in parent knowledge of child development; parents who received public assistance had less knowledge of child development before and after the program, but grew similarly from pre-test to post-test in comparison to participants who did not receive public
assistance. These findings are discussed relative to their research questions and their broader implications below.

Four main research questions were posed in the current study. With research question one, I wanted to see if the LENA Start™ program could help improve the linguistic environment of participants who completed the program. After comparing adult word count and conversational turn across the program, significant growth was found in the number of words spoken to the focus child and the amount of conversational turns between the participant and child. The growth for both variables was best explained by a quadratic trend, suggesting that participants increased the number of words and conversational turns very rapidly through the first weeks of the program, and began to plateau at a high amount of talk and conversation near the end of the program (see Figure 2). Overall, participants increased their talk from under 14,000 adult words spoken at time one, or about 900 words per hour over the 16 hour recording period, to over 18,000 adult words spoken at the end of the program, or about 1125 more words per hour over the 16 hour recording. This is roughly a 25% increase in the number of adult words spoken to the child per day. If the increase in number of words persists for only six months after the program, the child will have heard over 650,000 more words from which to learn new vocabulary or sounds, which is helpful for later reading success. This raises an interesting point, as there have been no studies investigating the lasting effects of attending the LENA Start™ program, and future research should follow participants to see if the growth achieved is maintained without receiving weekly quantitative feedback and weekly instruction.

As for the conversational turns standard score, a similar trend was observed. Most participants at time one were having more conversational turns than is typically observed between a parent and child of similar age, with an average standard score of around 108, or
roughly the 69th percentile. The participants grew rapidly in their number of conversational turns and tapered off to an average standard score of about 114, or about the 82nd percentile, an increase of over 10 percentile points. This increase in conversation is quite substantial, and allows the child many more conversations from which to learn the social conventions of language and learn to talk. Together with the increases in child-directed speech, these data suggest that completing the LENA Start™ program is related to improving the linguistic environment for children of the participants.

Research question two regarded whether the LENA Start™ program could raise participants’ knowledge of child development, and how that knowledge was related to the ability to grow the participants’ adult word count and conversational turns. The SPEAK was selected as a measure of parent knowledge and the increase in score from pre-test to post-test was large. The participants learned about child developmental milestones and research in the field of child language development from the program and raised their knowledge over 10 points (on a 100 point scale). A corrected Cohen’s $d$ of -.99 indicates a large effect size of the program on parent knowledge of child development (Cohen, 1988). In other studies, parent knowledge of child development has mediated the relation between child-directed speech and a home-visiting intervention (Suskind et al., 2015) and mediated the relationship between SES and amount of child-directed speech (Rowe, 2008). Therefore, raising parental knowledge of child development with this program may be helpful in closing the achievement gap between low and high SES families and children. In corroboration of those studies, I found that the pre-test score of knowledge of child development was significantly correlated ($r = .496$) with amount of child-directed speech, but only before the program began. Although my design lacked the ability to complete a mediation analysis, this finding offers some convergent evidence as the program also
significantly raised the number of words spoken. Overall, parents with greater knowledge of child development may understand that children need to be exposed to books and language at a very early age, increasing their chance for future success (Rowe, 2008). Furthermore, raising parent knowledge of child development might be particularly effective for helping parents of low SES, as it is a mediator of parent-child talk (Rowe, 2008).

In research question three, I investigated whether participants who received public assistance (participants who are at a higher risk of having children with lower pre-literacy and language skills entering school) have differential growth of adult words spoken to the child, conversations with the child, or parent knowledge of child development due to completing the LENA Start™ program. Contrary to my hypotheses, there was no difference between participants who did and did not receive WIC supplements on the growth of adult word count or conversational turns across the program or at any individual time point. This result was surprising given the research about participants with low-income and their home linguistic environment covered in the literature review. However, the results may not be significant due to the high educational attainment of the sample in this study as a whole. Maternal education is shown to be strongly positively related to children’s cognitive outcomes, such as language (Magnuson, Sexton, Davis-Kean, & Huston, 2009). Of the 41 participants who responded with demographic information, 39% responded as having a bachelor’s degree and 43.9% had a graduate or professional degree (see Table 1). Even the participants who reported receiving WIC supplements reported having very high educational attainment, with 44.4% having a bachelor’s degree and 33.3% having a graduate or professional degree. Despite these numbers, participants who received WIC had significantly lower parental knowledge of child development. Despite having lower scores at the beginning and end of the program, the growth of participants from the
program was not different; indicating knowledge of child development grew similarly for participants regardless of receiving public assistance or not. Further research should be done with more traditional participants who are receiving public assistance, those with lower educational attainment and enduring poverty, to see the impact of the LENA Start™ program on high-risk families.

