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Infant-Directed Language Following a Brief Behavioral Parenting Intervention: The Importance of Language Quality

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Abstract

Behavioral parenting interventions decrease early childhood behavior problems and increase positive parenting skills. However, few studies have examined the impact of low intensity interventions for infants at risk for behavior problems on changes in parent language. This study examined the effect of a brief parenting intervention, the Infant Behavior Program, on changes in parent linguistic input and its influence on infant language. Participants were 58 mothers and their 12- to 15-month-olds, with elevated levels of behavioral problems. Mothers and their infants were from primarily Hispanic and low-income backgrounds. Mother-infant dyads were randomly assigned to receive the Infant Behavior Program or standard pediatric primary care. Mothers receiving the Infant Behavior Program provided more linguistic input, which indirectly influenced infant language, and suggest targeting infants at risk for behavior problems can have a broader impact on language development.

Keywords

Language Nutrition; Infancy; Behavioral Parent Training

1. Introduction

The first three years of life represent a critical period for language development (Shonkoff & Phillips, 2000). Learning to communicate with others is important for children's cognitive and social development and is strongly influenced by environmental factors, such as the quantity and linguistic diversity of the child's early language environment (Forget-Dubois et al., 2009; Hoff, 2013). Early language skills also have been shown to predict important functional outcomes, such as school readiness, reading ability, and vocabulary size (Dickinson & Porche, 2011; Forget-Dubois et al., 2009; Hart & Risley, 1995). Despite the importance of early language exposure, language interventions do not typically start until after a delay has been identified. Intervening earlier in life and in populations at risk for language delay, such as children with early behavior problems or at risk for behavior

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problems, can have a significant impact on developmental outcomes. Specifically, targeting improvements in parent-child interactions in the home environment may help to promote both language and behavior in young children.

Typically, children are first exposed to language from their parents in the home. However, there are vast disparities in how much language children are exposed to, often depending on their socioeconomic status. Specifically, children (birth to 3 years) from low-income families are, on average, exposed to 30 million fewer words when compared to children from more affluent families (Hart & Risley, 1995). This “word gap” has been shown to be associated with discrepancies in vocabulary and language processing efficiency and observed in children as young as 18 months (Fernald, Marchman & Weisleder, 2013). The amount of words an infant hears also has been shown to predict later cognitive functioning. For example, Caskey and colleagues (2014) found that the number of words spoken by parents to their infants born preterm accounted for 20% of the variance on the Bayley Scales of Infant Development cognitive scores at 18 months.

In addition to the amount of language a child hears, the quality of the linguistic input an infant receives is important. Specifically, *lexical diversity*, which can be measured by the number of different words spoken, and *linguistic productivity*, the ability to use and construct new sentences (Zauche, Thul, Mahoney, Stapel-Wax, 2016), have been shown to have a stronger effect on child language outcomes compared to the number of total words alone (Pan, Rowe, Singer & Snow, 2005). Mean length utterance (MLU) is often used as a proxy for linguistic productivity because longer utterances tend to be more grammatically complex (Zauche et al., 2016). A third construct, *language nutrition*, also has been shown to predict later language development in children. The term language nutrition was coined by Zauche and colleagues (2016) and refers to the important linguistic “nutrients” a child needs to flourish cognitively and academically as embedded in the back-and-forth conversations so essential to the parent-child relationship (e.g. Romeo et al., 2018). While the term language nutrition serves as a public campaign message found to resonate well with nurses and mothers, it can be operationalized linguistically as a more diverse and complex sentence structure (Zauche et al., 2016). Specifically, language nutrition includes nouns, adjectives, and prepositional phrases, as well as conjunctions, in child-directed speech. Overall, the quantity and quality of parent linguistic input in early childhood has been consistently shown to be a stronger predictor of child language and literacy skills than socioeconomic status, race/ethnicity, or parent level of education (Dickinson & Porche, 2011; Hart & Risley, 1995; Hoff, 2003, 2013; Hurtado, Marchman, & Fernald, 2008). However, little research has examined its influence on early language and behavioral intervention programs.

