Providence talks: A citywide partnership to address early childhood language development

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ABSTRACT

Early research has shown that there may be inconsistencies in how parents in different socioeconomic classes prepare their children to learn to read. Previous research has highlighted a "word gap" between children from low-income families and high-income families. Effects of this "word gap" are evident at the start of kindergarten and contribute to the current nationwide achievement gap in educational outcomes for low-income children. Providence Talks (PT) is a city-wide initiative launched in 2014 in an effort to close this gap. PT helps caretakers learn about the importance of speaking with their children at an early age and supports them in their ability to improve the language environments within their home. We uncover positive results for the efficacy of a citywide intervention dedicated to improving outcomes for vulnerable children across the urban landscape.

1. Introduction

Early Childhood Education is a rapidly developing field with far-reaching policy and research implications. Research has long indicated that many children, particularly in lower socioeconomic classes, begin kindergarten already behind their peers (Fernald & Weisleder, 2015; Fernald, Marchman, & Weisleder, 2013; Hart & Risley, 1995; Rowe, 2012). In an effort to close this gap the City of Providence, RI launched Providence Talks (PT) in 2014. Due to its potential for replication in other cities, the PT initiative won the Bloomberg Philanthropies' 2013 Mayoral Challenge Grand Prize for Innovation. Providence Talks established a strong partnership between the City of Providence, Bloomberg Philanthropies,[1] and local nonprofit organizations with close connections to community members.

Providence Talks is a free, early intervention program for families with a child between 2–30 months of age living in Providence, RI. PT helps parents and caregivers learn about the importance of speaking with their children while supporting them in their efforts to improve home language environments. In order to measure child progress, PT uses a product called a Digital Language Processor (DLP) that children wear to record their interactions with adults for one day. The DLP, developed by the Colorado-based LENA Research Foundation,[2] acts as a "word pedometer" to capture a comprehensive picture of a child's auditory environment. Home visitors share the results from the DLPs during bi-weekly coaching visits so parents and caregivers can quickly see a picture of their home auditory environment and how it may or may not be improving.

Providence Talks partnered with a local university to evaluate the impact of their program in the short-term (What are the immediate effects of the coaching and feedback?) and will soon investigate the long-term effects (Do early changes in the home auditory environment continue after the child enters kindergarten?). PT is unique among peer programs in early childhood: It aims to intervene at a critically early age on a city-wide scale to ensure that every child enters kindergarten ready to achieve.

Using a treatment-control research design, this study found that Providence Talks improved the home auditory environment for parents and primary care takers who started with a lower level of Adult Word Count and Conversational Turns. This study also showed the benefits of having design variations in Providence Talks – the two intervention types, discussed in further detail below, both demonstrated success in improving the home auditory environment for participants. Further, based on self-assessment, parents in both interventions increased their sense of self-efficacy providing evidence that Providence Talks may serve as a strategy to promote parental engagement. Given Providence Talks' scale, design, and efforts to recruit the targeted populations in diverse neighborhoods, this study concludes that Providence Talks constitutes a promising strategy to disrupt the status quo to advance

early learning for all children.

2. Literature review

Early research has shown that there may be inconsistencies in how parents in different socioeconomic classes prepare their children to learn to read. Research completed by Child Psychologists Hart and Risley (1995) found that children from different income backgrounds were exposed to vastly different levels of adult talk over the course of their early, formative years. They projected that by the time children from low-income backgrounds reached their fourth birthday, they will have heard approximately 30 million fewer words, on average, than their higher income peers. Although, subsequent studies have identified flaws in Hart and Risley's theoretical and methodological approach (Dudley-Marling & Lucas, 2009; Johnson, 2015), ongoing research shows that differences in verbal ability are evident as early as 18 months (Fernald et al., 2013); and these differences may contribute to the ongoing nationwide achievement gap in educational outcomes for low-income children (Phillips, 2011).

Additional research has demonstrated that the quality of parental language engagement, including the use of diverse vocabulary and back-and-forth conversation between parents and infants, is important for children's language development (Fernald & Weisleder, 2015; Rowe, 2012; Suskind et al., 2013). Specifically, the quantity of words spoken to a child measured by "adult word count", and the quality of the interaction between adults and children measured by "conversational turns" are associated with children's language development (Suskind et al., 2013).

Due to substantiated differences in children's early verbal engagement and auditory environments, some researchers have attempted early developmental interventions (EDIs) as a mechanism to improve cognitive outcomes for vulnerable children before they begin school. Specifically, interventions that administer home visits, including the use of real-time feedback indicating progress over time, have found success (Bann et al., 2016; Suskind et al., 2013; Walker, Chang, Vera-Hernández, & Grantham-McGregor, 2011). A study by Walker et al. (2011) showed that early psychosocial intervention by home visitors (a weekly play-session to improve mother-child interactions) for malnourished children in Jamaica had positive impacts into adulthood including higher educational attainment and less involvement in violent behavior. This was not true for the group that received only increased nutritional supplements. A more recent study (Bann et al., 2016) looked at whether home-based early intervention can help the development of children in families with fewer resources. Their results showed that "A home-based EDI [Early Developmental Intervention] during the first 3 years of life can substantially decrease the developmental gap between children from families with lower versus higher resources, even among children in low- to middle-resource countries."[3] Findings from these studies suggest that early home-based interventions can substantially decrease the developmental gap between children from families with lower versus higher resources (Bann et al., 2016).

A group at the University of Chicago has also been examining the potential of using the LENA DLPs to provide feedback to caregivers regarding the amount they talk to their children. A study published in 2013 (Suskind et al., 2013) gathered a small group of caregivers and gave them a one-time educational intervention that focused on enriching a child's home language environment. They then followed up with six DLP recordings where they gave feedback to the caregivers on their progress. It was a small study, but it showed a potential positive impact on the adult language output and concluded that quantitative linguistic feedback, such as that provided by the DLP reports, would have a positive influence on a child's auditory environment.

While aforementioned studies have demonstrated success in home-based EDIs designed to enhance cognitive development, few studies have focused on the feasibility of such interventions implemented at the city-level, particularly in an urban center (Bailet, Repper, Murphy, Piasta, & Zettler-Greeley, 2013; Fuerst & Fuerst, 1993; Walker et al., 2011). Further, while some citywide early childhood interventions have attempted to improve outcomes for children such as nurse-family partnership programs and the Chicago Parent-Child centers (Olds, 2006; Reynolds, 2000), few citywide interventions have specifically focused on increased speech exposure.

Cities are uniquely poised to administer innovative interventions and programs designed to improve outcomes for the most vulnerable across city landscapes. Providence Talks intertwines a groundbreaking approach with evidence-based technology to increase speech exposure for children in low-income households and help parents close the word gap. The current study focuses on comparing the differences in adult word counts, and conversational turn counts between families who participated in Providence Talks interventions and families in the control group. It light of findings from previous research, it is our hypothesis that participation in both of the Providence Talks intervention models will improve the auditory environments for young children. Further, findings from this study will have important implications for the feasibility of city-level interventions.

3. Providence talks: program design & implementation

Providence Talks is administered by the City of Providence through contracts with seven non-profit service delivery organizations. Providence Talks, administered via two primary intervention models discussed below, is delivered by 114 trained professionals, including 24 home visitors within the seven non-profit organizations. The affiliated professionals receive a full day of initial training, quarterly refresher training sessions and one-on-one mentor coaching. PT adheres to an established operations manual and curriculum to ensure program fidelity across all agencies.[4] The curriculum is aligned to Rhode Island's Early Learning and Development Standards and focuses on integrating skill development within the context of a family's existing daily routines.

