DISRUPTING THE EARLY LEARNING STATUS QUO: PROVIDENCE TALKS AS AN INNOVATIVE POLICY IN DIVERSE URBAN COMMUNITIES

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Introduction

Early childhood education is gaining prominence as a strategy to narrow the achievement gap. A challenge in the field of early childhood education is the existence of the learning gap for many children even before they enter kindergarten. This gap is particularly notable for children from socioeconomically disadvantaged backgrounds (Garcia 2015). In an effort to disrupt the learning status quo before formal schooling starts, the City of Providence launched "Providence Talks" in 2014.

Providence Talks (PT) is a free, early intervention program that enrolls children between 2-30 months of age from families living in Providence, RI. Depending on the age of their initial enrollment, some participating children are older than 36 months of age when they complete the program. PT helps caretakers learn about the importance of speaking with their children and supports them in their ability to improve the language environments within their home. 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 a bi-weekly coaching visit so parents and caretakers can quickly see a picture of their home auditory environment and how it may or may not be improving. Currently, due to funding availability, only families living in Providence are eligible to participate in PT.

The Brown University Evaluation Team (BUET) has partnered with Providence Talks to evaluate the impact of their program in the short-term (What are the immediate effects of the coaching and feedback?) and will soon look at the long-term effects (Do early changes in the home auditory environment continue to contribute to learning after the child enters kindergarten?). Understanding the effects of Providence Talks is important because PT is engaged in accomplishing something never before attempted at the municipal level: to intervene at a critically early age on a city-wide scale to ensure that every child enters kindergarten ready

[1] This study receives helpful research inputs from Dr. John Papay and Dr. James Morgan at Brown University. Research assistance was provided by Caroline Carper, Maureen Dizon, Juilia Dodenhoff, Lehidy Frias, Odalmy Molina, Liz Quinones, Daniela Rojas, and Huilin Zhang. The study received generous support from Bloomberg Philanthropies, Overdeck Family Foundation, Rhode Island Foundation, and Brown University. Data sharing was made available by Providence Talks and the LENA Research Foundation. Finally, Caitlin Molina and Kevin Slattery at Providence Talks and Jill Gilkerson at LENA provided ongoing professional advice.
[2] The official website of LENA technology can be found at:
https://www.lena.org/

to learn.

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. While the home visiting model worked well for some participants, the play group model showed promising results across several demographic groups. Further, based on self-assessment, parents in both the home visiting and the play group models tended to increase their self-efficacy. 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.

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 Betty Hart and Todd Risley (1995) found that children from different economic 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 than their higher income peers. It is increasingly believed that the effects of this "word gap" are evident on the very first day of kindergarten and contribute to the current nationwide achievement gap in educational outcomes for low-income children.

The framework for the Providence Talks program design, providing home visits to families to help them improve their auditory environment and giving them feedback as to their progress, is well-grounded in other, similar interventions. 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]

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

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

by the DLP reports, would have a positive influence on a child's auditory environment.

Providence Talks: Design and Implementation

The idea for Providence Talks was developed during Bloomberg Philanthropies' 2013 Mayoral Challenge. Due to its innovative idea and the potential of that idea to be replicated in other cities, the City of Providence won the grand prize and launched Providence Talks in 2014. The PT program was established through a strong partnership between the City of Providence, Bloomberg Philanthropies,[4] nonprofit organizations in Providence with close connections to community members, and Brown University.

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 which lists several criteria, including:

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

Providence Talks works by providing feedback on a family's home auditory environment and a curriculum[5] on how they can incorporate more speech and interactions with their children into their daily routines. In order to provide this feedback, PT uses a Digital Language Processor (DLP), which the child wears in a vest for one day. 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), and 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 seconds. 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. 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.

The goal of PT is for each parent and caretaker, particularly those who start with low AWC and CT counts, to increase the number of words and conversational turns they share with their children. The percentiles and goals for total number of words and conversational turns were

[4] Additional support has also been provided through the Rhode Island Foundation and the Overdeck Family Foundation.

[5] A link to a sample of the PT Curriculum can be found at: http://www.providencetalks.org/resources/#curr

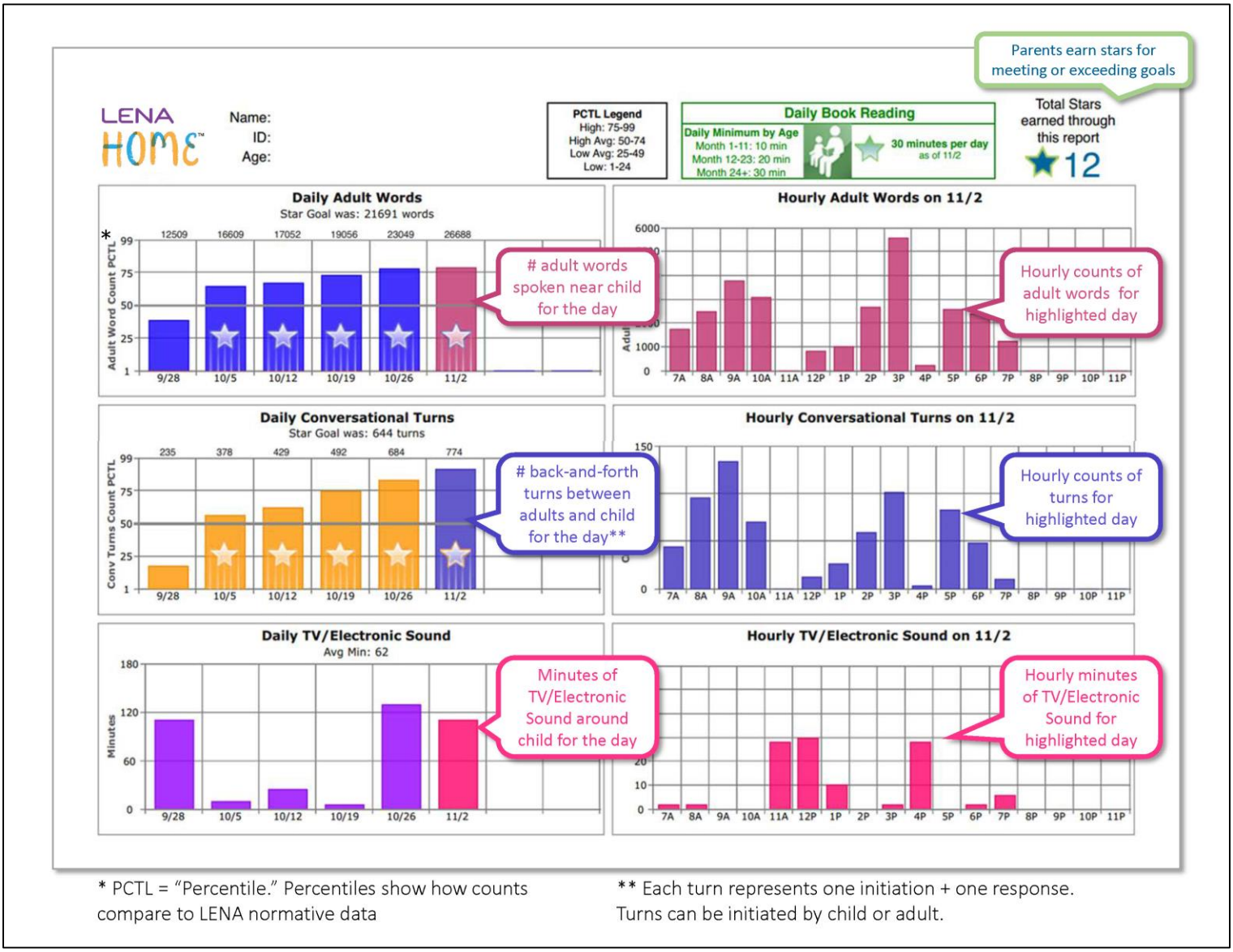
developed by the LENA Research Foundation and a normative database they have developed. The targets for each of the three indicators (AWC, CT, TV/ Electronic Sound) are set differently. The Adult Word Count (AWC) measures potential language stimulation in the environment of the child. The AWC goals are the same regardless of the age of the child with the 50th percentile being about 12,000 words/day. This is because how much an adult speaks to a child should be independent of any feedback from the child.