1.1 Early Language Interventions in the Home Setting

Given that early language exposure is important for a child’s language acquisition and future academic success, many early language interventions focus on increasing the amount of time a parent plays or reads with their child (Robert & Kaiser, 2011; Dockrell, Stuart & King, 2010). However, these interventions are typically implemented once a child is identified as having a language delay or another developmental delay. For example, the Enhanced Milieu Teaching (EMT) is a home-based program for preschool-aged children with language

delays, autism spectrum disorders or other developmental delays that helps parents learn to follow their child's lead in play, respond and expand on their child's language, pause between utterances and has been associated with improvements in child MLUs and linguistic diversity (Kaiser, Yoder, & Keetz, 1992; Kaiser, Hancock & Nietfeld, 2000). Another language intervention for children with language delays, called the Hanen Early language Parent Program, teaches parents to follow their child's lead in play by initiating, elaborating on, and using turn taking during communication with their child (Girolametto, Greenberg, Manolson, 1986).

It is critical that interventions targeting language and behavior for at-risk infants begin early. Research in neuroscience and neurolinguistics shows that an infant's neural circuitry is 85% established by the third year of life (National Research Council, 2000). For example, 700–1000 new neuronal connections are formed during the first three years (Suskind, 2015), suggesting this time period is critical for interventions targeting language and behavior. Recently, efforts have been made to start interventions earlier and in the naturalistic home setting for at-risk parents and infants. Examples of early interventions include *My Baby and Me* (Guttentag et al., 2014), Playing and Learning Strategies (PALS; Zajicek-Farber, 2010), and Thirty Million Words (TMW; Suskind et al., 2018). All three are naturalistic interventions that involve home visitations to at-risk and/or low-income families and teach parents about the importance of parental responsiveness and parent-child back-and-forth engagement. *Háblame Bebé* (Talk to Me Baby, in partnership with the state of Georgia's Talk With Me Baby campaign), is another naturalistic home intervention implemented with low-income Spanish-speaking families that teaches Hispanic parents the importance of having sociolinguistic pride to continue using their native Spanish with their infants and to promote bilingual language development (e.g. Baralt, Darcy Mahoney, & Brito, 2017).

1.2 Language Delay and Behavior Problems

While these early language interventions show promise for improving children's language outcomes, none target behavioral problems directly. Given that about half of children who present with a language delay in clinic settings also have associated behavior disorders (Cohen, 2001), targeting behavior problems may subsequently impact language development. However, the evidence regarding the direction of the relation between language delay and behavior disorders is mixed. On the one hand, evidence that early language difficulties can lead to behavioral problems, such as aggression due to frustration about not being able to communicate one's needs (Temple, Wagner & McNeil, 2009), suggests targeting early language can lead to improvements in behavior problems (Curtis, Kaiser, Estabrook & Roberts, 2019). On the other hand, research has found that decreases in infant externalizing behavior problems predicted subsequent increases in infant language production (Bagner et al., 2016), which may be due to higher levels of attentiveness to adult directions that, in turn, enhances language development (Temple et al., 2009). Given the mixed research regarding the directionality of the relation between language development and behavior problems, it may be more effective to intervene based on when impairments can be reliably identified. While early language delays can be reliably identified by 24 months (Heilmann, Weismer, Evans & Hollar, 2005), early aggressive behaviors can be reliably identified as early as 12 months (Briggs-Gowan, Carter, Bosson-Heenan, Guyer &

Horwitz, 2006). Thus, targeting early behavior may be a more reliable indicator than language delay, especially among infants from economically disadvantaged and ethnically and racially diverse backgrounds who display higher rates of externalizing behavior problems (Fernald et al., 2013; Halle et al. 2009; Qi & Kaiser, 2003).

Given that infants at risk for behavior problems are reliably identified earlier than language delay, research should evaluate the utility of programs focused on reducing externalizing behavior problems as a mechanism by which to improve language acquisition. Interventions targeting early child behaviors have similar targets for change as interventions targeting language delays. For example, Parent Child Interaction Therapy (PCIT; Zisser & Eyberg, 2010), an intervention focused on reducing externalizing behavior problems in young children, incorporates similar strategies to parent-focused language programs. In PCIT, therapists coach parents to follow their child's lead in play by using behaviorally-based "do skills," which include praise (e.g., "Great job drawing"), reflections (e.g., repeating the child's speech), and behavior descriptions (e.g., "You are building a tower), and avoiding behaviorally-based "don't skills," which include commands (e.g., "Give me the block), questions (e.g., "What do you want to play with?"), and criticisms (e.g., "You're being naughty"; Temple et. al., 2009). Parents are taught to avoid "Don't skills" because they are directive and take the lead away from the child. Given the overlap between behavioral parent interventions and early language interventions, further examination of behavioral parenting interventions is warranted for children at risk for language delays to help streamline treatments.

