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Impacts of a Parent-Implemented Language Intervention on Children's Language Development Within Home Visiting

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The purpose of this study was to conduct a pilot randomized controlled trial to evaluate the efficacy of an intervention for enhancing the language development of young children enrolled in home visiting programs. The participants were 59 children (18–30 months old) enrolled in one of three types of home visiting programs. Children's language skills were assessed pre- and post-intervention with the Preschool Language Scale. To estimate the impacts of the intervention on children's language scores, we conducted a two-level hierarchical linear model. Results from this model provide promising evidence for the benefits of using systematic parent-implemented language interventions. **Key words:** *home visiting, language-facilitating strategies, language intervention*

IN A LANDMARK STUDY, Hart and Risley (1995) established the critical influence of early language environments on the immediate and long-term development of young children. A key conclusion from this research was that differences in the quantity and quality of language input resulted in a cumulative 30-million-word gap by age 4 for children from the least advantaged socioeconomic status households, and a vocabulary twice as large as their counterparts by age 3 for children from the most advantaged households. The "word gap" not only predicted young children's vocabulary development at age 3 (Hart & Risley, 1995, 2003), but was also associated with their later language learning and academic achievement (Rowe, Raudenbush, & Goldin-Meadow, 2012; Walker, Greenwood, Hart & Carta, 1994).

Although Hart and Risley's findings have been criticized by some on methodological grounds (Dudley-Marling, & Lucas, 2009; Sperry, Sperry, & Miller, 2018), other researchers have suggested that Hart and Risley's basic premise regarding the critical importance and lasting effects of early language

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environments is supported by a large body of research on language development across various cultures and income groups (Golinkoff, Hoff, Rowe, Tamis-LeMonda, & Hirsh-Pasek, 2019; Purpura, 2019). With respect to the broader impact of the study, Hart and Risley's findings emphasized the importance of the earliest years for children's development and from there, a line of intervention research seeking to improve the quality and quantity of language input that children receive before entering school (Walker & Carta, 2020). Systematic reviews and meta-analyses evaluating this body of research described these interventions as primarily focusing on parents' use of naturalistic strategies and developmentally supportive conversations during daily routines and activities (Greenwood, Schnitz, Carta, Wallisch, & Irvin, 2020; Heidlage et al., 2020; Kong & Carta, 2013; Roberts & Kaiser, 2011; Walker et al., 2020). Such strategies include, for example, following the child's lead to create joint attention and increase turn-taking exchanges (e.g., Warren, Yoder, Gazdag, Kim, & Jones, 1993), using contingent responsiveness and recasting to enhance vocabulary and language complexity (e.g., Landry et al., 2012; Pan, Rowe, Singer, & Snow, 2005; Rodriguez & Tamis-LeMonda, 2011), and generally working to improve both the quantity and quality of parent–child language interactions (e.g., Suskind et al., 2016).

Overall, research reviews and meta-analyses show that parent-implemented language interventions have been effective in improving language outcomes in children birth to 6 years of age. Kong and Carta (2013) synthesized 26 studies, which included both parent- and early childhood educator-implemented interventions, with rigorous designs and found significant positive changes in adults' responsiveness and children's social–emotional and communicative outcomes for children birth to 6 years of age with or at risk for developmental delays. Roberts and Kaiser (2011) conducted a meta-analysis of 18 studies evaluating parent-implemented language interventions for children 18–60 months of age with language and developmental delays. They found an overall positive effect for these interventions on children's language skills (with effect sizes ranging from 0.35 to 0.82). Further, a meta-analysis of 25 studies examining the efficacy of parent-implemented language interventions (Heidlage et al., 2020) was generally consistent with the Roberts and Kaiser (2011) work indicating that parent-implemented language interventions may have positive effects on linguistic outcomes for young children with or at risk for language impairment (with effect sizes ranging from 0.15 to 0.95).

Most of the studies included in these research syntheses were not focused on children below the age of 3 years, highlighting the need to conduct further research with younger groups of children (Greenwood, Schnitz, et al., 2020; Heidlage et al., 2020; Roberts & Kaiser, 2011; Walker et al., 2020). Only a limited number of studies evaluating parent-implemented language interventions have been conducted in the context of early intervention or home visiting programs serving children birth to 3 years old (e.g., Bigelow, Walker, Jia, Irvin, & Turcotte, 2020; Buzhardt et al., 2011). Further, these results suggest important gaps in research knowledge about the effects of parent-implemented language interventions on children birth to 3 years old with disabilities or at risk for developmental delays.