The Conversational Turn (CT) measure helps to capture the engagement aspect of speech. An adult speaking to a child is great, but unless the adult is also engaging the child and helping them to use their language, talking to the child is only moderately helpful in the child's development. The CT target does change as the child gets older and is therefore discussed in terms of percentiles as opposed to total turns. It is intuitive that the number of conversational turns should increase as a child gets older as you would expect a 24-month old child to have more "conversations" than a 3-months old child.

The TV/Electronic Sound measure is reported back to parents and caretakers so they can see where times of more electronic media may correlate with times of less conversation. This measure is not supposed to make a family feel guilty, as not all exposure to electronics is bad. A lot of it might come from music or educational programs and it can often serve as a necessary distraction so a parent can get ready in the morning or make dinner in the evening. However, for parents and caretakers who are struggling to engage their children, this can also reveal times where the TV could be turned off.

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. Figure 1 is an example of one of these reports. The stars on the report help show the parent or caretaker when they are making progress. A star can be earned by reaching the 75th percentile in a particular metric, or by increasing a metric by 10% between recordings.

Figure 1. Illustrative Feedback Report from a LENA Digital Language Processor (DLP)



* PCTL = "Percentile." Percentiles show how counts compare to LENA normative data

** Each turn represents one initiation + one response. Turns can be initiated by child or adult.

An important factor of Providence Talks is that no home visitor, coordinator, or PT staff member can listen to the DLP recordings. After each recording, the DLP is downloaded onto a secure computer and the actual recording automatically erased upon upload. LENA Research's own software processes the downloaded recording to measure the language environment (AWC, CT, TV/Electronic Sound) so a family's privacy is maintained.

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. Each organization dedicates at least one full-time Home Visitor to PT. In order to recruit families into Providence Talks, PT also funds 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. PT also hosts a page on Facebook and provides a toll-free hotline for families to call to enroll.

PT 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.

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.

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 not only participates in a detailed curriculum, but also receives feedback from each of their DLP recordings via the LENA Feedback Report. 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 shows the differences in services between PT Home Visiting and Playgroup families and Table 2 shows the recording schedules for both groups.

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[6]
PT Home Visiting	✓	✓	✓	✗	✓	✗
PT Playgroup	✓	✓	✗	✓	✓	✓

[6] Cash incentives (in the form of gift cards) were offered for the *follow up* recording sessions in the Home Visiting and Playgroup models, and a $50 gift card were offered to participating families who completed 5/6 recordings in the Playgroup Model

Table 2. Comparison of Recording Schedule for PT Home Visiting and Playgroup Families

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

Evaluation Design: Control Group Comparison

The Brown University Evaluation Team (BUET) has worked with Providence Talks since they submitted their Mayoral Challenge application to execute a rigorous, third-party evaluation of the impacts of Providence Talks. The most significant part of this evaluation, and the one addressed in this paper, began in March 2016 after PT was able to implement a higher level of fidelity across all their Home Service Providers and expand the program to recruit many more families. In order to allow PT to continue its focus on achieving city-wide scale, BUET decided to recruit a quasi-control group of families from the cities directly around Providence with similar demographics. These families were also asked to use the DLPs to record their home language environment, but were only asked to make six recordings over an 8-month time period instead of 13, since BUET was trying to capture any natural change that might occur in that time period and not on giving feedback to families. A few months into recruiting, the recruitment area expanded to also include a few cities in southeastern Connecticut in order to increase the number of families enrolled in the control group evaluation[7]. Tables 3 and 4 show a comparison of various indicators between the city of Providence and the other cities where BUET focused recruitment[8].

Table 3. Comparison of Common Indicators Used to Determine Whether a Child is "At-risk" for Starting School Behind His/Her Peers

City	Children living in families below the federal poverty threshold	Children in Single-Parent Families	Births to Mothers with less than a HS Diploma	WIC Participation	Children in Families Receiving Cash Assistance
Providence[9]	39%	46%	22%	63%	9%
Central Falls	41%	49%	36%	65%	8%
Pawtucket	33%	43%	16%	56%	6%

[7] See Appendix A for a full history and lessons learned from the evolution of the Evaluation Design.

[8] Rhode Island Kids Count does a really excellent job of gathering and publishing these indicators every year, but Connecticut does not have a similar nonprofit organization in place to do the same, so some of the values are missing for the two Connecticut cities.

[9] Data for the Rhode Island cities comes from Kids Count for 2015. Accessed on 10/3/17. http://www.rikidscount.org/DataPublications/CommunitySnapshots.aspx

East Providence	18%	31%	8%	47%	2%
New London, CT[10]	43%	55%	n/a	n/a	5%
Groton, CT	12%	33%	n/a	n/a	3%

Table 4. Comparison of Common School Indicators

City	Chronic early absence in grades K-3	Identified as low income in public school	ELL Students	Schools Identified For Intervention	Student Mobility Rate
Providence	21%	86%	22%	55%	24%
Central Falls	20%	81%	27%	75%	27%
Pawtucket	10%	69%	10%	6%	19%
East Providence	12%	56%	3%	18%	12%
New London, CT	16%[11]	73%[12]	24%[10]	n/a	n/a
Groton, CT	7%[10]	42%[11]	3%[10]	n/a	n/a

BUET worked to execute their recruitment and data gathering techniques as close to PT as possible in order to get the most similar control group as possible. However, BUET also did not want families in their study to associate it with Providence Talks or know exactly what data the DLPs were gathering for fear families might change their behavior. Therefore, in March 2016, BUET 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. BUET worked with nonprofit organizations in cities around Providence and in Southeastern Connecticut to enroll families comparable to those enrolled in PT. Like PT, BUET researchers visited the homes of interested, eligible families with a child between 2-30 months of age[13] to enroll them in the study and train them on how to use the DLPs. Unlike PT, LDS participants did not know what the DLPs measured and did not receive any feedback from their recordings until all their recordings were complete. Once a family completed all 6 recordings, a LENA report like that in Figure 1 above that showed all six recordings and an explanation of the report was mailed to the family.