A handful of studies have examined the impact of behaviorally-based parenting skills for managing children's behavior on children's language outcome. For example, Garcia and colleagues (2015) found that parents' use of do skills mediated the effect of PCIT on total and different words in children aged 20–70 months with developmental delay. Similar results were found when examining the effects of do skills following an adaptation of PCIT for infants at risk for behavior problems in a low-income and ethnically diverse sample (Garcia, Hungerford, Hill, Barroso & Bagner, 2018). However, given the importance of early linguistic input, as demonstrated in the above-reviewed literature, further research is needed to understand the impact of this intervention on parent linguistic input, including lexical diversity, linguistic productivity, and language nutrition. As children living in poverty are exposed to lower levels of language input compared to their middle- and upper-class peers (Hart & Risley, 1995; Dickenson & Porche, 2011; Fernald et al., 2013), it is particularly important to examine how parenting interventions can effectively target parent language in low-income and ethnically diverse populations.

1.3 The Current Study

The goals of the current study were to examine how parent linguistic input changed as a function of the Infant Behavior Program, an adaptation of PCIT for infants at risk for behavior problems (Bagner et al., 2016), and whether those changes mediated the effect of infant language at 3 and 6 months following the intervention. To answer these questions, we analyzed parent linguistic input before the intervention, after the intervention, and at 3- and 6-month follow-ups. We hypothesized that parents who received the Infant Behavior

Program would display a significantly higher frequency of total words, lexical diversity (different words), linguistic productivity (MLUs), and language nutrition (adjectives, conjunctions, noun phrases, and prepositional phrases) at post-intervention and follow-ups, compared to parents who received standard pediatric primary care. Additionally, given research demonstrating that parent language quality and quantity is associated with the amount of words a child produces (Dickinson & Porche, 2011; Hart & Risley, 1995; Hoff, 2003, 2013; Hurtado et al., 2008), we hypothesized that parent linguistic input at the post-intervention would have an indirect effect on the relation between the Infant Behavior Program and infant word production at the 3- and 6-month follow-up assessments.

2. Methods

2.1 Participants

Participants were 60 mother-infant dyads who participated in a randomized controlled trial of the Infant Behavior Program (Bagner et al., 2016). Families were recruited from a large pediatric primary care center primary serving ethnically diverse and low-income children and provided informed consent prior to screening for the study. Families were eligible for the study if their infant was between the ages of 12 and 15 months and scored above the 75th percentile on the problem scale of the Brief Infant-Toddler Social and Emotional Assessment (BITSEA; Carter & Briggs-Gowan, 2006), a parent-report screening measure of infant behavior problems. Primary caregivers, all mothers, were required to speak either English or Spanish and score a 70 or higher on the Weschler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) for those who spoke English (42%), or a scaled score of 4 or higher on the Escala de Inteligencia Wechsler Para Adultos-Third Edition (EIWA-III; Pons et al., 2008a) for those who spoke Spanish (58%).

Sixty families were randomized 1:1 (using a random number generator) to the Infant Behavior Program ($n = 31$) or to standard pediatric primary care ($n = 29$). Families in the standard pediatric care group received ongoing sick and well visits but did not receive the Infant Behavior Program. Of the 60 families randomized, 58 families completed the baseline assessment in their home. The participants were mostly living in poverty (60%) and were of Hispanic or Latino ethnicity (94.7%). Infants (55% male) were, on average, 13 months at baseline ($M = 13.53$, $SD = 1.30$). Intervention and control families did not differ on infant age, ethnicity/race, and maternal IQ. However, there was a significant difference in the percent of Spanish spoken during the play across groups. Specifically, mothers in the standard care group used a higher percentage of Spanish spoken compared to mothers in the intervention group. As a result, the percent of Spanish spoken was used as a covariate in all analysis. See Table 1 for all demographic information.