LANGUAGE INTERVENTION SELECTED FOR EVALUATION

The intervention in this study, Promoting Communication Tools for Advancing Language in Kids (PC TALK), is a standardized set of research-based strategies indexed to various levels of development, derived from milieu and responsive teaching techniques (Kong & Carta, 2013; Roberts & Kaiser, 2011; Tannock & Girolametto, 1992; Walker, Bigelow, & Harjusola-Webb, 2008; Warren & Brady, 2007), and designed for use by parents or childcare providers with their children in the context of daily routines and activities

(e.g., play, mealtime, bedtime, and shared book reading). The intervention also includes corresponding assessment tools, to provide feedback on child progress in language learning, and to provide feedback on parents' use of language strategies in relation to child language usage (Greenwood, Buzhardt, Walker, Jia, & Carta, 2020; Walker, Bigelow, Turcotte, Reynolds, & Muehe, 2015; Walker, Carta, Greenwood, & Buzhardt, 2008). Importantly, the PC TALK intervention is meant to supplement, not supplant, home visiting model curriculum or standard practices.

To support implementation of the PC TALK program by the early childhood home visitors (i.e., early childhood professionals who provide a specialized set of supports and resources to families using various program models and curricula), we used the Institute for Healthcare Improvement (IHI, 2003) Breakthrough Series Collaborative program improvement model (IHI, 2003). The defining features of the IHI model included establishing local- and leadership-level planning teams, conducting three professional learning sessions, convening monthly implementation calls, and using data to measure children's developmental change. The IHI model is consistent with recent recommendations for supporting early childhood initiatives focused on scaling program improvement, including the use of evidence-based practices and data to document progress toward goal attainment (Buzhardt et al., 2018; Maxwell, LaMonte, & Halle, 2017).

The study settings included the most widely implemented home visiting models serving young children with disabilities in one state: Part C Early Intervention (Part C), Early Head Start–Home-Based Option (EHS-HBO), and Parents as Teachers (PAT). Each of these models is guided by program standards on health, safety, and service delivery that primarily emphasize the use of regular home visiting to provide parent supports to enhance child development. These programs are all similar in key components of home visiting practices, making the programs ideal for adding the PC TALK intervention as a complement to home visiting practices. The defining characteristics of each program are described in Table 1.

Although these models follow program standards to ensure high-quality services and family engagement with the goal of supporting parenting that enhances children's development, they lack well-specified, research-based approaches linked to specific aspects of children's early development and learning (National Academies of Sciences, Engineering, and Medicine, 2016; Sama-Miller et al., 2018). For this reason, the PC TALK intervention fits well as a supplement to these existing models by providing home visitors with specific approaches to encourage parent use of a set of language strategies, as well as assessment tools to individualize support to children and parents by tracking children's progress in language learning and providing feedback to parents on use of language-facilitating strategies. This intervention was designed specifically to give additional evidence-based tools to home visitors to use to supplement their model curriculum and promote the language-learning opportunities for infants and toddlers in center- and home-based early intervention. This study offered an opportunity to investigate the systematic use of a research-based parent-implemented language intervention to assess its use and impact within widely used home-based parent support services.

STUDY GOALS

The goal of this study was to conduct a pilot randomized controlled trial (RCT) to evaluate the efficacy of an intervention for enhancing the language development of children 18-30 months of age enrolled in one of three types of home visiting programs: (a) Part C, (b) EHS-HBO, and (d) PAT. Building on previous research related to the intervention (e.g., Bigelow et al., 2020; Buzhardt et al., 2018; Early Childhood Technical Assistance Center, 2013; Walker, Bigelow, Atwater, & Beecher, 2014), the study was designed to contribute to the knowledge base on the impacts of a parent-implemented language intervention

Table 1. Defining Characteristics of Home Visiting Programs

Program	Children/Families Served	Program Characteristics
Part C Early Intervention	Children birth to 3 years of age with identified disabilities and their families. *Note*: this is a federal program, authorized under the Individuals with Disabilities Education Act (IDEA)	• Individualized Family Service Plan (IFSP) is used to guide services to address the child's and family's individual needs, priorities, and goals • Majority of the children served have a language delay or communication disorder (https://sites.ed.gov/idea/statute-chapter-33/subchapter-iii/1431) • Guided by procedural components required under Part C of IDEA (https://ectacenter.org/partc/componen.asp) • Guided by practice components outlined in the ECTA's Seven Key Principles for Providing Early Intervention Services in Natural Environments [e.g., infants and toddlers learn best through everyday experiences, IFSP outcomes must be functional, etc. (https://ectacenter.org/topics/eiservices/keyprinckeyprac.asp)]
Early Head Start–Home-Based Option (EHS-HBO)	Children birth to 3 years old from low-income families living below the federal poverty threshold, families receiving social assistance, and families with foster children	• Part of the federal Head Start program and is governed by the Head Start Performance Standards, with guidance on service settings, caseload size, service duration, and safety requirements • Standards incorporate the Head Start Early Learning Outcomes Framework, which encourages use of research-based curricula and practices • Requires that 10% of the children enrolled in a program of this type have an identified disability and an IFSP
Parents as Teachers (PAT)	Low-income families and families of children at risk for disabilities	• Local PAT affiliates must follow the PAT Essential Requirements—including guidance on home visitor qualifications, service duration, and professional learning • PAT emphasizes activities to increase parents' knowledge of child development and practices aimed at increasing school readiness