Despite PT's widespread marketing campaign, most LDS families did not know about PT or associate this study with PT. For the ones that asked BUET researchers if this study was like PT, they were told that LDS was using the same DLPs as PT, but that it was not the same program. When parents or caretakers asked BUET researchers about what the DLPs were measuring,

[10] From Community Facts from American Fact Finder from US Census for New London and Groton town, estimates for 2015. Accessed on 10/3/17. https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

[11] EdSight Chronic Absenteeism Trend Reports by Grade for New London and Groton, School Year 2015-2016. Calculated assuming the same enrollment numbers in each grade and using a basic average for grades K-3. Accessed on 10/3/17. http://edsight.ct.gov/SASPortal/main.do

[12] EdSight Profile and Performance Reports for New London and Groton, School Year 2015-2016. Accessed on 10/3/17. http://edsight.ct.gov/SASPortal/main.do

[13] 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.

researchers said that they could not tell them specifically because it might change the results, but the DLP looked at things like when the child spoke, when an adult spoke, and similar things. 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 5 shows the differences in services for the PT participating families and the LDS families and Table 6 shows the recording schedules for each group.

Table 5. Comparison of Services for PT Families and LDS Comparison Group Families

Service	LENA Recording	DLP Recording Report	Home Visit Coaching Session	Group Coaching Session	Book Donation	Cash Incentive[14]
PT Home Visiting	✓	✓	✓	✗	✓	✗
PT Playgroup	✓	✓	✗	✓	✓	✓
LDS Control Group	✓	✗	✗	✗	✗	✓

Table 6. Comparison of Recording Schedule for PT Families and LDS Control Group Families

Month	Providence Talks Home Visiting	Providence Talks Playgroup	LDS Control Group
1	Recs 1-2	Recs 1-4	Recs 1-2
2	Recs 3-4	Recs 5-6	Recs 3-4
3	Recs 5-6	Follow-up 1	
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		

The first four recordings were made every other week for the first two months, like PT, in order to capture any baseline differences or similarities. Recordings 5 & 6 were stretched out to capture later differences or similarities and to see if possibly parents/caretakers naturally increased their talking as children got older.

In order to recruit families into the Language Development Study, BUET wanted to use a similar model to PT and worked with nonprofit organizations (NPOs) in the focus cities. BUET

[14] Cash incentives (in the form of gift cards) were offered for the *follow up* recording sessions in the Home Visiting and Play Group models.

recruited families by going to events the NPO held, sitting in the lobbies of many daycares and talking to caretakers as they picked up their children, setting up weekly appointments with the local WIC offices to sit in the lobby and talk to mothers with young children who were there, along with other efforts. For each of the NPOs BUET worked with, BUET offered them $20 for each family that was recruited through them and who completed at least one recording. BUET also worked through families who were already enrolled in LDS because often, parents of young children are friends with other parents of young children. These parents were offered a similar deal and for any friend they referred who completed at least one recording, they were given another $20 Walmart gift card. BUET also created the Brown University Language Development Study Facebook page as another avenue of recruitment and paid to advertise this page to the target demographic. This page had a link to a sign-up form where interested families could leave their name and phone number to be contacted. LDS also worked with NPOs to put up posters where families could see them and leave informational postcards that interested families could take. All recruitment materials were published in English and Spanish and all Research Assistants involved with LDS were fluent in English and Spanish. (See Appendix A for a full history and lessons learned from the evolution of the BUET Research Design).

Data Collection and Analysis

The main source of data for both PT and LDS comes from the DLPs, which participating children wear in a vest for up to 16 hours on the days they record. The DLP records all of what the child hears in a day. 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 hears from an adult (Adult Word Count- AWC), the number of conversational turns the child participates in with an adult (Conversational Turns- CT), and the amount of time the child is exposed to electronic media. 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.[15] 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 Measurement Instrument scores, which came from parental self-assessment of their efficacy between orientation and a subsequent (follow-up) session.

Providence Talks is collaborating with the LENA Research Foundation to gather and collect data for the purposes of evaluation. Providence Talks then shares data with the Brown University Evaluation Team, which is collected via LENA Research. Data fields of interest include:

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

- Participant enrollment and demographic information
- Adult Word Counts and Conversational Turn Counts
- LENA Snapshot results
- Relevant dates of program activity (recordings, enrollments, disenrollments/dropped participants, participant ages)

BUET and PT worked together to establish parameters and definitions within the data analysis in order to ensure we were performing the same analysis. When sharing data with BUET, PT sent both their raw and processed data from (November 11th, 2013 through November 16, 2017. By sending both the raw and processed data BUET was also able to check assumptions PT made during their data processing.

In order to determine the number of children BUET needed to recruit for the Language Development Study, they used a power calculation. A power calculation is a commonly used tool to determine sample size to ensure that an experiment has enough people to detect a treatment effect. If too few people are enrolled in a study, the effect of the treatment might be missed. Enrolling too many people in a study will reveal if there's a treatment effect, but it also wastes valuable time and money.

In this study, a commonly assumed power (1-β) of 80% (0.8) and significance level (α) of 5% (0.05) were used. An effect size (δ) of 0.25 was assumed in order to detect a relatively small effect from the PT program.[16]

Characteristic of Participants in Control/Comparison Group

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 Figures 2-5, this was accomplished in most aspects, although primary caretaker education level was notably higher in the comparison group, with participants who experienced some level of college education making up a greater percentage of all participants in the comparison group (46%) when compared to the intervention group (36%).

[16] Appendix B discusses issues of statistical significance regarding the sample size of the recordings.

Figure 2. Comparison Group Advanced Demographics - Primary Caretaker Education Level