2.2 Mother-Infant Play Observation

Home-based assessments were completed at pre-intervention (Time 1), post intervention (Time 2), and 3- (Time 3) and 6- (Time 4) month follow-ups. During the assessments, the mother-infant dyads participated in a videotaped infant-led play interaction. Mothers were instructed prior to the start of the interaction to follow their infants lead in the play for 10 minutes. This 10-minute interaction was transcribed and used for the language coding and to

identify the percentage of Spanish spoken. All families received an identical set of developmentally appropriate toys (e.g., blocks and cars) to play with at each observation.

2.3 Intervention

The Infant Behavior Program is a home-based adaptation of PCIT for high-risk infants. During the Infant Behavior Program, parents learned to follow their infant's lead in play and ignore safe but disruptive behaviors (e.g., temper tantrums). Therapists coached parents to increase their use of behaviorally-based positive parenting do skills while decreasing behaviorally-based don't skills (defined above). Families received up to seven weekly 1-hour sessions with an average of 6.1 sessions in their home. The first session was a teach session, where families learned the skills that were to be used in the intervention. The remaining sessions were coach sessions, where the therapist coached the parent to use the skills learned in the teach session. The intervention was provided in either English or Spanish based on the preference of the family. See Bagner, Rodriguez, Blake, and Rosa-Olivares (2013) for more details about the Infant Behavior Program and Bagner and colleagues (2016) for main outcomes demonstrating the effect of the Infant Behavior Program on infant and mother's behavior change within this sample.

2.4 Screening Measures

Brief Infant-Toddler Social and Emotional Assessment (BITSEA; Carter and Briggs-Gowan, 2006).—The BITSEA is a 42-item standardized screener that assesses behavioral problems and competencies in 12- to 36-month-old children. The problem scale is a 31-item subscale with excellent test-retest reliability ($r = .91$ to $.92$) and good interrater reliability ($r = .70$ to $.78$; Carter & Briggs-Gowan, 2006). There is also strong support for the use of the 75th percentile as the clinical cut-off (Briggs-Gowan, Carter, Irwin, Wachtel & Cicchetti, 2004). Cronbach's alpha for the problem scale in the current sample was .77.

Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) and Escala de Inteligencia Wechsler Para Adultos- Third Edition (EIWA-III; Pons et al., 2008a).—The WASI is a measure of intelligence with high reliability and validity (Hays et al., 2002). The EIWA-III is the Spanish version of the Wechsler Adult Intelligence Scale (Wechsler, 1999) that is reliable (Pons et al., 2008a) and valid (Pons et al., 2008b). The vocabulary and reasoning subtests were administered. In order to ensure the understanding of the program content, mothers were required to receive an estimated IQ score at or above 70 on the WASI or an average scaled score at or above a 4 on the EIWA subtests. No mothers were excluded based on this criterion.

2.5 Outcome Measures

The *Child Language Data Exchange System* (CHILDES; MacWhinney, 2000) is a widely used and psychometrically valid tool to examine language (Corrigan, 2011). The CHILDES program consists of a database of language transcripts, codes for human analysis of transcripts (CHAT), and computerized language analysis (CLAN). The CHAT program allows for a standardized way to transcribe mother-infant interactions, while the CLAN program allows researchers to analyze these transcripts (Parker & Brorson, 2005). Mother and infant language were analyzed using the CLAN program at all four time points. For

mother's language, we examined total words, different words, MLUs, and a composite score variable for language nutrition, which included a total of conjunctions, adjective phrases, noun phrases, and prepositional phrases. The mothers in this study were primarily Latino/Hispanic (92%) and Spanish-speaking (58%). As is natural in bilingual settings, 67% of the mothers spoke a combination of English and Spanish words during their 10-minute interaction. Thus, we created an average percent Spanish language variable, which was defined as the percent of Spanish words used during the interaction and included as a covariate in analyses to better represent the language spoken during the interaction. For infant language, we measured the total and different number of utterances produced. Total utterances included all word and word approximations produced by each child during the 10-minute interaction. Different utterances were measured by the number of "unique" word or word approximations used. Interactions were coded twice for 20% of the videos to assess interrater reliability. Reliability videos were chosen at random across all four time points. The primary coder was masked to which families received the intervention or standard care and which videos were randomly selected for reliability. Reliability was high across coders with a Kappa ranging from .74 to .95 for all language variables.