Research question four was designed to investigate the transfer of parent linguistic behavior to a meaningful change in child language development. As posed in Figure 1, and throughout the introduction and literature review, there is a consensus that these types of parent linguistic behaviors, such as increased talk and conversation, are necessary for typical language development of the child. During the LENA Start™ program, participants talked more to and with their child, and raised their knowledge of child development. These changes in the parent appeared to result in changes to the child’s language ability that is above what was expected for those eight-weeks of programming, at least when participants completed three, rather than just two Snapshots. For participants who completed three Snapshots, growth in standard scores was observed over the three time points in a linear fashion. On average, children of the participants were just below average, at a standard score of 98, but increased to a standard score of 101 at time two, and at the end of the program, a standard score of 104. This is a change from approximately the 45th percentile to the 60th percentile, resulting in the mean child language ability being average at first but above average after the eight-week program. These results are encouraging, and due to early language skill predicting later language and literacy achievement, could lead to better academic success for these children (Bleses et al., 2016; Schoon et al., 2010; Sénéchal et al., 2006). However, there was no difference in participants who only completed two Snapshots, which could be for several reasons. First, it is possible the test lacked sufficient power
to detect a difference between the two Snapshots. Second, participants who only completed two Snapshots missed the program session that the second or third Snapshot was given, which could indicate missing important information from the program. The Snapshot is also a self-report measure completed by the participants; it is possible that participants who were absent made the program less of a priority, and as such, did not employ the information learned at home as fully. Furthermore, participants who completed three Snapshots could have observed their children more intently, resulting in more yes answers on the questionnaire. In the future, a behavioral or observational measure of the children’s language ability could be conducted alongside the Snapshot to offer converging evidence of the growth seen across the program. This might be difficult for participants with younger children, as behavioral measures are limited for children under one year of age.

In sum, the community-based, parent-education program, LENA Start™ appears to be effective in enhancing the early language and linguistic environment for the children of participants. Overall, a significant, positive, quadratic trend was observed for adult word count and conversational turns for participants. The growth was most pronounced after week one, where they learned about the power of conversation and talk for their child’s development. Participants in the study significantly grew their knowledge of child development and that knowledge was related to their adult word count at week one. With the current sample, there were no differences in adult word count or conversational turns between participants who were receiving WIC and those that were not, but there was a significant difference in their knowledge of child development. Growth from the beginning to the end of the program was the same for all those measures for participants who did and did not receive WIC. There is evidence of child language growth that is greater than expected during the program’s period, indicating the
program results in transfer of participant behavioral change to their child’s language development. This is an important finding for consideration of the LENA Start™ program as a tool to prevent the achievement gap before it even begins. A discussion of the limitations and future directions for this program of research are provided below.

Limitations

There were several limitations to this study which must be discussed. First, the data in this thesis was collected as part of iterative development for the program and changes to the program are continually being made. The program which provided the data for this study was only eight-weeks long, a relatively short program if we are looking for large effects on parent behavior. Recently, the curriculum has been changed to 13 weeks, allowing for more instruction, practice, and data from participants of the program. In the future, I will analyze data from the new curriculum for more insight into the growth of participants. Due to the nature of the program, data currently exists for comparison within-subjects only, and there is no comparison or control group with which to compare directly. This also limits the scope of analyses, such as the inability to conduct a mediation analysis. Furthermore, there was no randomization, so we cannot be sure that the effects were entirely due to the LENA Start™ program and not some other aspect of the study. For example, young parents can be isolated at first, especially families of low SES. This act of getting out to the library and visiting with other parents of young children may drive some of the differences seen in our analyses irrespective of the program. Furthermore, other than the participants recruited at the WIC Clinic, the participants mostly self-selected into the program, meaning they could already be aware of the importance of such a program for their child’s development. Additionally, the participants of the study did not have to disclose demographic information, meaning data was not complete for all analyses in this thesis.
Of the information we did collect, many of the participants in this study were very highly educated, begging the question of whether the high-risk sample in the study actually reflects high-risk parents in general. A concerted effort will be made in the future to collect a more representative and generalizable sample.