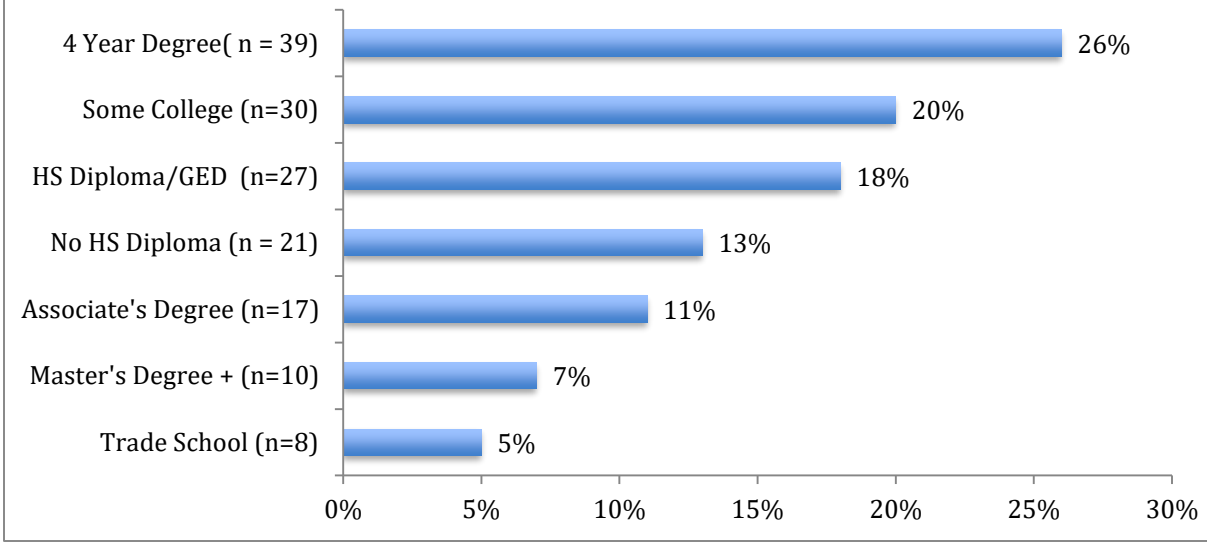


Figure 3. Comparison Group Advanced Demographics - Household Type

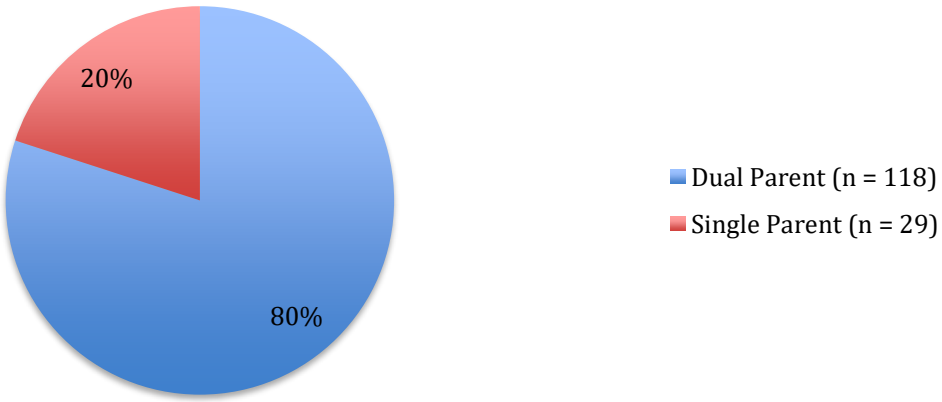


Figure 4. Comparison Group Advanced Demographics - Race/Ethnicity

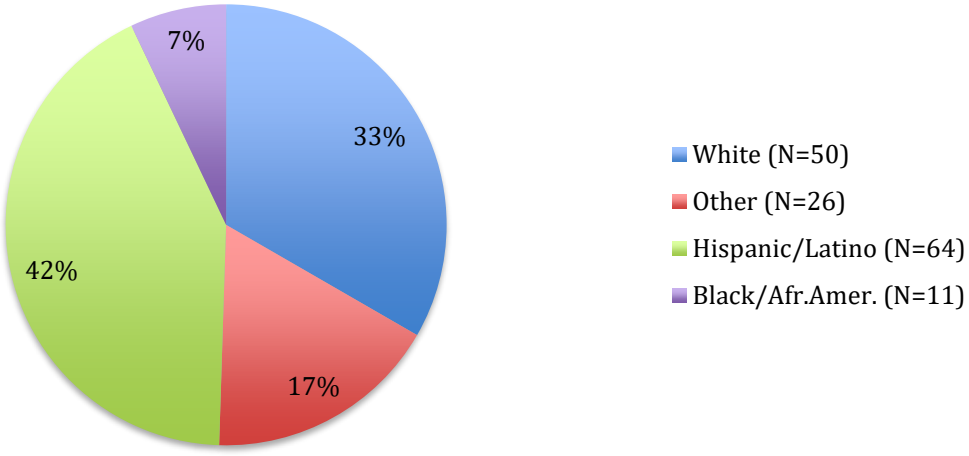
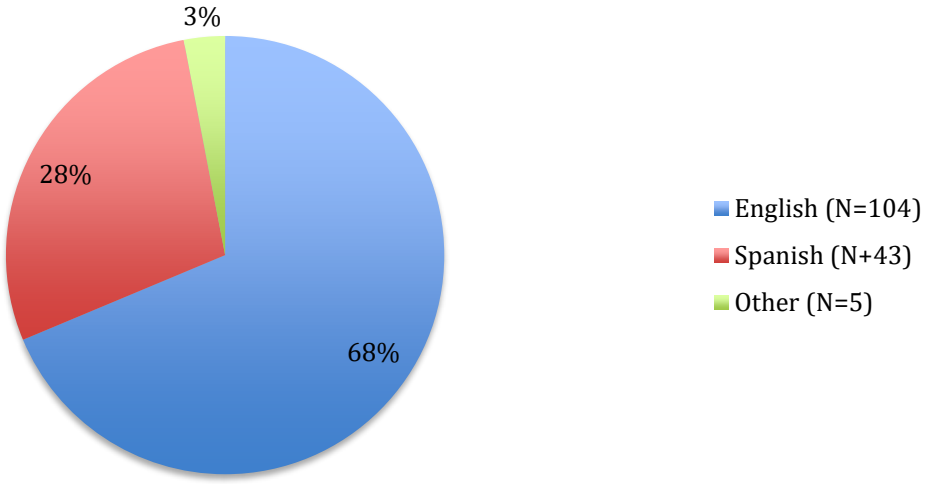


Figure 5. Comparison Grouop Advanced Demographics - Primary Language Spoken at Home



In addition, we looked at 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. In Table 7 below, we can see the general consistency on baseline data in various demographic categories with a few noticeable differences:

- For the Providence Talks Home visiting group, English-speaking households showed a higher base line, while the group with high school diploma/GED or less showed a lower baseline on AWC.
- For the Providence Talks Playgroup, there was noticeable difference on the AWC baseline among English-speaking households.
- For the Brown comparison group, English-speaking households showed a higher baseline on AWC than the single parent households.

Table 7. Baseline measures for Providence Talks and control groups

Advanced Demographic Metric	Baseline AWC Average (Home Visit Only)	Baseline AWC Average (Playgroup Only)	Baseline AWC Average (Brown Control Only)
Primary Caregiver Education Level: HS Diploma/GED or Less	11,518 (N=608) Median = 10,305	10,503 (N=234) Median = 9,364	14,409 (N=48) Median = 13,046
Single Parent Household	12,256 (N=353) Median = 11,027	10,641 (N=168) Median = 9,289	12,455 (N=29) Median = 10,350
Dual Parent Household	12,214 (N=731) Median = 10,687	10,852 (N=269) Median = 9,880	14,713 (N=118) Median = 14,188
English Speaking Household	12,671 (N=357) Median = 11,593	11,211 (N=170) Median = 10,127	14,432 (N=104) Median = 13,547
Spanish Speaking Household	12,000 (N=714) Median = 10,658	10,418 (N=247) Median = 9,392	13,803 (N=43) Median = 13,613

Full Participant Sample Comparison on AWC: Providence Talks and Control Group

Using the full participant sample of Providence Talks and the Control Group, this study compared the two groups on changes on AWC. This comparison focused on the recording schedule as stated in Table 6. Recordings 1 through 4 were compared for both groups. Then, recording #11 in the PT group was compared with recording #5 in the Control Group.