(PC TALK, along with Early Communication Indicator [ECI] and Promoting Communication Observation System [PC-Obs]), using the IHI model to support implementation, on the development of children birth to 3 years of age with disabilities or at risk for developmental delays in an understudied context (home visiting programs). Because parent-implemented interventions have been understudied with young children with disabilities and families in the context of home visiting, and because the feedback component of the intervention combined with parent-implemented language strategies is an innovative approach not evaluated in previous research reviews and meta-analyses, we conducted a pilot study to examine the efficacy of using the PC TALK intervention within the context of the IHI model with a small sample of early intervention home visitors from EHS, Part C, and PAT programs to determine the promise for future scale-up research projects. This pilot study addressed the following research questions:

1. Does parental use of language-facilitating strategies increase after implementing PC TALK using the IHI model to support implementation among families receiving PC TALK?
2. Do children who are exposed to PC TALK make greater gains in language development than children receiving business-as-usual (BAU) home visiting practices?

METHODS

Study overview

We report findings from a pilot RCT with 23 home visitors and 59 children who participated in two contrasting conditions in the fall of 2018 through the spring of 2019. The two conditions represent planned variation in the way home visitors conducted their home visiting sessions with study children over a 30-week period. Home visitors in both the treatment and BAU conditions continued to conduct home visits using the procedures set forth in their respective program models. Home visitors in the treatment condition also implemented the PC TALK intervention during their home visits. Depending on the home visiting model, home visitors typically visited homes biweekly (i.e., every other week) or weekly for hour-long sessions.

Participants

Home visitors

Twenty-three home visitors affiliated with three home visiting programs participated in the study. These home visiting programs serve families of children with identified disabilities and those who are at risk for developmental delays. The participating programs are Part C Early Intervention (13 home visitors), EHS-HBO (seven home visitors), and PAT (three home visitors).

To recruit home visitors, informational webinars were offered and flyers describing the study were distributed. Interested home visitors self-selected into the study (and gave informed consent, as approved by the institutional review board). The home visitors conducted home visits in nine counties in the state. On average, each home visitor served three study children (with a range of one to five).

Twelve (52%) home visitors were randomized into the treatment condition and 11 (48%) into the control condition. Of the participating home visitors, 43% held an advanced/graduate degree ($n = 10$), 44% held a bachelor (22%, $n = 5$) or associate degree (22%, $n = 5$), 4% held a technical or vocational degree ($n = 1$), and 9% held a high school diploma ($n = 2$). All home visitors were female and White. The average home visitor had 8 years of home visiting experience ($SD = 7.1$) and was 42 years old ($SD = 9.3$). The most common curricula used by the home visitors in their routine practice included Creative Curriculum, Parents as Teachers Curriculum, and Partners for a Healthy Baby.

Children

A total of 81 children participated in the study. After attrition, which occurred due to children testing out of home visiting services,

moving out of state, or being unreachable for home visiting and data collection sessions, 59 children were included in the analysis sample (see Appendix A for CONSORT diagram).

Of the 59 children included in the analytic sample, 29 (49%) were in the control condition and 30 (51%) were in the treatment condition. On average, the children were 22 months old (*SD* = 4.0) at the start of the study. Based on parent report, 56% of the study children were male and 44% were female. The majority of children spoke English at home (98% had a home language of English and 2% had a home language of French). Seventy-six percent of the study children were White, 15% were Black, and 9% were another race. According to parent report, 63% of children received early intervention services. Through an additional parent survey question, parents reported that study children had the following disabilities: 39% of study children had a speech–language disability, 12% had speech–language and developmental delays, and 7% had developmental delays. In regard to home visiting services, 47% of children received Part C services, 37% received EHS-HBO services, and 17% received PAT services. On average, each child had 11 home visits (*SD* = 6) during the 30-week implementation period. We present summary statistics for key home visitor and child variables in Table 2.

Families had an average of five people (*SD* = 2) living in their household. Seven percent of the study children's parents/guardians highest degree was less than a high school

Table 2. Summary of Home Visitor and Child Variables

	Treatment	Control	Total
Home visitors	(*n* = 12)	(*n* = 11)	(*n* = 23)
Female	100%	100%	100%
Race: White	100%	100%	100%
Years of experience	8 (7)	8 (7)	8 (7)
Age	41 (11)	43 (7)	42 (9)
Children	(*n* = 30)	(*n* = 29)	(*n* = 59)
PLS baseline	52 (14)	54 (13)	53 (13)
PLS outcome	62 (12)	56 (17)	59 (15)
Age in months (baseline)	22 (4)	21(4)	22 (4)
Gender			
Male	46%	66%	56%
Female	54%	34%	44%
Home language			
English	96%	100%	98%
French	4%	0%	2%
Race			
White	86%	65%	76%
Black	7%	23%	15%
Other	7%	12%	9%
Home visiting model			
Part C	47%	45%	46%
Early Head Start	37%	38%	37%
Parents as Teachers	17%	17%	17%
Disability[a]	68%	59%	63%