Providence Talks is a free program that works with "at-risk" families who have a child between 2–30 months of age to help them learn about the importance of speaking with their children. The criteria of whether a family was "at-risk" was defined using the Rhode Island Department of Health Evidence Based Home Visiting Assessment. Parents need to only meet one of the following criteria to be eligible for program enrollment:

1 Medicaid/RIte Care members
2 Caregiver's education less than 11th grade
3 Mother's age less than 19 or greater than 37
4 Single Caregiver
5 Mother's number of live births greater than 5
6 No previous live birth to mother

3.1. Recruitment and service delivery

Providence Talks is administered by the City of Providence through contracts with different non-profit service delivery organizations. These service delivery organizations provide the Home Visitors who meet with the individual families. The organizations are well established within the community and are experienced service providers who were already working with "at-risk" families before joining PT.

In order to recruit families into Providence Talks, the program funds

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[3] Bann et al. (2016) page 3766.

[4] See "Closing the Word Gap: The Providence Talks Playbook." http://mayorschallenge.bloomberg.org/wp-content/uploads/2017/05/The-Providence-Talks-Playbook.pdf Viewed 7/21/17.

Table 1
Comparison of Services for PT Home Visiting and Playgroup Families.

Service	LENA Recording	DLP Recording Report	Home Visit Coaching Session	Group Coaching Session	Book Donation	Cash Incentive
PT Home Visiting (N = 426)	✓	✓	✓	✗	✓	✗
PT Playgroup (N = 174)	✓	✓	✗	✓	✓	✓
Control Group (N = 105)	✓	✗	✗	✗	✗	✓

a part-time recruitment specialist at each service delivery organization. These recruitment specialists are all Spanish speaking and representative of the communities in which PT serves. The program also hosts a page on Facebook and provides a toll-free hotline for families to call to enroll.

Providence Talks is currently disseminated through three different service delivery models: a one-on-one Home Visiting model, a Playgroup model, and a Professional Development model. This evaluation only focuses on the Home Visiting and Playgroup models. Providence Talks has an established operations manual and curriculum to ensure program fidelity across all agencies. The curriculum is aligned to Rhode Island's Early Learning and Development Standards (RIELDS) and focuses on integrating skill development within the context of a family's existing daily routines.

The PT Home Visiting model is the most intensive and is administered over an 8-month period, exposing families to a rigorous intervention through 13 one-on-one home visits where the family participates in a detailed curriculum and receives feedback from each of their DLP recordings via the LENA Feedback Report. Home Visitors share the results from the DLPs during bi-weekly coaching visits so parents and caretakers are able to quickly see a picture of their home auditory environment and how it may or may not be improving. Home Visiting participants also receive 2–3 free books for the family to keep each visit. The PT Playgroup model is less rigorous and focuses on delivering services at a lower cost to more families. Families in the Playgroups get together with four or five other families at a community site to receive a similar Providence Talks curriculum from a Service Provider, but only over the course of six weeks. Families still complete recordings at home using the DLP and receive data reports from the Service Provider. Currently, due to funding availability, only families living in Providence are eligible to participate in either of these PT models. Table 1 depicts the differences in services for participating families.

3.2. Providence talks curriculum and intervention design

Providence Talks has a 205-page fully detailed curriculum in addition to an established 123-page operations manual designed to ensure program fidelity across all agencies.[5] The curriculum is aligned to Rhode Island's Early Learning and Development Standards (RIELDS) and focuses on integrating skill development within the context of a family's existing daily routines. Paired coaches tailor the program to each family's unique needs, using the word count and conversation data to measure progress.

Coaches model positive engagement with children, including the use of instructional media such as video and song. A structured, age-appropriate curriculum provides sample activities to improve both the quantity and quality of parent-child interactions and the language used. Providence Talks home visitors coach caretakers in identifying and implementing specific strategies proven to improve the quality of household auditory environments (e.g. narrate your day, follow your

child's lead, repeat and expand on your child's words).

Tenets of the PT curriculum center on four distinct principles: 1) Data co-discovery: Through use of the LENA-generated feedback report, parents and caretakers engage with data in meaningful ways, such as identifying the times of day with the highest and lowest count of adult words and conversational turns, comparing the adult words count and number of conversational turns to national norms for appropriate vocabulary development, and longitudinally over their participation in the program; 2) Strategy coaching: Providence Talks coaches guide caretakers in identifying and implementing specific strategies proven to improve the quality of household auditory environments (e.g. narrate your day, follow your child's lead, repeat and expand on your child's words); 3) Resource sharing: In addition to providing one free book during each coaching session, PT coaches also provide an inventory of family- and community-specific information and resources that support healthy vocabulary development. These may include read aloud opportunities at local bookstores, no-cost events at local children's museums, zoos or aquariums, or public viewings at local observatories; 4) Caretaker goal setting & reflection: Providence Talks coaches end each session by ensuring caregivers are identifying and reflecting on their progress toward meeting quantifiable, measurable goals for improving the quality of their household auditory environment. Specific content of each training session is detailed in the Providence Talks curriculum. See Appendix 1 for a full description of the Providence Talks Theory of Change.

4. Methods

4.1. Evaluation design – treatment-control study

In order to allow PT to continue its focus on achieving citywide scale, the evaluation team recruited a control group from the cities directly around Providence with similar demographics. Families enrolled in the control group serve not only as a quasi-control group to those enrolled in PT, but will also help establish a baseline of need to support the expansion of PT into surrounding cities. As PT is an ongoing citywide program, evaluation at this juncture of PT participant performance in comparison to participants in the control group will help illuminate the benefits, if any, of enrollment in PT.

To that end, in March 2016, the evaluation team launched the Language Development Study as a way to market the evaluation and recruit families to participate. The Language Development Study (LDS) was promoted as a study to further understand the early language development environments of young children and how these environments may contribute to children's readiness for school. The evaluation team worked with nonprofit organizations in cities around Providence and in Southeastern Connecticut to enroll families comparable to those enrolled in PT. Like PT, researchers visited the homes of interested, eligible families with a child between 2–30 months of age[6] to enroll them in the study and train them on how to use the DLPs. Unlike PT,

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[5] See http://www.providencetalks.org/resources/#curr for additional curriculum details and access to the operations manual.

[6] If the family had more than one child in that age range they were only allowed to enroll one of them in the study to avoid duplicate data sets.

Table 2

Comparison of Recording Schedule for PT Home Visiting, Playgroup Families, and Control Group Families.

Month	Providence Talks Home Visiting	Providence Talks Playgroup/Control Group
1	Recs 1-2	Recs 1-2
2	Recs 3-4	Recs 3-4
3	Recs 5-6	
4	Recs 7-8	
5	Recs 9-10	
6	Rec 11	Rec 5
7	Rec 12	
8	Rec 13	Rec 6
12	Follow-up 1	
18	Follow-up 2	

LDS participants did not know what the DLPs measured and did not receive any feedback from their recordings until all their recordings were complete. Specifically, families in the control group were aware that DLPs were recording, but they were not informed that DLPs measure the number of adult words spoken to a child or the number of back and forth conversations between child and caregiver. Families in the control group were only asked to make six recordings over an 8-month time period instead of 13, since the evaluation attempts to capture any natural change that might occur in that time period and not on giving feedback to families. Once a family completed all 6 recordings, a LENA Feedback report that showed all six recordings and an explanation of the report was mailed to the family (see Fig. 11).

LDS families were also given a $20 Walmart gift card after completing each recording as an incentive to participate since they did not receive anything else in return. Table 1 shows the differences in services for the PT participating families and the LDS families and Table 2 shows the recording schedules for each group.