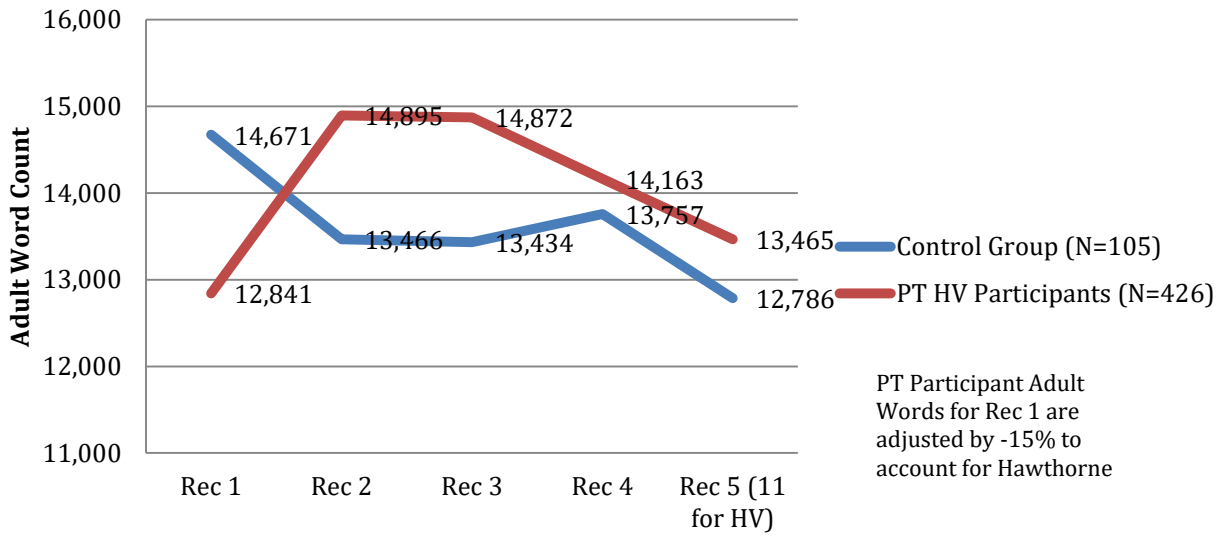
Further, the AWC scores in recording #1 in PT were adjusted downward by 15% due to potential Hawthorne Effect. According to the focus group with PT parents conducted in December 2014 by PT, parents mentioned their awareness of the pedometer throughout their first recording day. This heightened awareness was likely to cause their AWC counts to be higher than usual. Parents were anticipating home visitors, which could lead to stronger effort to perform better in the short term. **The 15% downward adjustment was consistent with other LENA research studies.**

The full-sample comparison on AWC showed a curvilinear pattern for both the PT and the Control groups (see Figure 6):

- 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.

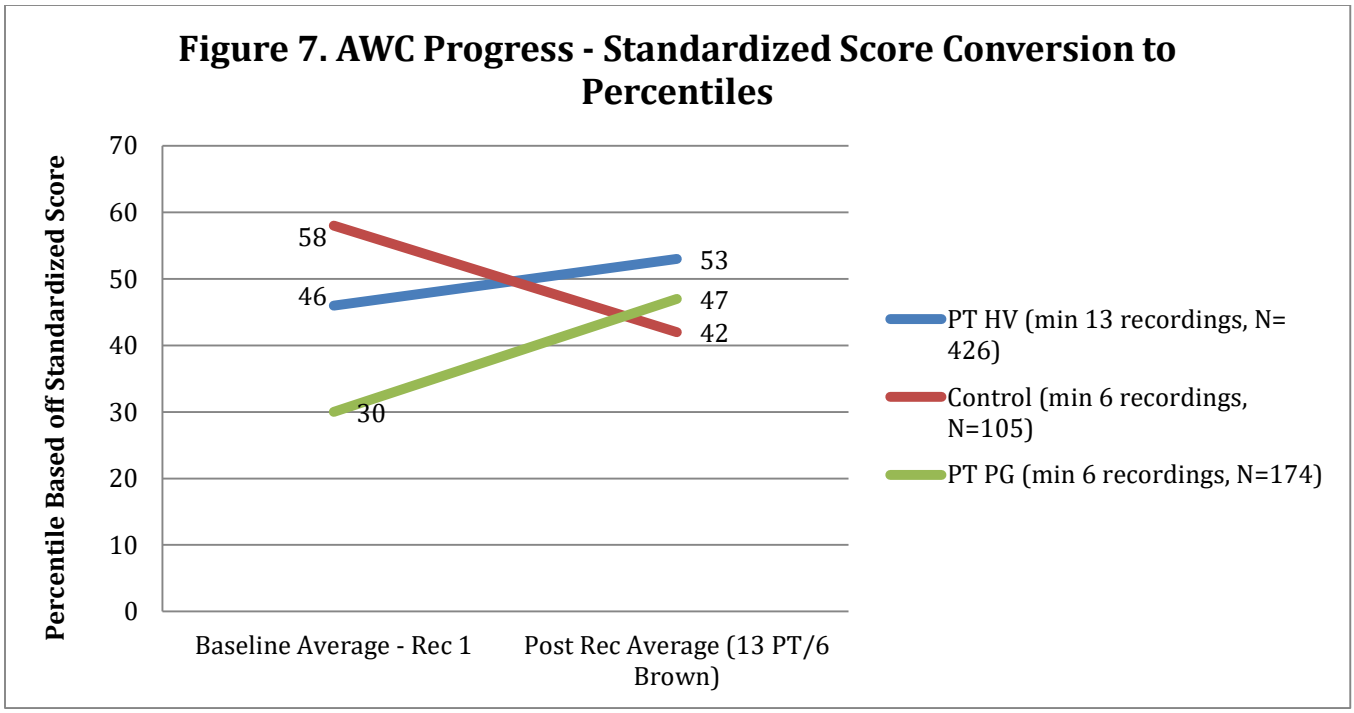
- For the Control group, the baseline started relatively high at 14,671 AWC, followed by an increase through the fourth recording and dropped to 12,786 AWC for the 5th recording. This recording was slightly lower than the PT baseline shown in the first recording.

Figure 6. Adult Word Count Average - Week 1 to Month 6 for Brown & PT HV Participants



Further, this study converted AWC standardized scores to percentiles. We also included additional recordings in the comparison with the baseline -13th recording for PT HV group, 6th for PT PG group, and 6th for Control Group (see Figure 7):

- 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.



Looking at AWC Trends For Duration, Intervention Frequency (for participants with follow up recordings completed)

The three charts below (Figures 8, 9, & 10) show changes in Adult Word Count over time for the two primary intervention models, as well as Brown's quasi-control group. The charts take the amount of time between interventions (or recordings, for Brown) into account, showing the sometimes large gaps between intervention coaching sessions in the Home Visiting model, and how the early increases in AWC stop occurring by the monthly recording stage and follow up recording stages.