Note. PLS = Preschool Language Scale. Standard deviation is provided in parentheses for continuous variables.
[a]The disability status variable contrasted children without any delay or disability with children reported to receive early intervention services for any of the following: a speech–language delay, a developmental delay, or both.

diploma, 58% had a high school diploma or GED, 12% had a technical or vocational certificate, and 23% had an associate degree or higher. Approximately half of the children's families had an annual household income of $25,000 or less, and the majority (96%) of families had an annual income below $75,000.

Intervention

The PC TALK intervention (Walker & Bigelow, 2012) is a suite of resources developed by researchers from the Juniper Gardens Children's Project at the University of Kansas (Walker, Bigelow, et al., 2008; Walker & Bigelow, 2012; see also http://www.talk.ku.edu/). The core components included (1) PC TALK (Walker & Bigelow, 2012), an evidence-based set of parent-implemented language strategies indexed to various levels of development, derived from milieu and responsive teaching techniques (Kong & Carta, 2013; Roberts & Kaiser, 2011; Walker, Bigelow, et al., 2008; Warren & Brady, 2007); and (2) corresponding assessment tools, one to provide feedback on child progress in language learning (ECI; Greenwood, Buzhardt, et al., 2020; Walker., Carta, et al., 2008), and another to provide feedback on parents' use of language strategies in relation to child language usage (PC-Obs; Walker et al., 2015).

In the present study, home visitors provided parents with information and support to use strategies to promote children's communication skills. Specifically, intervention support materials (available in English and Spanish) used by home visitors include DVDs, posters, and checklists to teach and guide caregivers in the use of the eight PC TALK strategies, summarized in Table 3. Given that the PC TALK intervention was embedded in the usual format in which home visiting support was delivered by home visitors, it used an ongoing coaching format that was informed by the data collected and the home visitors' observations during their home visits and within the context of the home visitors' sensitivity to and acknowledgement of, cultural and linguistic norms and parents' level of education. The PC TALK intervention strategies are designed to be used across any daily routines selected by the family and home visitor, commensurate with family preference and cultural and linguistic practices. The PC TALK manual is not prescriptive, but instead, emphasizes flexibility to encourage intervention individualization and implementation. The manual has been the primary training resource in multiple studies (e.g., Bigelow et al., 2020; Buzhardt et al., 2018; Walker, Bigelow, et al., 2008) and may be delivered in any language. Home visitors' strategy instruction occurred through discussion, practice, and feedback based on parent–child observation data. Importantly, home visitors were encouraged to integrate the PC TALK strategies within their program's curriculum or standard practices, and support parents in using the strategies across daily routines. Home visitors provided the PC TALK resources to support parents in using the strategies throughout the week, and data from parent–child observations were used to provide data-based feedback to parents.

Treatment and BAU conditions

Home visitors in both the treatment and BAU conditions continued to conduct home visits using the procedures specified by their respective program models. To complement these practices, home visitors in the treatment condition also implemented the PC TALK program for 7 months. Depending on the home visiting model, home visitors typically visited homes every other week or weekly for hour-long sessions.

Professional learning

Both treatment and BAU conditions received professional learning. Professional learning activities for the treatment condition followed the IHI Breakthrough Collaborative Series to create a structure to promote communication and use of data to monitor progress around implementation and results. Activities included: (a) establishing local-level planning teams of home visitors, (b) three learning sessions focused on PC TALK and the ECI assessment (sessions one and two

Table 3. PC TALK Strategies and Descriptions[a]

PC TALK Strategy	Description
Arranging the environment	Structuring the physical environment of the home to promote opportunities for children to communicate more frequently throughout the day.
Following child's lead/responsiveness	Noticing what a child is interested in, looking at, playing with, and talking about.
Commenting and labeling	Describing the actions in which a child is involved.
Imitating and expanding	Imitating is repeating or signing a child's vocalizations or words back to the child. Expanding is repeating or signing what the child has just said and adding new information.
Asking open-ended questions	Questions asked in a way that allows children to respond in multiple ways rather than simply answering yes/no or nodding their head.
Giving praise and positive attention	Praise is making positive comments about a child's behavior and communication. Positive attention is encouraging children in what they are doing, such as sharing or playing nicely with other children, by paying attention and being engaged with them.
Providing choices	Structuring the environment in a way that allows children to choose from more than one activity or toy. Providing choices means that the child will need to communicate which toy or activity they prefer.
Time delay/fill in the blank	Time delay is providing the child an opportunity to fill in a sentence or a song with a familiar word or vocalization that they know and have used before. For example, singing "Twinkle, twinkle, little _____," and then the child filling in "star."