4.2. Study measures

Primary evaluation data is derived from the DLPs, which participating children wear in a vest for up to 16 h on the days they record. The DLP acts as a "word pedometer" and captures the number of words spoken to the child or in the near vicinity of the child by an adult (Adult Word Count- AWC). Thus, AWC also captures "overheard speech" which includes the number of words spoken near the child. DLPs also capture the number of times the child wearing the device had a back-and-forth conversation with an adult (Conversational Turns- CT). An example of one Conversational Turn is the caretaker saying something to their child and the child saying a word or making a sound back within 5 s. If the adult and child go back and forth several times, it counts as several Conversational Turns. The DLP cannot tell which adult is speaking, so it adds this up for all adults. Age-standardized scores and percentile rankings were determined by LENA headquarters based on their Language Development Study, an assessment of normative information based on a nationally representative sample (Gilkerson & Richards, 2008). The age-standardized scores were created to facilitate interpretation of results across child ages. The percentile values are simply the cumulative distribution function values corresponding to the standardized scores. Age-standardized scores are presented here as percentiles to facilitate interpretation of results for readers who are more familiar with comparisons made based on percentile rankings.[7] These numbers, along with the raw counts of AWC and CT, were provided by LENA. The DLP also captures the amount of time the child was around noise from a TV, radio, CD, or other

electronic device (TV/ Electronic Sound). The DLP only captures the language of the child wearing the device. No other children's voices or words are taken into account. The DLP only accounts for the words of adults ages 15 and older who are talking to, or close to the child. All of these measures are presented to the parent or caretaker in a LENA Feedback report that shows both the total number of adult words, conversational turns, or media minutes from that recording, along with an hourly breakdown of all the measures (Fig. 1).

After the recording, the DLP is downloaded on to a secure computer where software analyzes the recording, focusing on the number of words the child speaks and the number of conversational turns the child participates in with an adult. The recordings are never listened to and are automatically deleted after being downloaded.

An accompanying measurement tool that was also developed by LENA is the LENA Developmental Snapshot.[8] The Developmental Snapshot is a norm-referenced, 52-item, parent-completed evaluation of language skills for infants and toddlers focusing on well-established milestones associated with expressive and receptive language skills. It has been statistically validated (Gilkerson & Richards, 2008) and has a high correlation when compared to other well-established developmental assessments. The benefit to using the Developmental Snapshot is that it is relatively short, it is easy to administer, and it can quickly show developmental progress or delays in children. For Providence Talks and the Language Development Study, it is being used to establish at what developmental age children began the program and any progress made during the program.

Finally, this study included an analysis of the Parental Ladder Assessment Instrument scores, which came from parental self-assessment of their efficacy between orientation and a subsequent (follow-up) session. The assessment is completed at Orientation and Week 6 in the Playgroup curriculum, and at Week 1, Week 6, and Month 8 in the Home Visiting curriculum. The instrument is scored by summing the individual scores on each of the scaled questions on parental efficacy. See Table 4 for a summary of all primary dependent measures.

4.3. Sample population

Currently, 2500 children have enrolled in Providence Talks[9] and have completed at least one recording, and of those, 705 participants have completed the program including 426 participants in the Home Visiting intervention, 174 participants in the Playgroup intervention group and 105 participants in the control group. According to a number of research studies, this is a considerably higher retention rate than similar home-visitation model programs. Moreover, 62% of all eligible Providence Talks participants have either graduated from the program or are still actively engaged. Between October 2015 and December 2016, 97% of parents reported being satisfied or extremely satisfied with the Program.

Efforts were made throughout the recruitment process to enroll families into the comparison group were demographically similar to the families enrolling in the Providence Talks intervention group. As indicated in Table 3, there are some differences in sample demographics among families that completed the program: primary caretaker education level is notably higher in the comparison group, with participants' parents who graduated college making up a greater percentage of the control group (33%) when compared to the PT Home Visiting intervention group (14%) and the PT Playgroup intervention group (19%). There are also more white families enrolled in the control group (39%) compared to the PT Home Visiting intervention group (15%) and the PT Playgroup intervention group (19%). Finally, 87% of families

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[7] For further insight into age-standardized scores and percentile calculations please refer to Gilkerson and Richards (2008). The LENA natural language study. *Boulder, CO: LENA Foundation.*

[8] A more detailed description of the Developmental Snapshot can be found at: https://www.lena.org/developmental-snapshot/.

[9] This figure includes families enrolled in PT Home Visiting, PT Playgroup, and the control group.
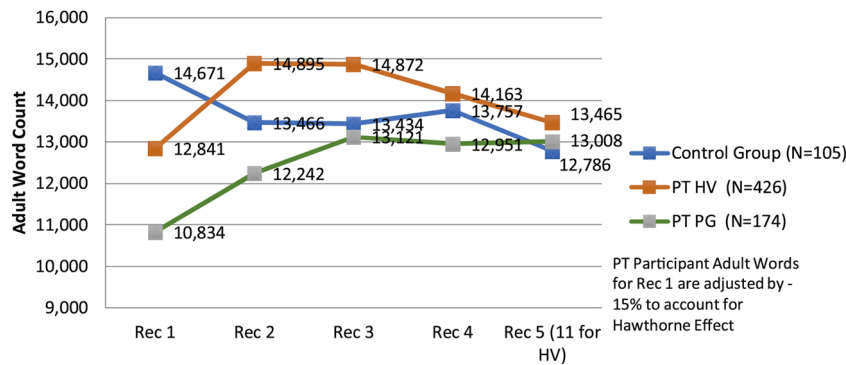
Fig. 1. Adult Word Count Average - Week 1 to Month 6 for Control Group & PT HV Participants.

Table 3
Descriptive Data of Completed Program Participants.

Descriptive Variables	Home Visiting		Playgroup		Control Group	
	N	% or M (SD)	N	% or M (SD)	N	% or M (SD)
Age of the Child	426	2.73 (1.12)	174	2.45 (0.92)	105	2.08 (0.82)
Gender						
Male	223	52	89	51	55	52
Female	203	48	85	49	50	48
Race						
Latino	266	66	108	63	36	34
Black	51	13	16	9	8	8
White	62	15	28	16	41	39
Other	26	6	21	12	20	19
Household Type						
Dual Parent	295	73	115	66	89	87
Single Parent	110	27	58	34	13	13
Primary Caregiver Education Level						
Masters +	11	3	5	3	8	8
Four Year College	56	14	33	19	35	33
Some College	76	19	25	15	19	18
Associates Degree	26	7	17	10	12	11
Trade School	13	3	7	4	4	4
HS Diploma or Less	218	54	84	49	27	26

enrolled in the control group are dual-parent families compared to 73% of families in the PT Home Visiting intervention group and 66% of families in the PT Playgroup intervention group. Given the differences in the population sample, we examined baseline Adult Word Count data in the context of certain demographics to get a sense of where families (with a minimum of only 1 recording) were starting between the intervention and comparison groups. A one-way between subjects ANOVA was conducted to compare the effect of the intervention type on baseline average word count among various demographic groups. Table 5 displays baseline data in various demographic categories with a few noticeable differences:

1 Among participants who have a high school diploma or less, participants in the Control group have a significantly higher baseline average word count average [$F(2, 326) = 4.50$, $p = 0.012$].
2 Among participants in a single-parent household, participants in the Home Visiting group have a significantly higher baseline word count average [$F(2, 178) = 6.39$, $p = 0.002$].
3 Among English-speaking households, participants in the Control group have a significantly higher baseline word count average [$F(2, 283) = 5.51$, $p = 0.004$].
4 Among Spanish-speaking households, participants in the Control group have a significantly higher baseline word count average [$F(2, 387) = 3.19$, $p = 0.042$].

Table 4
Descriptive Data of Dependent Variables for Completed Program Participants.