2.6 Statistical Analysis

Analyses were conducted in SPSS version 24. To estimate the impact of the intervention on maternal linguistic input, linear regressions were used to examine group differences in language outcomes from pre- to post-intervention, as well as at 3- and 6-month follow-ups. A separate model was conducted for each language outcome (total words, different words, MLUs, language nutrition composite). Maternal total words at pre-intervention, IQ score on the WASI or EWA, and the percent of Spanish spoken were used as covariates in the model because they were significantly associated with and are conceptually related to the parent language variables examined in the current study.

To examine the indirect effects of change in maternal linguistic input from pre- to post-intervention on the relation between the Infant Behavior Program and infant language production at 3- and 6-month follow-ups, we conducted a mediation analysis (PROCESS 3.0; Hayes, 2017). A separate model was conducted for each mother language outcome (total words, different words, MLU, language nutrition composite) to examine the effect of linguistic input at post-treatment on infant language at the 3- and 6-month follow-up visits. As in the linear regressions, maternal parent total words at pre-intervention, IQ score on the WASI or EWA, and the percent of Spanish spoken were used as covariates in the model.

3. Results

3.1 Missing Values Analysis

Fifty-eight families completed the baseline assessment and were included in the analyses. There were no significant differences on outcome measures between families that completed the assessment points and those that dropped out. Forty-eight families completed the post evaluation and forty-two families completed the follow-up assessments. Missing value analysis showed that missingness was associated with mother's score on the WASI or EIWA and group at the follow-up and post assessments. The WASI or EIWA was used as a

covariate in all analysis where as group was used as a predictor. This pattern of missingness is consistent with the definition of missing at random (MAR; Rubin 1976), and missingness due to group is common for longitudinal studies (Diggle & Kenward, 1994). Multiple Imputation was conducted with 20 imputations to estimate the missing data.

3.2 Descriptive Analysis

Descriptive analyses were conducted to examine group baseline differences in maternal speech. Means and standard deviations are presented in Table 2 for all outcome measures. Independent sample *t*-tests showed significant differences between the intervention and standard care groups at baseline in the percent of Spanish spoken, $t(56) = -2.97, p = .004$, total words, $t(56) = 2.28, p = .026$, different words, $t(56) = 2.52, p = .015$, MLUs, $t(56) = 2.08, p = .042$, and total language nutrition, $t(56) = 2.60, p = .012$. Overall, mothers in the intervention group had a higher base rate for these language variables compared to the mothers in the standard care group. All baseline scores were included as covariates in their respective models to account for change over time. Additionally, total words (at each timepoint assessed including baseline), the percent of Spanish spoken during the interactions, as well as maternal IQ score, were included as covariates.

3.3 Direct Effects

The first series of linear regression models tested the direct effect of the intervention group on maternal language at post treatment. There was a statistically significant effect of group on mothers' total words, $F(4, 54) = 7.23, p = .027, r^2 = .34$, different words, $F(5, 53) = 10.21, p = .045, r^2 = .49$, and overall language nutrition composite, $F(5, 53) = 6.70, p < .001, r^2 = .39$. Mothers in the intervention group used a higher number of total words and different words, as well as a higher level of the language nutrition composite, compared to the mothers in the standard care group. However, the effect of group on mothers' MLUs was not significant, $F(5, 53) = 1.92, p = .104, r^2 = .15$, at post treatment.

At the 3-month follow-up, there was a statistically significant group effect on mothers' total words, $F(4, 54) = 6.15, p = .033, r^2 = .31$, and language nutrition composite, $F(5, 53) = 2.55, p = .004, r^2 = .19$. However, there was not a significant group effect on the number of different words, $F(5, 53) = 8.06, p = .138, r^2 = .43$, or MLUs, $F(5, 53) = 2.77, p = .064, r^2 = .20$. Mothers receiving the Infant Behavior Program used significantly more total words and a higher level of the language nutrition composite compared to mothers in the standard care group. At the 6-month follow-up, there were significant effects on mothers' total words, $F(4, 54) = 7.92, p = .003, r^2 = .37$, different words, $F(5, 53) = 9.19, p = .014, r^2 = .46$, MLUs, $F(5, 53) = 2.91, p = .011, r^2 = .21$, and language nutrition composite, $F(5, 53) = 2.83, p = .002, r^2 = .21$. At the 6-month follow-up, mothers in the Infant Behavior Program used more total words and different words, as well as higher levels of the language nutrition composite and longer MLUs, compared to mothers in the standard care group.