We can also see in both Home Visiting and Playgroup that there are no significant decreases in AWC between the final regular recording and the follow up recordings, suggesting two things: That the families who are making outcome gains in AWC are maintaining them, and that the stagnation in outcome gains for some families may be occurring earlier in the program.

Figure 8. AWC Average Over 14 Months - Home Visiting (minimum 15 recordings, N=73)

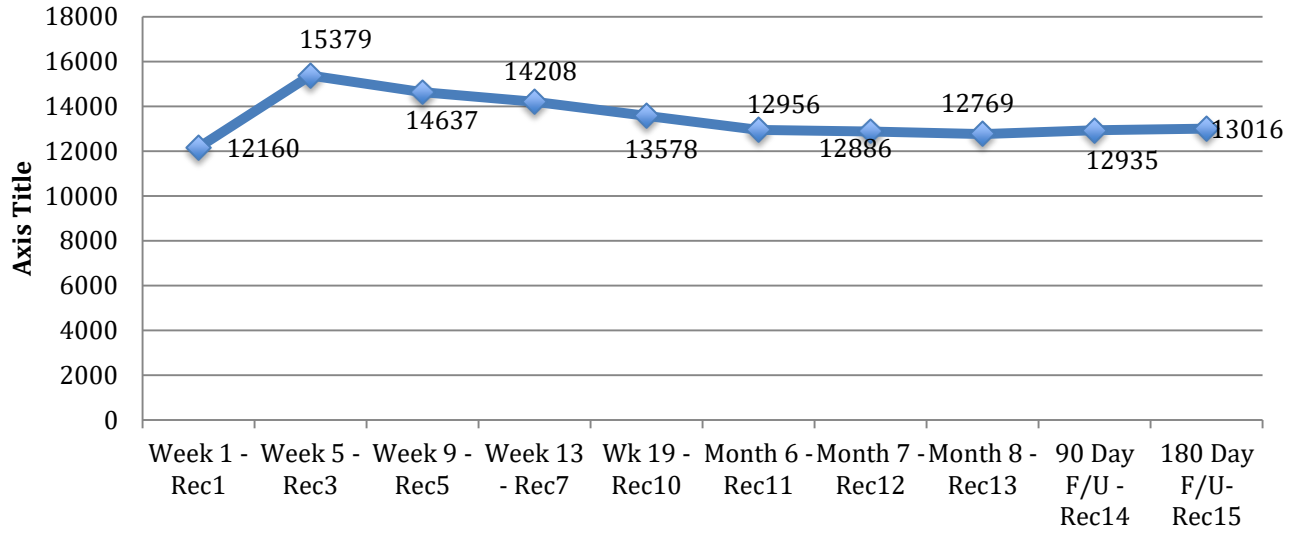
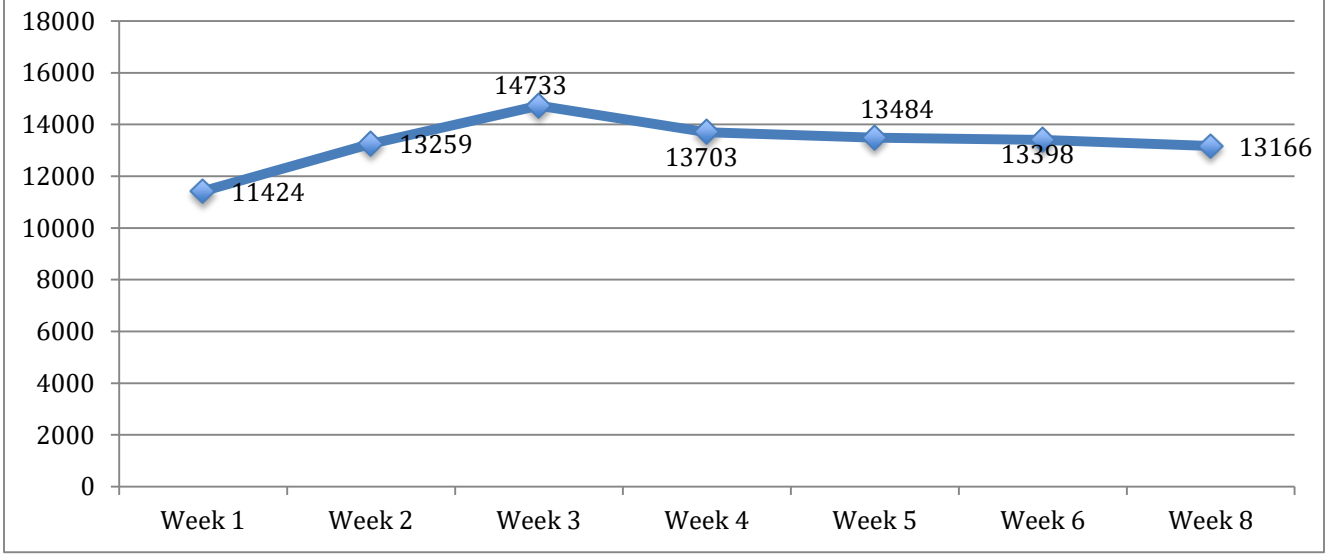
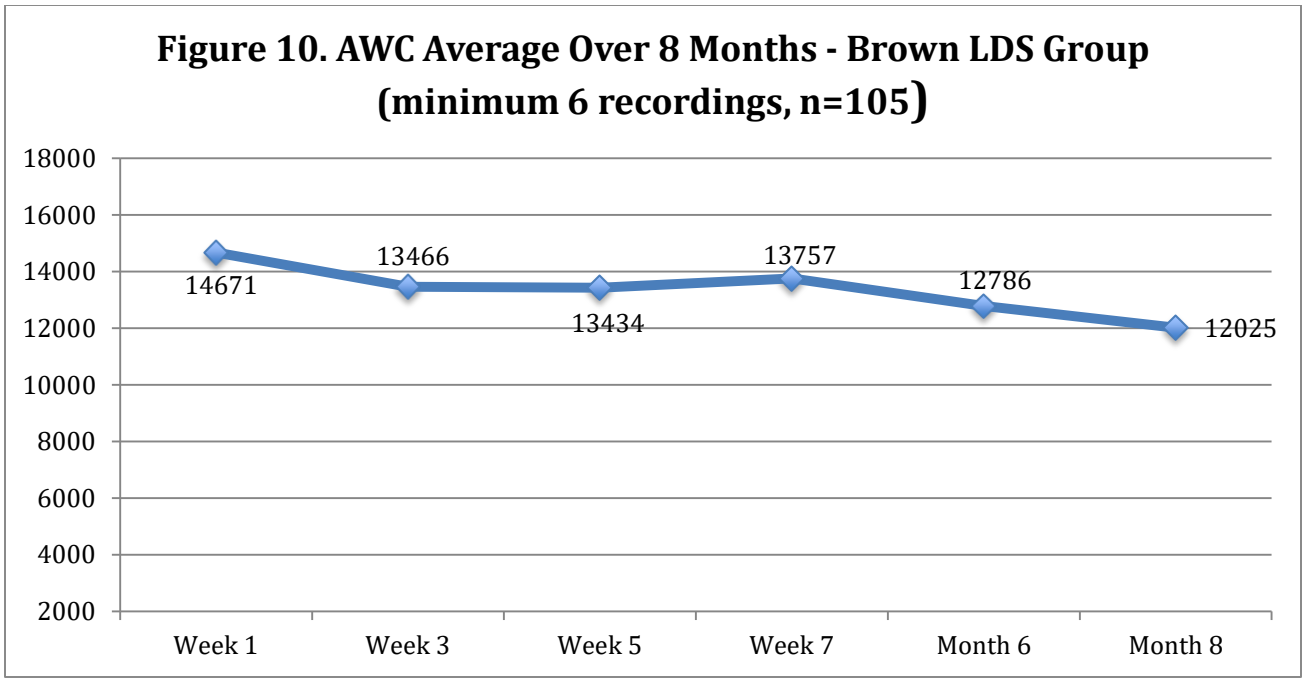