Dependent Variables	Home Visiting		Playgroup		Control Group	
	N	M(SD)	N	M(SD)	N	M(SD)
AWC Count	426	13.294.5 (6829.47)	174	1249.78 (5600)	105	12025.41 (5306.46)
CT Count	426	413.16 (226.58)	174	438 (254.38)	105	423.10 (218.52)
AWC Standard Score	426	101.66 (22.99)	174	99.12 (20.11)	105	97.55 (20.30)
CT Standard Score	426	96.63 (15.18)	174	97.30 (15.44)	105	97.16 (15.03)
AWC Count Final 3 Average	426	13359.06 (5443.38)	174	12796.46 (4837.86)	105	12856.61 (3939.11)
CT Standard Score Final 3 Average	426	97.14 (12.85)	174	98.35 (14.29)	105	98.24 (12.05)
AWC Change	426	517.17 (7058.67)	174	1962.16 (4129.01)	105	386.32 (5817.89)
CT Change	426	−3.86 (16.05)	174	2.79 (11.99)	105	−1.32 (14.23)
LENA Developmental Snapshot Change	333	5.40 (20.11)	129	7.13 (12.91)	101	−0.07 (14.14)
Parent Ladder Assessment Score Change	56	4.73 (4.55)	78	1.55 (2.54)	30	0.87 (3.27)

Table 5
Baseline measures for Providence Talks and Control Group participants that completed the program.

Advanced Demographic Metric	Baseline AWC Average (Home Visit Only)	Baseline AWC Average (Playgroup Only)	Baseline AWC Average (Control Group Only)
Primary Caregiver Education Level: HS Diploma/GED or Less*	12,120 (N = 218) Median = 10,908	10,140 (N = 84) Median = 9,329	15,827 (N = 27) Median = 15,580
Single Parent Household**	13,406 (N = 110) Median = 12,613	10,072 (N = 58) Median = 8,849	12,802 (N = 13) Median = 11,640
Dual Parent Household	12,679 (N = 295) Median = 11,537	11,145 (N = 115) Median = 10,237	14,954 (N = 89) Median = 14,460
English Speaking Household**	13,721 (N = 146) Median = 13,657	10,778 (N = 62) Median = 9,816	14,230 (N = 78) Median = 13,170
Spanish Speaking Household*	12,323 (N = 264) Median = 13,657	10,909 (N = 103) Median = 9,868	16,484 (N = 23) Median = 17,206

***p < 0.001.
** p < 0.01.
* p < 0.05.

Nonetheless, sample characteristics are similar to the characteristics of children under the age of 18 in the city of Providence. In 2010, 56% of children in Providence under the age of 18 identified as Hispanic or Latino, 16% identified as White, and 16% identified as Black.[10] During that same year, 46% of children in Providence lived in a single-parent household while 41% lived in a dual parent household. With regard to parent education level, of parents in Providence who had a child between 2012 and 2016, 21% had less than a high school diploma, 25% had a high school diploma, 18% had some college attainment, and 21% had a bachelor's degree or higher.

Further, based on recommendations from LENA headquarters, the AWC scores in the baseline recording were adjusted downward by 15% for PT Home Visiting and Playgroup participants due to potential Hawthorne Effect (Gilkerson & Richards, 2008; Wolfe & Michaud, 2010). This official recommendation was finalized based on LENA analysis of the normative database in the LENA Natural Language study.[11] The 15% statistic is derived from elevations observed on the first recording for a subset of participants that demonstrated Hawthorne effects. Given that families in the control group were not provided any information on what the recording device was collecting nor the focus of the study, the downward adjustment was only made for participants in the treatment group who were simultaneously receiving instruction on the importance of talking with your child.

4.4. Data analysis techniques

In order to evaluate the effectiveness of the PT intervention models in comparison to the control group, a combination of descriptive analysis and regression analysis was employed. First, the evaluation team compared outcomes from the baseline recording to the final recording for all primary measures reported. This analysis was also conducted for the "target group" population, namely participants who started with a lower baseline on primary outcomes. Next, regression analyses were conducted to provide a comprehensive assessment of study outcomes.

5. Results

5.1. Full participant sample comparison on AWC: providence talks and control group

At start of the evaluation assessment, this study compared the Providence Talks intervention groups and the control group on changes in AWC from the baseline recording to the final recording. This comparison correlated with the recording schedule as stated in Fig. 3. Recordings 1 through 4 were compared for both groups. Then, recording #11 in the PT Home Visiting group was compared with recording #5 in the control group to assess end of study results for both intervention groups. The full-sample comparison on AWC showed a curvilinear pattern for both the PT and the Control groups (see Fig. 1).

For the PT HV group, the baseline started relatively low at 12,841 Adult Word Count. The second recording sharply increased to 14,895 AWC and then steadily came down to 13,465 in the 11th recording. This was still much higher than the baseline measure. For the PT PG group, the baseline is the lowest at 10,834. The second recording increased steadily to 12, 242 and the AWC for the final recording is 13,008, substantially higher than the word count at baseline.

For the Control group, the baseline started relatively high at 14,671 AWC, followed by an increase through the fourth recording and dropped to 12,786 AWC for the 5th recording. This recording was slightly lower than the PT baseline shown in the first recording.

Further, this study converted AWC standardized scores to percentiles. Taking a closer look at the percentile ranking difference from baseline to the final recording (13th recording for PT HV group, 6th for PT PG group, and 6th for Control Group (see Fig. 2)): For the PT HV group, AWC improved from the 46th to the 53rd percentile. For the PT PG, AWC significantly improved from 30nd to 47th percentile. For the Control Group, AWC declined from 58th to 42nd percentile.

5.2. Full sample comparison on conversational turns: providence talks and control group

Similar to the above comparison on changes in average word count over the course of the program, this study further investigated changes in the number of conversational turns among study participants. A comparison of the full participant sample on Conversational Turns showed (see Fig. 3): For PT HV group, CT average count was relatively stable during recordings #2 through 4, around 422 to 415 percentile. Then it sharply dropped to 408 in the 11th recording.

For the PT PG group, CT average count began at 408 and steadily increased until the final CT count of 458. For the Control Group, CT average count also showed relative stability during first recording through recording 3, from 374 to 371. The 4th and 5th recordings stabilized around 412.
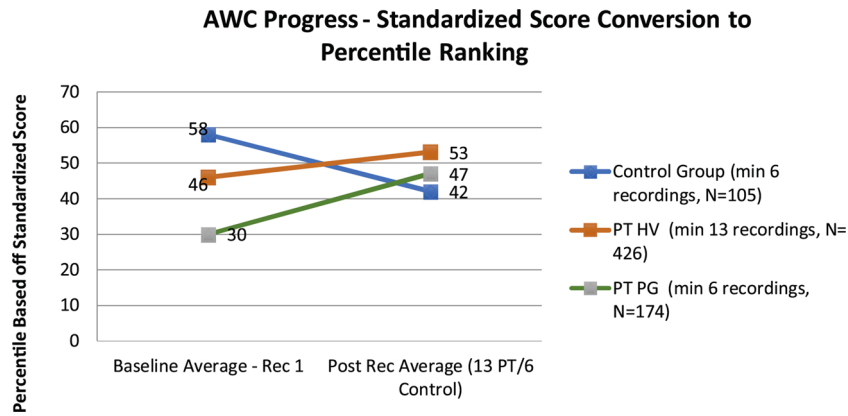
[10] All demographic data reported on children in Providence was derived from the 2018 Rhode Island Kids Count Factbook: http://www.rikidscount.org/Portals/0/Uploads/Documents/Factbook%202018/2018%20Factbook.pdf.

[11] For further insight into the adjustment analysis conducted by LENA please refer to Gilkerson and Richards (2008). The LENA natural language study. *Boulder, CO: LENA Foundation* and refer to Gilkerson, J. The Impact Assessment Strategy Guide. *Boulder, CO: LENA Foundation.*

AWC Progress - Standardized Score Conversion to Percentile Ranking

Fig. 2. AWC Progress – Standardized Score Conversion to Percentile Ranking.