3.4 Indirect Effects

Mediation analyses were conducted to examine the indirect effect of maternal linguistic input (total words, different words, MLUs, and language nutrition composite score) at post treatment on the relation between intervention group and infant language (total utterances

and different utterances) at the 3- and 6-month follow-ups. At the 3-month follow-up, there were no significant indirect effects when examining mothers' total words, different words, or MLUs. However, there was a significant indirect effect on the language nutrition composite variable. Specifically, the effect of group on mothers' language nutrition composite was significant ($b = 17.86$ 95% CI [8.72, 27.01], $p < .001$), such that mothers in the intervention group used higher levels of the language nutrition composite compared to mothers in the standard care group. The effect of the language nutrition composite on infant total utterances was also significant ($b = 1.02$ 95% CI [.21, 1.82], $p = .01$), such that the higher levels of maternal language nutrition infants heard, the greater number of total utterances they produced. The indirect effect of group on infants' total words through mothers' language nutrition composite was also significant ($b = 18.17$ 95% CI [2.10, 42.29]). The direct effect of group on infants' different words was not significant ($b = 12.10$ 95% CI [-15.17, 39.37], $p = .37$).

A similar pattern was observed for infant's different utterances (see Figure 1). Group was a significant predictor for the language nutrition composite ($b = 17.38$, 95% CI [8.26, 26.50], $p < .001$), and mothers' language nutrition composite score was significantly associated with infants' different utterances produced ($b = .466$, 95% CI [.10, .83], $p = .01$). The direct effect of group on infants' different utterances was not significant ($b = 3.82$, 95% CI [-8.62, 16.27], $p = .53$). However, the indirect effect of group on infants' different utterances through mother's language nutrition composite was significant ($b = 8.10$, 95% CI [.66, 18.86]). These results therefore indicated that mothers' language nutrition mediated the effect of the intervention on infants' different utterances produced.

Similar mediation analyses were conducted to examine the effect of mothers' language nutrition at the post treatment (Time 2) on the relation between group and infant language at the 6-month follow-up (Time 4). Mediation analyses for infant total and different words were not significant at Time 4.

4. Discussion

The current study examined the effect of a brief behavioral parenting intervention, the Infant Behavior Program, on changes in maternal linguistic input during interactions with their infant. The Infant Behavior Program targets infants at risk for early childhood behavior problems through coaching parents to use more positive behavioral parenting skills. Previous research has examined the use of these skills and their indirect effect on child language (Garcia et al., 2015; Garcia et al., 2018). However, no work has examined the effect of this brief intervention on changes in the complexity of parent language. We found that mothers who participated in the program displayed higher levels of lexical diversity and used more language nutritious components in their speech with their infant (e.g., more conjunctions, adjective phrases, noun phrases and prepositional phrases) following the intervention, as compared to mothers in the standard care group. These group differences were maintained at the 3- and 6-month follow-ups, suggesting the Infant Behavior Program had a long-term positive impact on maternal linguistic input.

A different pattern emerged when examining MLUs. Specifically, we found no significant group differences at post-treatment or at the 3-month follow-up. However, at the 6-month follow-up, mothers who received the Infant Behavior Program had longer MLUs compared to mothers in the standard care group. This delayed effect may be due to differences in parent responses to their infant's vocalizations depending on the infant's level of developmental functioning. For example, during play interactions, mothers regulate and provide contingent responses to their child's vocalizations, such as more complex responses when their child produces higher level vocalizations (e.g., babbling compared to vowel only vocalizations; Gros-Louis, West, Goldstein & King, 2006). At Time 4, the infants were 18 to 24 months, a time when infants display increases in expressive language (McMurray, 2007). Thus, it is possible that there was only a delayed effect of the Infant Behavior Program on maternal linguistic productivity when infants produced more utterances. As a result of these delayed effects future research on the effectiveness of booster sessions on parent and infant language is warranted.