Figure 9. AWC Average Over 2 Months - PT Playgroup Model (minimum 7 recordings, n=67)



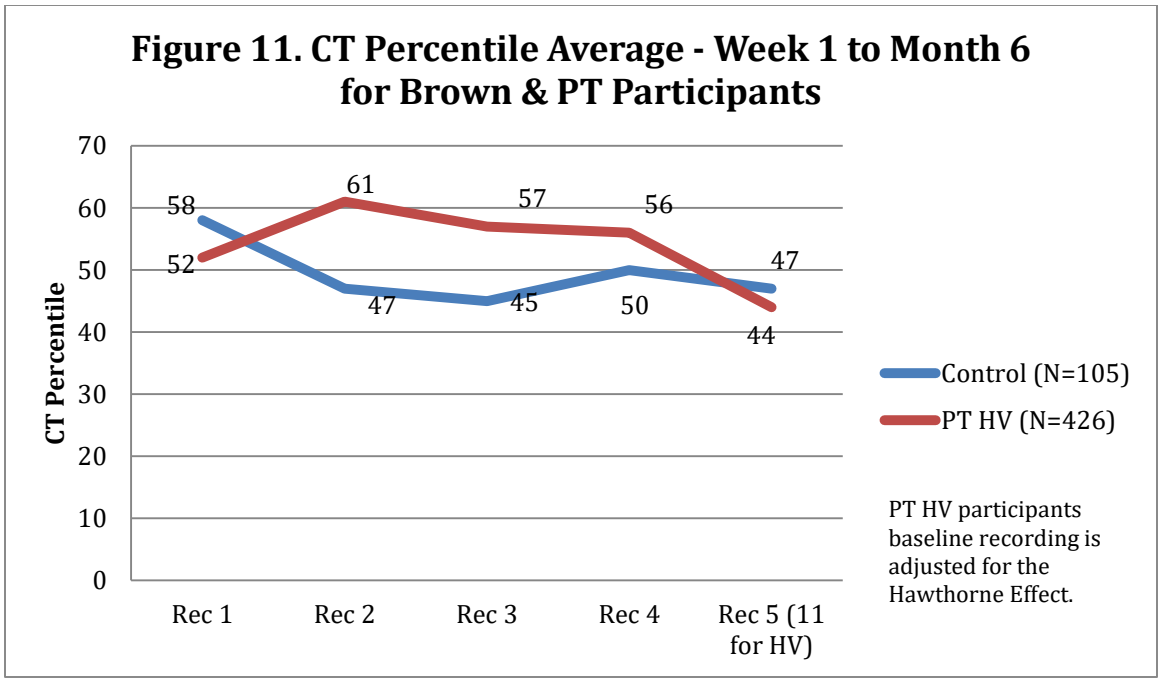


Full Sample Comparison on Conversational Turns: Providence Talks and Control Group

A comparison of the full participant sample on Conversational Turns showed (see Figure 11):

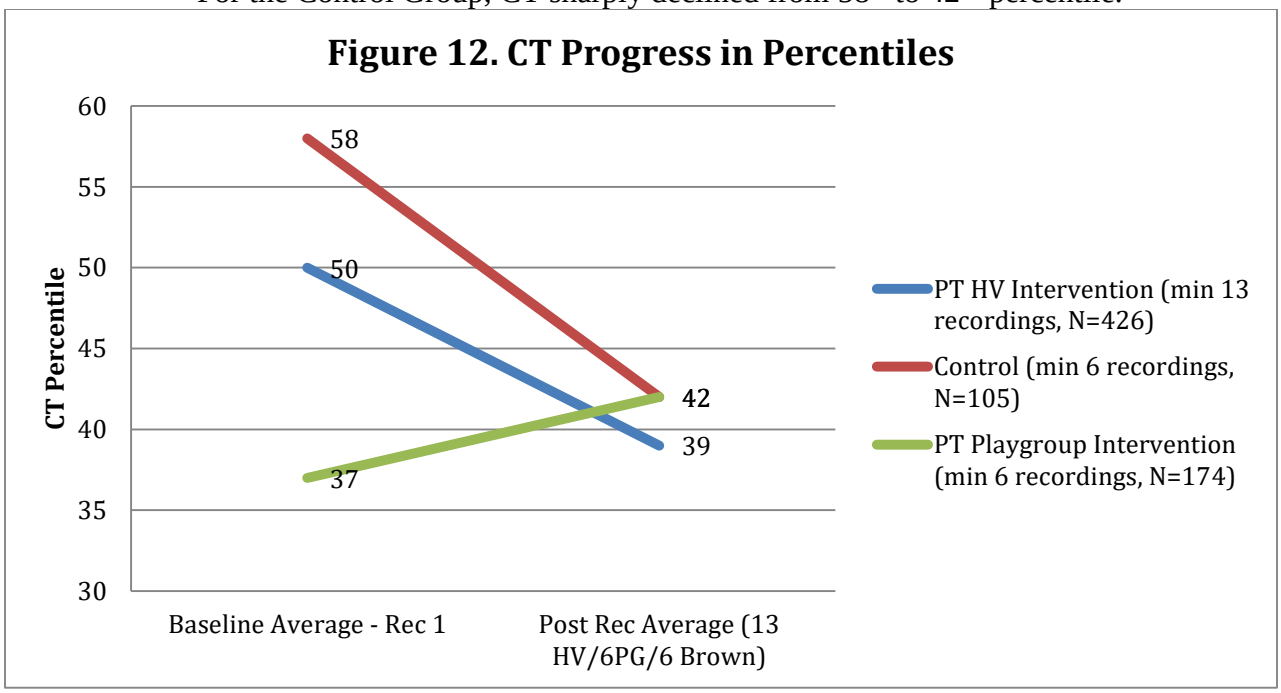
- For PT HV group, CT percentile average was relatively stable during recordings #2 through 4, around 61st to 56th percentile. Then it sharply dropped to 44th percentile in the 11th recording.

- For the Control Group, CT percentile average also showed relative stability during recordings #2 through 4, around 61st and 56th percentile. The 5th recording dropped to 44th, which was higher than the 47th percentile for the PT HV group in its 11th recording.