[a]From *Strategies for Promoting Communication and Language of Infants And Toddlers* by D. Walker and K. Bigelow, 2012, Kansas City, KS: Juniper Gardens Children's Project.

were day-long and in-person; session three was virtual and lasted 2 hr), and (c) monthly 1-hr all-team calls to support implementation, which involved data-driven discussions based upon results from the ECI and PC-Obs assessments. For the BAU condition, home visitors received professional learning focused on the ECI assessment only, with no monthly calls or meetings under the IHI format. The ECI training began with a generic and brief presentation on the importance of early learning and development.

Implementation fidelity

To ensure home visitors implemented the PC TALK intervention with fidelity, they were asked to complete an online log adapted from the PC TALK materials (http://www.talk.ku.edu/) after each home visit. These logs required home visitors to report (1) which strategies they introduced/discussed during the visit, (2) the contexts for delivering the strategies they discussed (e.g., play and toileting), and (3) the methods they used to share the information (e.g., modeling and reviewing manual). Each month, our research team generated individualized home visitor progress reports that summarized data from this survey both individually and across home visitors implementing the intervention. These reports provided summary statistics of both individual home visitor implementation progress with their case families and summary

statistics of all home visitors implementing the intervention. We generated both types of reports so home visitors could examine their implementation progress against the group as a whole, which helped to spur reflection and conversation in convenings. We discussed these reports on monthly webinar calls that included all home visitors in the treatment condition. If we noticed a certain strategy was not used frequently, for example, we would engage the home visitors in a conversation about why that strategy was used less, and how to increase its use. In cases where the logs showed a low level of home visitor engagement, we reached out individually to provide implementation support. With this level of implementation support, 100% of home visitors completed weekly implementation logs, attended monthly implementation team meetings, and reported introducing PC TALK strategies with study families.

Home visitor engagement was determined through a holistic set of factors. Home visitors were required to submit brief logs after home visits. If home visitors were not submitting logs, a research team member would prompt the home visitor with a reminder to do so. If this lack of response persisted, a member of the research team would have a phone call with the home visitor to assess the situation. After logs were submitted, the substance of the home visit logs was analyzed in the monthly reports. If home visitors did not report introducing any PC TALK strategies or they listed specific issues, a similar pattern of follow-up was pursued by a member of the research team. Given the small number of home visitors in this study, the research team was able to easily monitor home visitor implementation and provide individualized support.

Measures

Promoting Communication Observation System

The PC-Obs measures the frequency with which parents or caregivers implement different PC TALK language strategies, along with the frequency of child communicative behaviors (i.e., gestures, vocalizations, words, and multiple words) (Walker et al., 2015). The results are graphed and used by the treatment home visitors to provide feedback to parents on the frequency with which those parents used the intervention strategies in relation to children's responses, and to make any adjustments needed to further enhance child developmental progress. Criterion validity of the PC-Obs Total Communication Rate was $r = 0.42$ with the Infant/Toddler Environment Rating Scale (Harms, Cryer, & Clifford, 1990), and 0.53 with the Preschool Language Scale-4 (Zimmerman, Steiner, & Pond, 2002).

Data collectors administering the PC-Obs were initially trained to an 85% interobserver reliability criterion during training. PC-Obs data were collected during naturalistic observations in person of adult–child interactions in families' homes. The observation took 15 min to administer. PC-Obs data were collected for the treatment group only at three time points throughout the implementation window (i.e., beginning, middle, and end of the implementation). See Table 4 for an overview of administration procedures for all measures used in the study.

Early Communication Indicator

The ECI (Greenwood, Walker, & Buzhardt, 2010) is an individual growth and development indicator progress monitoring measure of infant/toddler growth in expressive communication (Greenwood, Carta & McConnell, 2011; Walker., Carta, et al., 2008). Specifically, the ECI is a reliable (0.90 interobserver agreement, 0.89 test-retest reliability) 6-min observational assessment of children's communication during a standard play session with a familiar adult (i.e., parent or caregiver). Two standard toy sets—a House and Barn—serve as alternate forms for the play context during administration. The ECI measures a child's communicative behavior through counts of gestures, vocalizations, single words, and multiple words. Administration of the ECI involves the parent playing with a child using one of two toys that are

Table 4. Overview of Measures and Administration Procedures

Measure	Description	Administrator	Times Collected
Promoting Communication Observation System (PC-Obs)	Measure of parent or caregiver use of PC TALK language strategies and child communication	Members of external evaluation team	Beginning, middle, and end of implementation (treatment group only)
Early Communication Indicator (ECI)	Measure of child communication in the form of gestures, vocalizations, worlds, and multiple words	Home visitors	Beginning, middle, and end of implementation (treatment and control groups)
Preschool Language Scale-5 (PLS-5)	Measure of receptive and expressive language skills	Members of external evaluation team	Beginning and end of implementation (treatment and control groups)

alternated across assessments: the Fisher-Price Barn or Fisher-Price House (Greenwood, Buzhardt, et al., 2020; Walker & Carta, 2010). Each toy comes with sets of figures including toy people, animals, and barn and household items that children can play with and which are used as stimuli for the assessment. The parent's role during an ECI session was to encourage the child's communication by following the child's lead and commenting on the child's actions and words. Because the goal was to capture the child's typical communication performance, parents followed the child's lead and supported the child's communicative behavior through responsive interactions and interest in the child's play. While observing the interaction, the home visitor documented the frequency of four key skills of gestures, vocalizations, words, and multiple words, tallied during each 6-min assessment session (https://igdi.ku.edu/).