CT Average Count - Week 1 to Month 6 for Control Group & PT Participants
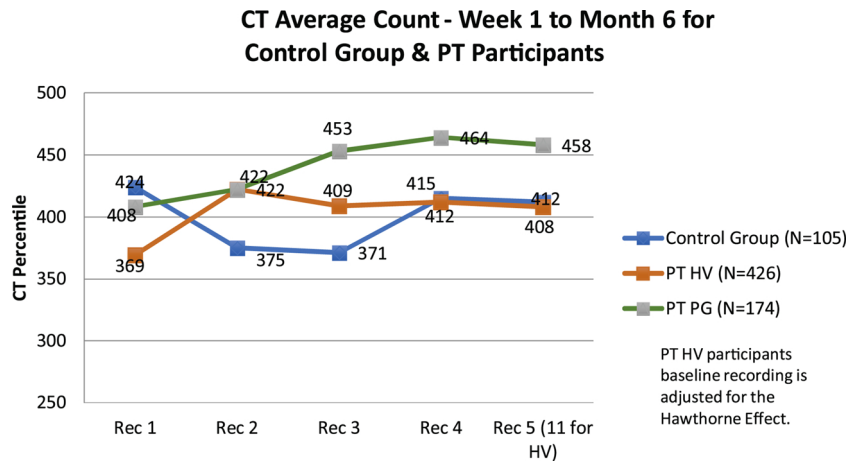

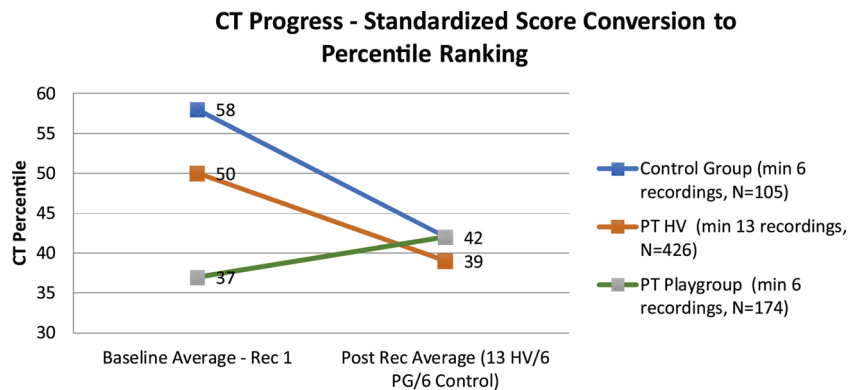Fig. 3. CT Average Count – Week 1 to Month 6 for Control Group & PT Participants.

CT Progress - Standardized Score Conversion to Percentile Ranking

Fig. 4. CT Progress – Standardized Score Conversion to Percentile Ranking.

Additionally, this study examined the difference in the standardized scores converted to percentile ranking for the conversational turns (see Fig. 4): For the PT HV group, CT declined from the 50th to the 39th percentile. For the PT PG, CT improved from 37th to 42nd percentile. For the Control Group, CT sharply declined from 58th to 42nd percentile.

5.3. Full sample comparison on LENA developmental snapshot: PT and control group

The LENA Developmental Snapshot™, a norm-referenced, 52-item, parent-completed evaluation of language skills for infants and toddlers, depicts the developmental delays or progress for child participants. The

analysis below examines the difference in snapshot scores for the full sample from baseline to follow-up for both PT and the Control Groups (see Fig. 5):

PT Home Visiting participants showed significant improvement between the baseline and the 6-month follow-up, an increase from 35th to 49th percentile on the Snapshot scores. PT Playgroup participants showed the greatest increase between the baseline and the follow-up measures, an increase from the 28th to the 46th percentile. Control Group participants showed no improvement between the baseline and the 6-month follow-up, a flat line at 50th percentile on the Snapshot scores.
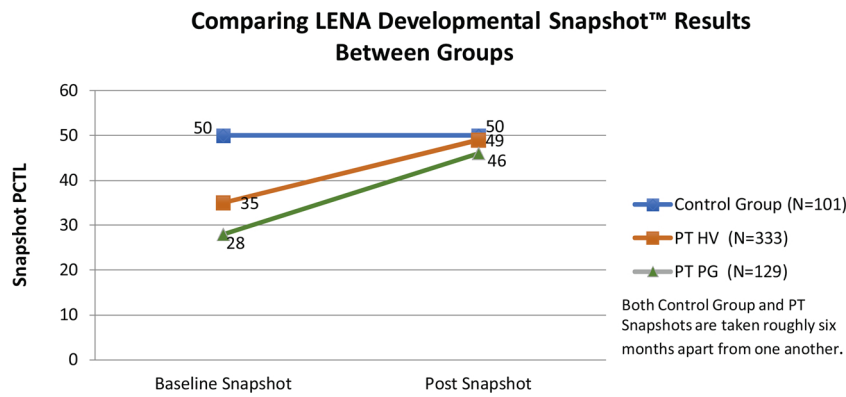
Comparing LENA Developmental Snapshot™ Results Between Groups

Fig. 5. Comparing LENA Developmental Snapshot™ Results Between Groups.

5.4. Full sample comparison on LENA parent ladder assessment: PT and control group

In addition to measuring the developmental age of the participants in Providence Talks across both intervention groups and the control group, this study also measured the perceived parental efficacy of parents involved in the study (see Fig. 6). Analysis of the parent ladder assessment including baseline and follow-up assessments revealed the following: PT HV Participants displayed the greatest gains in Parent Ladder Scores begin at an average of 40.61 at baseline. Follow-up scores at month 8 for this group average 45.14. PT PG Participants achieve a small gain in Parent Ladder Scores from baseline to the week 6 follow-up, beginning at 42.34 and ending with an average score of 43.66. Control group participants begin with an average Parent Ladder Score of 42.80 and end with an average score of 43.89 at week 6.

5.5. "Target group" comparison of primary outcomes

This study further investigated the outcomes of participants in the "Target Group," specifically those families that started below the 50th percentile of average word count at the baseline recording (See Fig. 7). Among these families in the HV model, the Target Group significantly improved the AWC from the 11th to the 42nd percentile. This improvement outpaced the Target Group in the PG mode, which gained from the 9th to the 31st percentile (see Fig. 7). The control group displayed smaller gains from the 11th percentile at baseline to the 35th percentile at the final recording.

Turning attention to the Conversational Turns, we examined outcomes of participants in the families that started below the 50th percentile of conversational turn count at the baseline recording (See Fig. 8). Among families that began below the 50th percentile in the Home Visiting model, participants experienced an increase from the 11th percentile to the 42nd percentile. Playgroup participants

experienced a smaller gain in comparison to HV families from the 11th to the 35th percentile. Families in the control group experienced smaller gains compared to the two intervention groups, beginning at the 9th percentile on average and ending at the 31st percentile on average.

We also investigated differences between the LENA Developmental Snapshot Scores from baseline to the final recording for families beginning below the 50th percentile in average word count who also completed the baseline and follow-up Snapshot assessments (See Fig. 9). Findings indicate that Home Visiting participants experienced an increase in the Snapshot Score percentile ranking from the 31st to the 43rd percentiles. Playgroup participants also experienced an increase in the Snapshot Score percentile ranking from the 19th to the 38th percentile. Participants in the control group experienced a small decrease in the Snapshot Score percentile ranking from the 47th percentile to the 45th percentile.

Finally, we examined the change in the Parent Ladder Assessment for families in the "target group" that began below the 50th percentile ranking in average word count at the baseline recording (See Fig. 10). Families in the Home Visiting model experienced the greatest gains in the Parent Ladder Score from baseline to follow-up. The average score at baseline was 39.52 and 44.93 at the 8-month follow-up. Families in the Playgroup model experienced a small increase from baseline to follow-up beginning at 41.86 with a final score of 43.47 at Week 6. Families in the Control group experienced minimal gains from 42.21 to 43.14 at Week 6.