Mothers who completed the Infant Behavior Program used greater lexical diversity and linguistic productivity following treatment. However, this greater quantity and quality of language did not mediate the effect of the Infant Behavior Program on infant language production. Instead, the richness of maternal language, or the language nutrition composite, led to improvements in the total and different utterances produced by the infants at the 3-month follow-up. These findings are consistent with research demonstrating the importance of the complexity of parent language (Zauche et al., 2016; Zauche et al., 2017). Although maternal MLU predicts children's later language and academic functioning (Pan et al., 2005), there was not an indirect effect of MLU on the relation between Infant Behavior Program and infant language, which may have been due to the delayed direct effect of the Infant Behavior Program on MLU. It is important to note that the effects of the language nutrition composite on infant language were only significant at the 3-month follow-up but not the 6-month follow-up. The discrepancy across time points may be due to a smaller effect at the 6-month follow-up than at the 3-month follow-up and the relatively small sample size with decreased power to detect a significant difference. Thus, further research with a larger sample is needed to understand the effect of changes in parent language and subsequent infant language in the context of behavioral parenting interventions.

Another important direction for future research is to investigate the type of language spoken during interventions. In the U.S. there is a growing population of children born into families who are not native English speakers, yet few language interventions have been adapted for these families (Baralt et al., 2017; Suskind et al., 2018; Larson et al., in press). Behavioral parenting interventions, such as PCIT and the Infant Behavior Program, have been found to be effective for culturally and linguistically diverse families, including Latino and Hispanic families (Matos, Baurmeister & Bernal, 2009; McCabe & Yeh, 2009; McCabe, Yeh, Lau, & Argote, 2012). Providing interventions in families' native language can promote the child's language acquisition in their native language as well as their secondary language (Castro, Pérez, Dickinson, & Frede, 2011; Durán, Hartzheim, Lund, Simonsmeier, & Kohlmeier, 2016) and also strengthen family ties (Oh & Fligni, 2010).

Although we controlled for language spoken by mothers, we did not examine differences in language variables between English and Spanish speakers due to the relatively small sample size of the current sample. Previous research has demonstrated differences in language use between English and Spanish speakers. For example, in the Infant Behavior Program, Spanish-speaking mothers used more questions and commands overall compared to mothers speaking English during play interactions (Ramos, Blizzard, Barroso & Bagner, 2018). Although there are preliminary data indicating differences between English- and Spanish-speaking parents, more research is needed to understand the effects of these differences on maternal language nutrition, the role of culture on language nutrition provision, and infant language outcomes.

4.1 Strengths and Limitations

The current study had several strengths, including the use of a randomized controlled trial methodology. Additionally, we measured parent and infant language using an objective coding scheme with high estimates of interrater reliability. Another strength was that there were multiple time points that allowed for longitudinal follow-up following the intervention. This study also included predominately low-income families from an ethnic minority background, and thus contributes to understanding how interventions can best serve these underserved families. However, the sample was relatively homogenous with respect to ethnicity (94.7% Hispanic/Latino), thus limiting generalizability to other cultures. Additionally, the families in this study were primarily Spanish-speaking. Although we controlled for language in this study, further research with a larger sample is needed to examine the potential impact of language spoken on the empirical questions examined herein.

Additional limitations are the relatively small sample size, which may have reduced the power to detect direct effects of parent language (e.g., MLU) on infant language, and the use of a brief (10-minute) sample to measure language, which may not have represented the full language abilities of the mother or child. Although secondary caregivers, including fathers, were encouraged to participate in the intervention, we only collected language data from the primary caregiver, which was the mother for all families in the current sample. Future research should examine the impact of language from other caregivers (e.g., fathers, grandparents) involved in parenting interventions on infant language. Finally, we conceptualized language nutritious speech as the total number of conjunctions, adjective phrases, noun phrases, and prepositional phrases (e.g., syntactic expansions in the dependent clause position of mothers' infant-directed speech). This study was the first to examine the effect of an intervention on language nutrition measured this way. However, there may be other ways to measure parent language nutrition, such as the grammatization via verbs or time phrases in syntactic recursion. Further research should evaluate the appropriateness of this composite and other ways of measuring language nutrition across multiple languages and cultures to better understand the construct and its impact on infant language.