The ECI produces individual scale scores for each skill category and a total communication score that is calculated based on the composite counts for these four key skills, with single word counts weighted by a multiple of two and multiple word counts weighted by a multiple of three. The results were graphed and the treatment home visitors used these graphs to provide feedback to parents on the child's progress in acquiring language skills. The home visitors administered the ECI during home visits at four time points throughout the intervention window, and were trained and tested for reliable administration of the instrument before gathering data on participating children.

Preschool Language Scale-5

The Preschool Language Scale-5 (PLS-5; Zimmerman, Steiner, & Pond, 2011) is a comprehensive developmental language assessment that is appropriate for children from birth through age 7. It assesses receptive and expressive language skills and includes items that measure skills ranging from preverbal interactions to emerging language and early literacy. This interactive, play-based assessment takes approximately 45 min to administer and has a test-retest reliability of 0.69 (Denman et al., 2017). The PLS-5 is one of few norm-referenced measures of young children's language; it has been used widely in previous parent-implemented language intervention studies (Roberts & Kaiser, 2011). Data collectors were trained to reliability on the PLS-5 by the research team and a certified speech–language pathologist. They then gathered the PLS-5 data with children during home visits at pre- and postintervention time points. The PLS-5 total score was used in analyses.

Missing data

To retain the full analytic sample in statistical analyses, we imputed missing data values using chained equations (Royston & White, 2011). Multiple imputation (MI) is a strategy for addressing missing data by using the

full set of existing data to estimate a set of plausible values for missing cells. Imputation methods have been shown to introduce less bias than alternative missing data methods, such as list-wise deletion, mean replacement, and dummy variable substitution (Royston & White, 2011). To impute the data, we used Stata's MI command to generate five imputed data sets (StataCorp, 2013).

RESULTS

Use of parent-implemented language strategies

Our first study aim was to explore parents' use of language-facilitating strategies before and after being exposed to PC TALK training. We conducted a paired-samples t test to determine whether there were significant differences between parents' use of language-facilitating strategies before and after the intervention for the treatment group as measured by the PC-Obs. Results revealed that parents used significantly more strategies after being exposed to the PC TALK intervention ($t = 5.60$; $p < .001$). Parents in the intervention group used an average of 70 strategies during the observation at baseline, compared with an average of 111 strategies at the conclusion of the intervention.

To better understand how home visitors and families were using the strategies during naturalistic observations, we also summarize data on the prevalence of different individual PC TALK strategies used, by observation wave, in Figure 1. Commenting and Labeling was the most common strategy observed, and its use grew over time (27 instances at baseline and 45 instances at the end of the intervention, on average). Other strategies used frequently included Open-Ended Questions (22 instances) and Imitating and Expanding (19 instances). Less frequently used strategies included Positive Attention and Praise (six instances), Providing Choices (one instance), and Time Delay and Fill in the Blank (one instance). These instances are the number of times observers recorded seeing each of the strategies over the course of a 15-min observation, averaged across intervention parents.

Additionally, related to parent and home visitor satisfaction with implementation of the PC TALK strategies, at the final monthly webinar, home visitors reported high satisfaction with the intervention. Specifically, home visitors reported that parents found the data and corresponding materials easy to understand and concrete. They also reported that parents found the strategies easy to implement and use on a daily

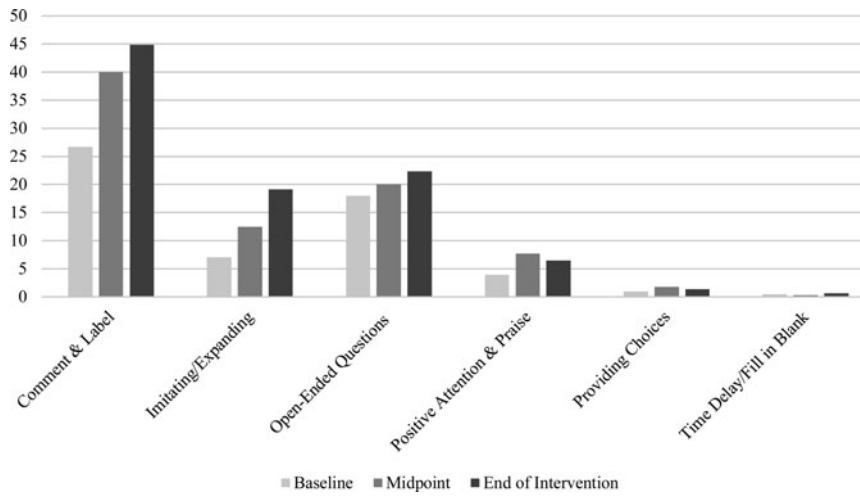

Figure 1. Parental use of PC TALK strategies in the treatment condition.

basis. Finally, home visitors reported that the intervention helped with providing more intentional use of the strategies with parents.