5.6. Regression analysis of study outcomes

After completing initial descriptive analysis of outcomes of interest, we further investigated these relationships among study participants to examine the associations, if any, to other factors. Parent/family characteristics that may predict mean differences in outcomes across the various dependent variables were included in the models as control
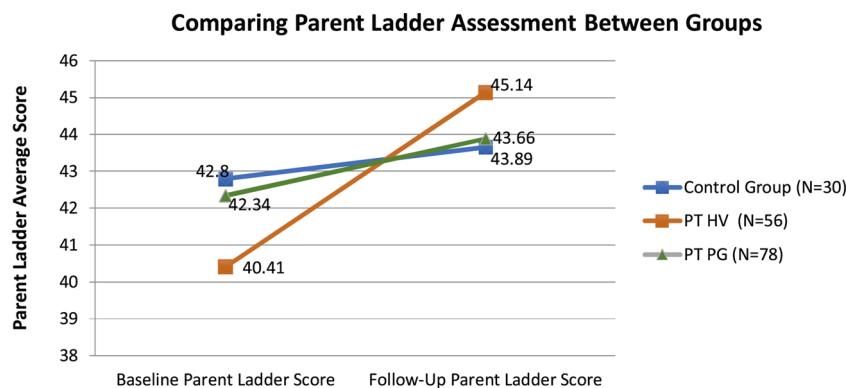
Comparing Parent Ladder Assessment Between Groups

Fig. 6. Comparing Parent Ladder Assessment Between Groups.

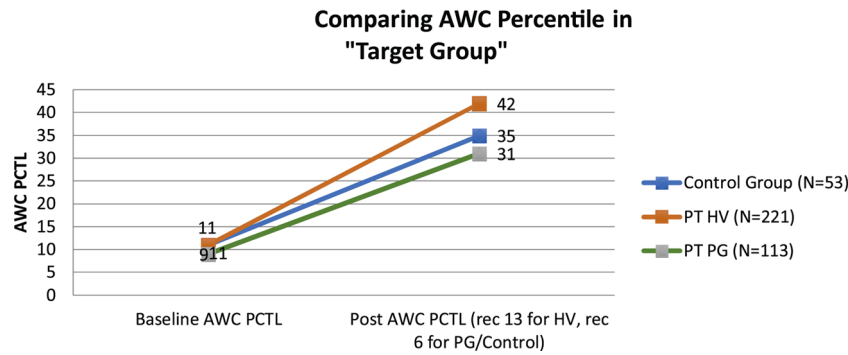**Comparing AWC Percentile in "Target Group"**

Fig. 7. Comparing AWC Percentile in "Target Group".

variables including: primary language, household type, race, and parental education. First baseline recording numbers are also included as a control variable in all models. Including the change is self-efficacy as a predictor to investigate if parental self-efficacy mediates the positive results of the intervention was also considered, however, after running test models, findings were insignificant and reduced the overall strength of the models as indicated by the r-squared results. For this reason, we have omitted this variable from the current models. The control group is omitted from the model for comparison. White students are also omitted from the model for comparison. This approach allows us to examine the data and descriptive findings in more detail while acquiring a more comprehensive insight into study effects. The following analysis reveals the results of regression analysis on primary outcomes of interest.

Regression analysis indicates that Providence Talks is associated with an improvement in children's home auditory environment. Table 6 shows the results for a regression of the Providence Talks interventions on the final average word count of child participants. Results show that the Home Visiting Intervention is significantly and positively related to the final average word count of PT participants compared to those in the control group ($ß = 1833.19$, $p < 0.05$). Unsurprisingly, the adult word count measured during the 1st baseline recording is also statistically significant ($ß = 0.26$, $p < 0.000$).

Similar results arise with the regression of the Providence Talks interventions on final average word standardized score. The Home Visiting intervention is significantly and positively related to the final average word count of PT participants compared to those in the control group ($ß = 6.15$, $p < 0.05$). Parents who completed four years of college are significantly related to higher average word standardized scores ($ß = 4.67$, $p < 0.05$) (see Table 6). Again, the average word standard score measured during the 1st baseline recording is also statistically significant ($ß = 0.29$, $p < 0.000$).

PT participants in the Playgroup intervention have significantly higher average conversational turn standard scores over the final three recordings compared to participants in the control group ($ß = 3.53$, $p < 0.05$) (see Table 7). PT participants in the Playgroup intervention are also significantly associated with a greater change in the standardized scores of conversational turns ($ß = 3.53$, $p < 0.05$) compared to participants in the control group (see Table 7).

In regard to the change in the LENA Developmental Snapshot Score from baseline to the final recording, participants in both the Home Visiting intervention ($ß = 4.73$, $p < 0.05$) have significantly higher growth in developmental age as compared to participants in the control group (see Table 8). Male participants demonstrate significantly lower growth in developmental age as compared to female participants ($ß = -0.26$, $p < 0.05$). Older children also display lower growth in developmental age ($ß = -3.57$, $p < 0.000$).

The final regression model investigates the association between the change in Parent Ladder Assessment Scores from baseline to the final recording for all participants. Findings indicate that parents of participants in the Home Visiting intervention ($ß = 2.03$, $p < 0.01$) and the Playgroup intervention ($ß = 1.44$, $p < 0.05$) indicated significantly higher levels of parental efficacy as compared to participants in the control group (see Table 8). Together, these findings provide meaningful implications for the effectiveness of the Providence Talks Intervention.

6. Conclusion

6.1. Significance of the study

The current analysis serves as a preliminary step in beginning to assess the impact of the Providence Talks model. Findings from this study suggest that both of the Providence Talks interventions demonstrate success in improving the home auditory environment of child participants. The Home Visiting model is associated with significantly higher average word count upon completion of the program as measured by the DLPs. The Playgroup model also demonstrated success in increasing standardized scores for conversational interactions between caregivers and children and this progress is consistent over the final three recordings. Further, the Home Visiting model is significantly related to greater gains in the developmental age of participants compared to participants in the control group suggesting that the program has positive benefits for child development. Parents enrolled in both the
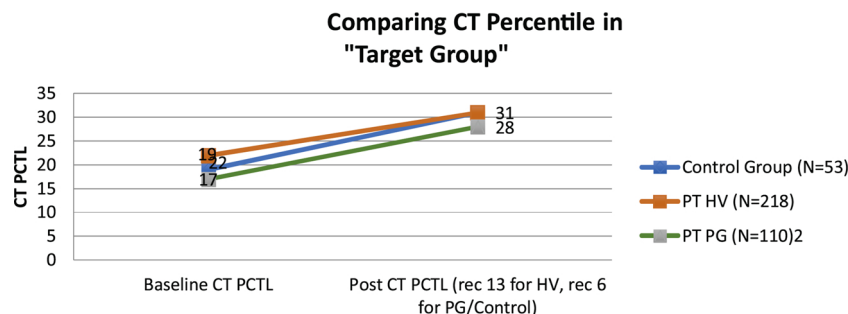
Comparing CT Percentile in "Target Group"

Fig. 8. Comparing CT Percentile in "Target Group".

**Comparing LENA Developmental Snapshot
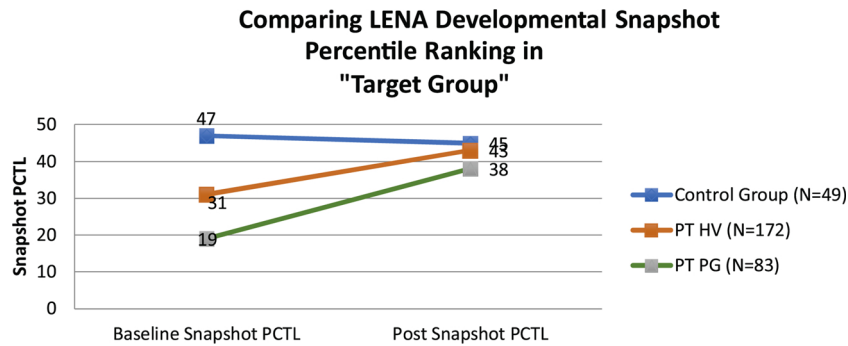Percentile Ranking in
"Target Group"**

Fig. 9. Comparing LENA Developmental Snapshot Percentile Ranking in "Target Group".