4.2 Conclusion

Despite the aforementioned limitations, this study has important implications. Research shows that behavioral parenting interventions lead to improvements in child behavior and

increases in parent use of behaviorally-based parenting skills taught during sessions (e.g., praises). However, this work extends previous research to include improvements in the quantity and quality of maternal language spoken following the intervention, which was demonstrated to predict subsequent improvements in infant language. Intervening early in development allows for a unique window of opportunity to target infants at risk for behavior problems and language delays in naturalistic settings prior to the onset of a diagnosis. Changes in infant language were observed immediately after a brief intervention targeting behavior and extended 6 months after completion of the intervention. Although future research is necessary, this preliminary analysis demonstrates the effectiveness of brief, naturalistic intervention for families from low-income and primarily Hispanic/Latino backgrounds and its impact on parent language, which was demonstrated to foster infant language development.

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Highlights

- Behavior parent training (BPT) increases maternal linguistic input.
- BPT increases lexical diversity, linguistic productivity, and language nutrition.
- Language nutrition has mediating effects on infant language.
- Findings highlight potential for targeting language through behavior treatments.

Figure 1.

Path Diagram for the Effect of Maternal Language Nutrition at Time 2 on Infant Different Utterances at Time 3

Note. The covariates of the percent Spanish and Maternal IQ, as well as baseline scores, were excluded from the figure to avoid clutter. Unstandardized values in the parentheses. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 1

Demographic Characteristics of Groups

	M (SD) or %		<i>p</i> -value
	IBP	Standard Care	
Child Age (Months)	13.71 (1.39)	13.25 (1.17)	0.17
Infant Sex (% Male)	41%	50%	0.54
Language Spoken (% Spanish)	55%	85%	< 0.01
Maternal IQ T-Score	45.88 (11.49)	46.03 (11.60)	0.96
Maternal Ethnicity (% Hispanic/Latino)	87%	96%	0.2
Living below poverty line	58%	63%	0.71

Note. IBP = Infant Behavior Program; M = Mean; SD = Standard Deviation.

Table 2

Means and Standard Deviations of Maternal Language Variables

	Mean (Standard Deviation)			
	T1	T2	T3	T4
Total Words				
Standard Care	149.14 (119.83)	150.46 (124.46)	153 (129.22)	186.75 (161.90)
IBP	234.97 (162.12)	270.75 (178.34)	324.78 (219.98)	348.83 (228.91)
Different Words				
Standard Care	51.68 (34.41)	52.21 (36.14)	55.67 (39.97)	72.71 (45.19)
IBP	76.47 (39.96)	85.90 (50.05)	94.11 (55.81)	110.67 (62.12)
MLU				
Standard Care	2.42 (.74)	2.55 (.88)	2.4 (.54)	2.53 (.75)
IBP	2.78 (.59)	3.41 (1.42)	3.42 (1.345)	3.39 (1.14)
Language Nutrition				
Standard Care	3.18 (3.95)	3.41 (3.91)	3.91 (4.40)	5.39 (5.85)
IBP	6.43 (5.42)	27.35 (23.18)	27.33 (38.46)	26.94 (27.59)
Conjunctions				
Standard Care	.11 (.42)	.71 (1.27)	.21 (.51)	1.25 (2.33)
IBP	.40 (.85)	1.90 (2.77)	1.33 (1.64)	2.61 (2.97)
Adjective Phrases				
Standard Care	.50 (1.07)	.22 (.58)	.92 (1.21)	1.17 (2.06)
IBP	1.93 (4.52)	10.40 (9.82)	12.83 (14.65)	12.44 (14.16)
Noun Phrases				
Standard Care	.25 (.75)	.04 (.19)	.21 (.42)	.54 (1.18)
IBP	.43 (1.61)	6.30 (8.31)	4.61 (6.90)	4.44 (8.97)
Prepositional Phrases				
Standard Care	2.32 (2.60)	2.48 (3.23)	2.42 (3.45)	2.25 (3.29)
IBP	3.67 (2.98)	8.75 (7.20)	8.56 (9.22)	7.44 (6.49)

Note. IBP = Infant Behavior Program; MLU = Mean Length Utterance