Main impacts of the intervention on children's language scores

Our second research aim was to estimate the impacts of the PC TALK intervention on children's language scores, as measured by the PLS total language score. See Table 5 for children's scores pre- and post-intervention on the PLS-5, as well as on the ECI. Baseline equivalence analysis revealed an effect size difference of 0.07 between treatment and control groups on the PLS-5, indicating a need for statistical adjustments; as such baseline

Table 5. Children's Language Assessment Scores

	Treatment		Control	
	Pre	**Post**	**Pre**	**Post**
		Full sample		
ECI				
M	76.35	152.68	87.54	146.74
SD	39.49	125.32	52.86	85.55
Min	10	24	9	27
Max	152	517	242	375
PLS-5				
M	51.92	61.67	53.45	56.00
SD	13.68	12.03	13.00	17.08
Min	22	29	22	17
Max	73	77	72	76
		Children with disabilities		
ECI				
M	64.65	131.46	70.70	100.18
SD	36.00	102.44	37.30	44.68
Min	10	24	9	27
Max	145	501	140	205
PLS-5				
M	50.32	59.49	49.05	49.87
SD	11.37	12.66	13.15	18.19
Min	30	29	22	17
Max	71	77	70	73
		Children without disabilities		
ECI				
M	104.90	201.20	111.41	212.71
SD	30.23	167.70	63.47	87.34
Min	68	86	45	70
Max	152	517	242	375
PLS-5				
M	60.30	67.33	59.68	64.58
SD	12.76	10.34	10.20	11.10
Min	32	44	44	45
Max	73	77	72	76

Note. ECI = Early Communication Indicator; PLS-5 = Preschool Language Scale-5. $N = 59$. The Cohen's d effect size for the ECI = 0.06. The distribution for the following variables was slightly skewed to the right: ECI treatment pre, ECI control pre and post; the distribution for the following variables was slightly skewed to the left: PLS treatment pre and post.

Table 6. Main Impact Models

	Model 1	Model 2	Model 3
Treatment coefficient	5.72	5.13	5.22
Standard error	3.77	2.93	2.81
p value	.13	.08	.06
Baseline PLS-5	–	0.82	0.85
Standard error	–	0.10	0.12
p value	–	.00	.00
Lagged PLS-5	–	0.11	0.10
Standard error	–	0.06	0.06
p value	–	.08	.12
Male	–	–	−4.78
Standard error	–	–	2.33
p value	–	–	.04
English	–	–	6.28
Standard error	–	–	6.56
p value	–	–	.34
Black	–	–	6.36
Standard error	–	–	3.53
p value	–	–	.07
Multiracial	–	–	0.89
Standard error	–	–	4.20
p value	–	–	.83
Home visiting model	–	–	−3.71
Standard error	–	–	2.21
p value	–	–	0.10
Age in months	–	–	.46
Standard error	–	–	0.34
p value	–	–	.17
Disability	–	–	−8.00
Standard error	–	–	3.15
p value	–	–	.01

Note. PLS-5 = Preschool Language Scale-5. The lagged PLS-5 variable is a measure of time between the baseline and outcome PLS-5.

PLS-5 scores are controlled for in the main impact analysis.

We present these findings, estimated by three separate impact models, in Table 6[1]. Each of the three models is estimated using two-level hierarchical linear modeling (HLM). Using HLM allowed us to account for the nested nature of our data. Model 1 estimates PLS scores as a function of treatment condition only. Model 2 estimates PLS scores as a function of treatment condition and

[1]Although the current study is an underpowered pilot study, we conducted a power analysis to understand the sample size that would be needed to detect a minimum detectable effect size (MDES) of below 0.35 [(note previous research on parent-implemented language interventions, which includes children with disabilities, has shown pooled effect sizes of 0.35–0.82 (Roberts & Kaiser, 2011)]. The power analysis was based on a two-level cluster, random assignment design and assumed that we would use two-level hierarchical linear models to estimate the impacts of treatment. The power analysis results indicate that under the assumptions of level-2 $R^2 = 0.70$, ICC = 0.15, and four control variables, a sample size of 100 home visitors has an MDES of 0.25.

baseline PLS scores (with an added measure of the time in months between the two assessment administrations). Model 3 estimates PLS scores as a function of treatment condition, baseline PLS scores, and a vector of covariates (gender, age, race, home language, disability status, and home visiting model). Note the disability status variable contrasted children without any delay or disability with children reported to receive early intervention services for any of the following: a speech–language delay, a developmental delay, or both.