Home Visiting intervention and the Playgroup intervention also complete the program with significantly higher perceptions of parental efficacy.

Together, these findings provide positive implications for the efficacy of a city-wide intervention dedicated to improving outcomes for vulnerable children across the urban landscape. PT is unique in its scale of service and support and its success is the result of a committed and diverse team that includes mayoral support, institutional support, and non-profit organizational support. PT provides ongoing training of diverse service providers paired with a strong curriculum that helps empower parents and provide feedback so they are able to make lasting changes in their child's developmental progress. Future research will shed light on the impact of this intervention on kindergarten readiness and formal schooling outcomes.

6.2. Limitations

While there are significant implications from the findings of this study, there are limitations that should be addressed. First, there are limitations of the DLP as a measure to assess the home auditory environment. Specifically, DLPs are unable to capture nonverbal aspects of communication such as the range in vocabulary, emotional tone, and other factors related to communication quality (Wang et al., 2017). Nonetheless, together with other assessment tools such as the LENA Developmental Snapshot score and the Parent Ladder Assessment, outcomes measured by the DLP can serve as a supplementary tool to measure child progress and home auditory environment.

Secondly, the Hawthorne effect (the alteration of behavior by the subjects of a study due to their awareness of being observed) may have an impact on study findings. To mitigate this limitation, the AWC scores in the baseline recording were adjusted downward by 15% for PT Home Visiting and Playgroup participants, however, it is possible that the Hawthorne effect persisted beyond the baseline recording. Parents engaged in the study may have talked to their children more simply because they were aware of the word pedometer on their children. While this is an important limitation to consider, the findings in this study

indicate that PT has positive outcomes for not only word count and conversational turns, but also children's developmental growth and parental efficacy.

Furthermore, the demographics between families in the PT intervention and the control group do differ as discussed in the 'Sample Population' section. To help mitigate these differences, we did assess outcomes for all families that began below the 50th percentile on primary outcomes in both the PT intervention groups and the control group. While demographic differences continue to be a limitation of the current study, results indicate that families in the PT intervention groups who started at a similar baseline performed better at the final recording as compared to families in the control group. We also controlled for these demographic differences in our regression models. We were also not able to include parental income or socioeconomic status beyond parental education level due to a lack of access to this data. Although this is a limitation of the current findings, we were able to include other family/parental characteristics that may relate to study findings.

Additionally, the current study examined the results of participants who have completed the full course of the program. Specifically, the analysis examined families in the Home Visiting model that completed 13 recordings and families in the Playgroup and the control group that completed 6 recordings. Although the PT program has a high completion rate as compared to similar studies (62% of families have either graduated or are actively engaged in the program), analysis of families who have dropped out of the program will have significant implications for program design. A comparison of families who dropped out of the program and families who completed the program is forthcoming.

Finally, while the findings from the current study show positive results related to some of the dependent measures, it remains unclear if the effects of the intervention persist into formal schooling outcomes. As the Providence Talks participants begin to matriculate through formal schooling, through data agreements with the Rhode Island Department of Education, the evaluation team will be able to construct a true comparison group of students in the larger Rhode Island student population. This upcoming analysis will hopefully provide additional
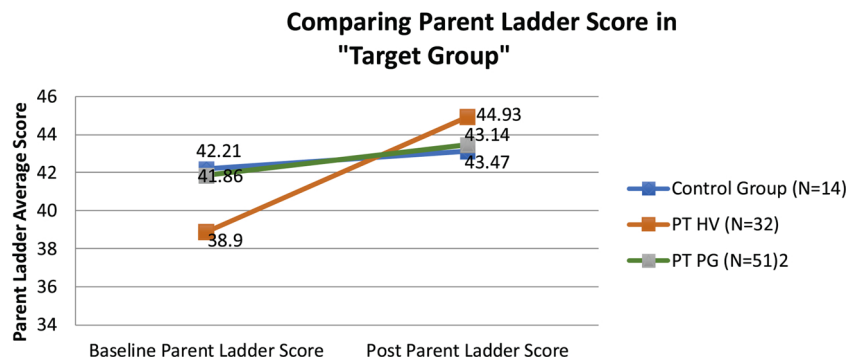
**Comparing Parent Ladder Score in
"Target Group"**

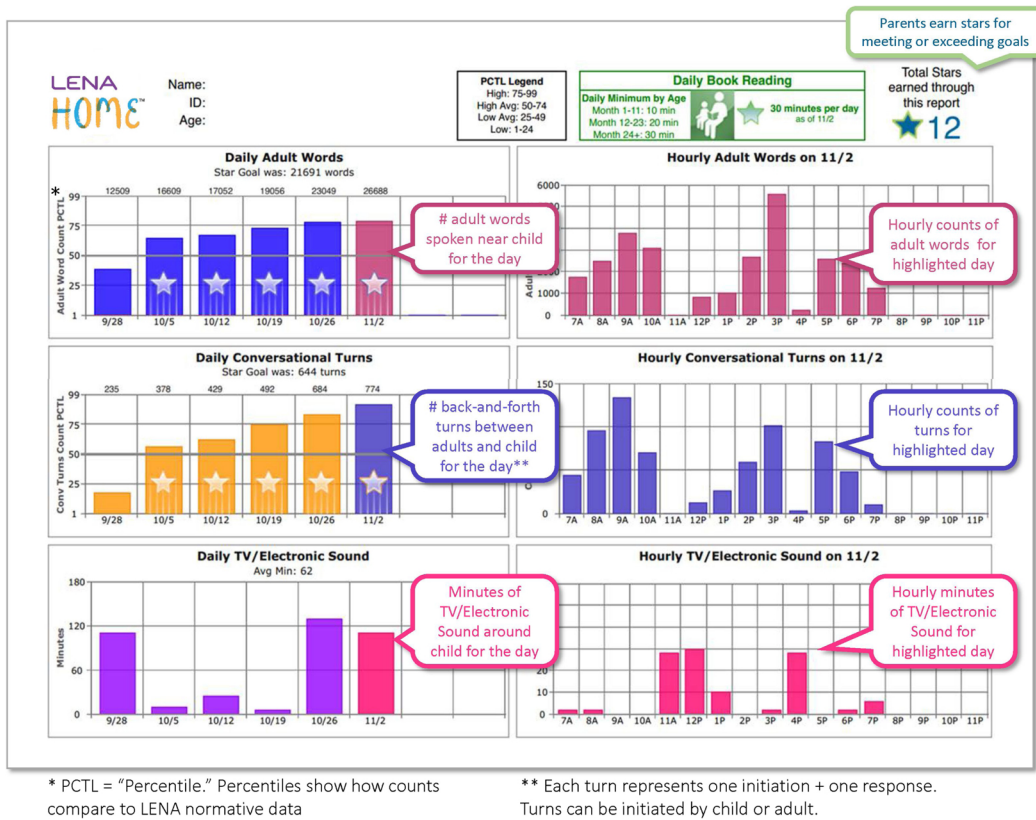**Fig. 10.** Comparing Parent Ladder Score in "Target Group".

Fig. 11. Illustrative Feedback Report from a LENA Digital Language Processor (DLP).

insight into the impact of the Providence Talks Intervention models. Nonetheless, this preliminary analysis serves to illuminate the short-term outcomes of the intervention model and provide promising indicators regarding the usefulness of a citywide intervention model. Upcoming analysis will also investigate the outcomes of participants in kindergarten to assess the program's impact, if any, on kindergarten readiness and reading ability.