Analyses in the current study were limited to ANOVAs, t-tests, and correlations. As such, missing data had to be removed. In future analyses, the use of statistical techniques which allow for missing data will be used to ensure utilization of all the data. Multi-level modeling could also help account for the nested nature of the cohorts and their family interactions. Missing data also led to problems with analysis of child language growth, as the analysis of Snapshot data had to be split into two separate tests, increasing type-one error and resulting in insufficient power to capture an effect simultaneously. Finally, the omnibus tests for research question three answer similar questions to the analyses completed for research question one. These additional analyses were done because public assistance information was not available for all participants. That is, if complete information was collected for all participants, the omnibus ANOVAs done for research question three would have covered research question one by interpreting the main within-subjects effect. However, since information was incomplete, two additional analyses were conducted, increasing type-one error.

In the most recent cohorts of the LENA Start™ program we are utilizing a “practice” recording which participants do right after orientation and before any instruction is received. This is to establish a true baseline recording because in the current study, participants received information from session one, about how important talk is, and did their first recording the following week. Therefore the growth in adult word count and conversational turns could be due to the Hawthorne Effect, or the idea that merely being observed can alter behavior.
(McCambridge, Witton, & Elbourne, 2014). The DLP and LENA vest might act as the “observer” and result in participants talking more and engaging in more conversations. A similar effect of observation could have happened for the Snapshot. Participants, in learning the importance of engaging with their children, could begin to observe them more intently, noticing more language developmental milestones and marking them in the questionnaire.

Future Directions

The findings in the current study are very promising, but there are also many refinements that can be made to the protocol and future research paths to be taken. First, I seek to do a comparison analysis of participants who complete LENA Start™ and participants who attend story time at local libraries. The comparison will be conducted in urban libraries in high-need communities as designated by a Needs Assessment. This kind of design will provide a more accurate comparison for families with low-income that experience the achievement gap, and will allow for mediation analyses and between-subjects comparisons. To increase the ability to infer causality, I would like to randomize participants into receiving LENA Start™ or story time, out of a pool of parents that are likely to attend either type of program. This randomized comparison trial will use the longer 13-week program to analyze trends more deeply and see greater growth across the program. Additional measures can be added to corroborate the growth seen using the DLP, like a measure of parent-child engagement or parent-child reading, to offer converging evidence of the program’s effectiveness. Furthermore, behavioral or observational measures of child language would add additional evidence to the Snapshot of increasing language ability over the course of the program. A self-report measure like the Snapshot may be prone to observational effects as described in the limitations.
There is currently no evidence of whether the behavior or knowledge changes from the program will last after graduation. I would like to recruit past participants to complete additional recordings of child-parent talk and conversations, another test of parenting knowledge of child development, and more Snapshots at six-month intervals after completion of the program to assess for the lasting effects of the intervention. The parent behavior changes from the program must last for meaningful changes in the child’s knowledge and development, which is the primary goal of the program. Additionally, as the program is meant to be a universal, preventative, community-based intervention, I wish to scale-up the implementation of the program and see if it has appreciable results on later community school readiness as determined by the Formative Assessment System for Teachers (FAST) or the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) conducted in Kindergarten.

Conclusions

In conclusion, given what is known about the importance of enhancing the early language environment of children at risk of entering school developmentally behind their peers, the LENA Start™ program shows promise as an effective intervention to improve the language environment and have an impact on child language development. Not only did I find that participants grow in the amount of talk to and conversation with their children, but they also grow in their knowledge of child development, which is important for providing a rich learning environment. This program, if widely provided to families of all socioeconomic statuses, could be instrumental in closing the achievement gap, setting up all children for future academic success.
REFERENCES