Our preferred specification is Model 3, which includes the full set of covariates. In this model, the coefficient for treatment status is 5.22 ($d = 0.38$), which suggests children in the treatment group scored 5.22 points higher, on average, than the control group. However, this estimate did not reach statistical significance, with a p value of .09. In this model, the majority of the vector of covariates were not significant; however, baseline PLS scores and gender were significant, as was disability status. The significant coefficient for baseline PLS scores indicates that those children with higher baseline PLS scores outperformed those with lower scores, the significant coefficient for gender indicates that females performed better than males, and the significant disability coefficient indicates that children with disabilities performed worse than children without disabilities.

DISCUSSION

This RCT evaluated the impact of a parent-implemented language intervention (PC TALK and corresponding assessments) on the language development of children 18–30 months old enrolled in home visiting programs. The results indicated that parents in the treatment group used significantly more language strategies with their children after they were introduced to the PC TALK strategies. The study also found that children in the treatment group scored 5.22 points higher on the PLS than children in the control group, on average; although this difference did not reach statistical significance, it suggests that this intervention may hold promise as an effective parent-implemented language intervention in home visiting. These findings provide further support for previous research showing that parent-implemented language interventions have been effective for improving language outcomes in children birth to 6 years of age (Heidlage et al., 2020; Kong & Carta, 2013; Roberts & Kaiser, 2011). It also contributes to the evidence supporting the efficacy of the PC TALK intervention as an effective model for increasing language-learning interactions between parents and their young children (e.g., Bigelow et al., 2020). Further, this study focuses on a previously understudied group—children birth to 3 years old with disabilities or at risk for developmental delays, although findings indicated that the intervention was differentially effective for children with and without disabilities, with children without disabilities outperforming those with disabilities. Notably, children with disabilities in the treatment group did demonstrate more growth in regard to scores on both the ECI and PLS-5 than children with disabilities in the control group, suggesting the promise of the PC TALK intervention for this group of children. However, future research with larger sample sizes is warranted to further investigate the systematic relationship between exposure to the intervention and growth in language skills for children with disabilities.

Importantly, findings indicate that these interventions can be successfully implemented across three different types of home visiting programming (i.e., Part C Early Intervention, EHS-HBO, and PAT). Specifically, all three program models aim to ensure family engagement with the goal of supporting parenting; however, they all lack well-specified, research-based approaches linked to specific aspects of children's early development and learning. Successful implementation of the PC TALK intervention across all three models suggests the feasibility for supplementing these existing

programs with specific, research-based approaches to encourage parent use of language strategies.

The study was subject to a few limitations. Most notably, the small sample size made it necessary to conduct an underpowered analysis, and thus more likely to miss genuine effects. The attrition of home visitors and children from this study can be primarily attributed to the demands of home visiting—which requires practitioners to spend a great deal of time traveling and working with families—and the high level of turnover in home visiting caseloads. Even though the difference in children's language scores between treatment and control groups did not reach statistical significance, the effect size of 0.38 suggests that the intervention as delivered in this study was promising and warrants further research in the home visiting context. Future research might focus on studying subgroups of children who could also benefit from additional language supports (e.g., dual language learners). Additionally, it is possible that parents in both treatment and control groups might have shown increases in their use of the PC TALK strategies over time as measured by the PC-Obs. Therefore, the absence of comparison data on the use of PC TALK strategies in the control group prevents us from ascribing with certainty that the increase in the intervention group parents' use of strategies was due to exposure to the intervention. Further, the PC-Obs was only gathered three times throughout the implementation window. The three PC-Obs observations may have introduced potential measurement error, in that it is possible that we are not able to fully generalize to typical family and child behaviors, given the relatively small number of observations. Finally, in this study, home visitor fidelity to implementation was measured through self-report only. Future research should include direct observation of home visitor fidelity conducted by trained assessors.

The study findings have implications for future research. Additional research is needed to address questions regarding for whom and under what conditions parent-implemented interventions such as PC TALK work and what adaptations may be needed, with greater attention paid to the direct and indirect causal pathways (e.g., nature of children's language delays/disorders, characteristics of the language environment; parent and caregiving practices) to increase understanding of factors that influence the effectiveness of these interventions with very young children and their families. In addition, this study did not separately evaluate the contribution of the IHI model (e.g., establishing local planning teams for home visitors, conducting three professional learning sessions on PC TALK components, convening monthly implementation calls, and using data to measure progress toward implementing and measuring children's developmental change). Therefore, further research should rigorously examine whether there are unique benefits of using the IHI model for supporting implementation and scaling of evidence-based practices in home visiting.

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Appendix A