6.3. Discussion

Previous research has highlighted the importance of engaging parents and caretakers to increase the quality and quantity of children's early auditory environments (Rowe, 2012; Weisleder & Fernald, 2013), specifically through the use of educational training interventions for caretakers (Suskind et al., 2013). For example, participation in a one-time educational intervention with trained professionals that centered

Table 6
Summary of Regression Analysis for Primary Outcomes.

	Final Average Word Count	Final Average Conversational Turn Count	Final Average Word SS	Final Conversational Turn SS
Home Visiting	1833.19 (753.05)*	6.62 (24.20)	6.15 (2.56)*	0.72 (1.69)
Playgroup	1327.62 (811.58))	23.89 (26.19)	5.35 (2.77)	3.52 (1.81)
Age of the Child	−192.39 (242.63))	42.40 (7.97)***	−0.52 (0.82)	1.69 (0.55)**
Male	−38.82 (471.30)	0.54 (15.19)	−0.46 (1.61)	0.42 (1.05)
Spanish-Speaking	8.16 (679.74))	−33.62 (21.91)	0.59 (2.32)	−1.81 (1.52)
Other Language	231.94 (1306.57))	−39.21 (42.07)	0.78 (4.45)	−4.37 (2.92)
Dual Parent Household	36.74 (557.68)	21.21 (18.04)	1.47 (1.90)	2.05 (1.25)
Black	−721.72 (948.12)	−22.15 (30.62)	−1.69 (3.23)	−0.75 (2.12)
Latino	−304.29 (732.15)	−6.96 (23.59)	−1.21 (2.49)	−0.45 (1.64)
Other Race	959.31 (968.28)	37.18 (31.23)	4.03 (3.29)	3.58 (2.17)
Four Year College	1356.84 (699.23)	86.22 (22.58)***	4.67 (2.38)*	5.44 (1.57)**
Some College	−139.89 (680.28)	−8.99 (21.93)	0.12 (2.32)	−0.84 (1.52)
Associates Degree	39.77 (914.46)	−3.27 (29.46)	0.59 (3.12)	.051 (2.04)
Master's Degree+	1197.24 (1354.13)	97.53 (43.55)*	4.93 (4.61)	6.78 (3.03)*
Trade School	−1747.43 (1294.02)	−5.81 (41.75)	−6.08 (4.41)	−0.70 (2.89)
1st Recording Baseline	0.26 (0.39)***	0.39 (0.04)***	0.29 (0.04)***	0.35 (0.03)***
Constant	8639.87 (1265.86)	138.95 (37.49)	66.72 (5.48)	54.52 (4.29)
Observations	673	673	673	673
R-Squared	0.09	0.28	0.12	0.21

Standard errors in parentheses.
  *** p < 0.001.
  ** p < 0.01.
  * p < 0.05.

Table 7
Summary of Regression Analysis for Primary Outcomes.

	Final 3 Recordings Average Word Count	Final 3 Recordings Average Conversational Turn SS	Final Average Word Count Change	Final Average Conversational Turn SS Change
Home Visiting	943.72 (569.57)	−0.07 (1.34)	943.72 (569.57)	−0.07 (1.34)
Playgroup	811.02 (613.84)	3.53 (1.44)*	811.02 (613.84)	3.53 (1.44)*
Age of the Child	−354.94 (183.52)	0.82 (0.43)	−354.95 (183.52)	0.82 (0.43)
Male	−126.86 (356.47)	.57 (0.83)	−126.86 (356.47)	0.57 (0.83)
Spanish-Speaking	−59.60 (514.12)	−0.87 (1.20)	−59.60 (514.12)	−0.87 (1.20)
Other Language	1667.41 (988.22)	−1.90 (2.31)**	1667.41 (988.23)	−1.90 (2.31)
Dual Parent Household	16.49 (421.80)	2.59 (0.99)	16.49 (421.80)	2.59 (0.99)**
Black	79.79 (717.12)	1.21 (1.68)	79.79 (717.12)	1.21 (1.68)
Latino	−182.57 (553.76)	−1.59 (1.29)	−182.57 (553.76)	−1.59 (1.29)
Other Race	287.92 (732.36)	2.43 (1.71)	287.91 (732.36)	2.43 (1.71)
Four Year College	1391.61 (528.87)*	4.19 (1.24)**	1391.61(528.87)**	4.19 (1.24)**
Some College	−100.80 (514.54)	−0.55 (1.20)	−100.80 (514.54)	−0.55 (1.20)
Associates Degree	−700.92 (691.66)	−1.25 (1.62)	−700.92 (691.66)	−1.25 (1.62)
Master's Degree +	2608.12 (1024.21)*	5.25 (2.39)*	2608.12(1024.21)*	5.25 (2.39)*
Trade School	−826.78 (978.74)	−1.31 (2.29)	−826.78 (978.74)	−1.31 (2.29)
1st Recording Baseline	0.28 (0.03)***	0.39 (0.03)***	−0.72 (0.03)***	−0.61 (0.03)***
Constant	9616.11 (957.43)	54.25 (3.40)	9616.10 (957.44)	54.25 (3.40)
Observations	673	673	673	673
R-Squared	0.18	0.32	0.70	0.70

Standard errors in parentheses.
*** p < 0.001.
** p < 0.01.
* p < 0.05.

Table 8
Summary of Regression Analysis for Primary Outcomes.

	LENA Snapshot Score	Parent Ladder Score Change
Home Visiting	4.73 (1.88)*	2.03 (0.60)**
Playgroup	2.58 (2.07)	1.44 (0.61)*
Age of the Child	−3.57 (0.72)***	−0.09 (0.22)
Male	−2.71 (1.24)*	−0.56 (0.35)
Spanish-Speaking	2.98 (1.81)	−1.10 (0.57)
Other Language	−1.84 (3.37)	−0.85 (0.91)
Dual Parent Household	1.33 (1.45)	1.37 (0.42)**
Black	−0.30 (2.46)	1.05 (0.79)
Latino	−0.26 (1.99)	0.78 (0.68)
Other Race	1.15 (2.47)	0.83 (0.82)
Four Year College	2.21 (1.84)	0.54 (.62)
Some College	1.02 (1.81)	0.04 (0.57)
Associates Degree	3.76 (2.42)	0.90 (0.61)
Master's Degree +	8.30 (3.47)*	−1.31 (0.89)
Trade School	1.24 (3.48)	−0.08 (0.95)
1st Recording Baseline	0.41 (0.03)***	−0.51 (.04)***
Constant	63.88 (4.75)	21.50 (1.85)
Observations	534	146
R-Squared	0.34	0.59

Standard errors in parentheses.
*** p < 0.001.
** p < 0.01.
* p < 0.05.

on enriching a child's home language environment through interpreting feedback from the LENA recordings and helping parents set language goals proved beneficial for a sample of 17 nonparental caregivers (Suskind et al., 2013). Evidence from the current study supports these findings and demonstrates the positive impact of early developmental interventions administered through two different intervention models, both of which include trainings with parents to encourage improvements in children's auditory language environments. The Home Visiting intervention consists of 13 home visits with trained professionals and the Playgroup intervention consists of 6 meetings with trained professionals suggesting that the use of one-on-one trainings for parents is beneficial for increased language exposure for children. Additionally, the use of quantitative linguistic feedback aided in the assessment of the impact of intervention similar to previous studies (Suskind et al., 2013).

Providence Talks is a citywide intervention that targets a range of families living in Providence. Given the positive findings from the current study, the Providence Talks program may serve as a model for early childhood intervention programs designed to improve the auditory language environments for young children in urban communities. Forthcoming research will also examine program dropout and attrition, as well as the impact of dual enrollment on key outcomes.

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