Further, this study included additional CT recordings in the comparison with the baseline -13th recording for PT HV group, 6th for PT PG group, and 6th for Control Group (see Figure 12):

- 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.



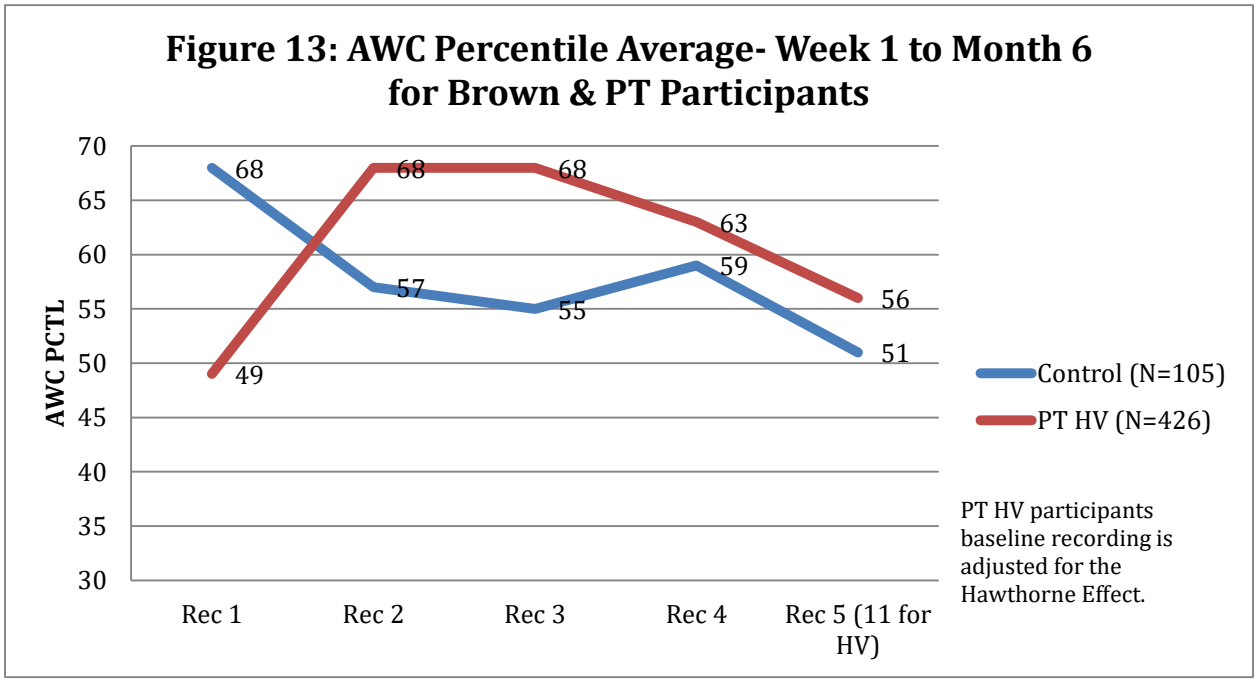
Greater gains achieved by participants in the PG model

Data from the Providence Talks Playgroup model has produced results that significantly differed from the Home Visiting model:

- 73% of all PT Playgroup participants were increasing their Adult Word Count (n=116/160), while 56% increased Conversational Turn percentile (n=90/160).
- These gains were in contrast to the Home Visiting model, where, when looking at all families who completed 13 recordings in the HV model, only 56% of all families increased their Adult Word Count (n=228/404) and only 42% increased their Conversational Turn percentile (n=172/404).

The reason for the greater gains in the PG model could be related to the duration of the program intervention. As seen earlier in Figure 11, after sharp initial gains in the bi-weekly stage of the program, a drop in average CT percentile occurred once the program transitioned into the monthly recording stage, leading up to Recording 11 in the home visiting model. It was possible that the strong initial effects that caused parents to respond early in the program with increased number of words spoken at home "wore off" as parents received less frequent interventions. Figure 7 also showed similar pattern on AWC percentile over time.

For the Playgroup model, it is worth researching further how the nature of a group setting, and a streamlined intervention timeline (six weeks, instead of nine months) may have contributed to the higher frequency of families increasing their AWC/CT outcomes.



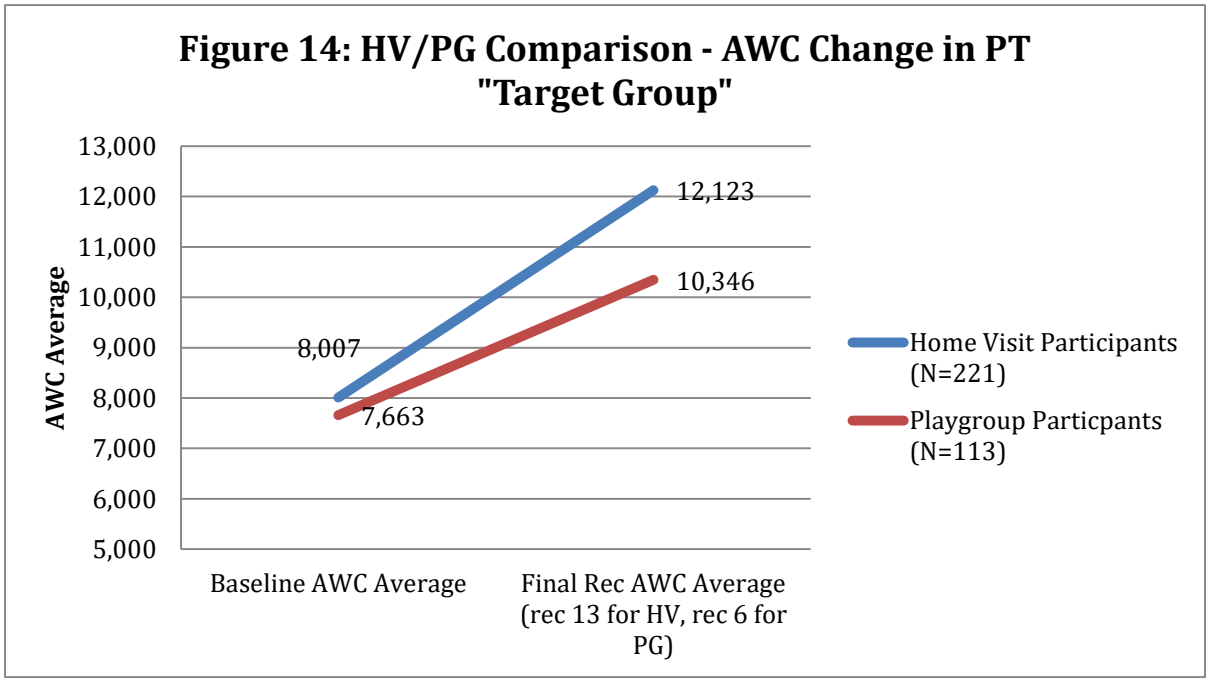
Great Gains Achieved by Target Group in HV and PG Models

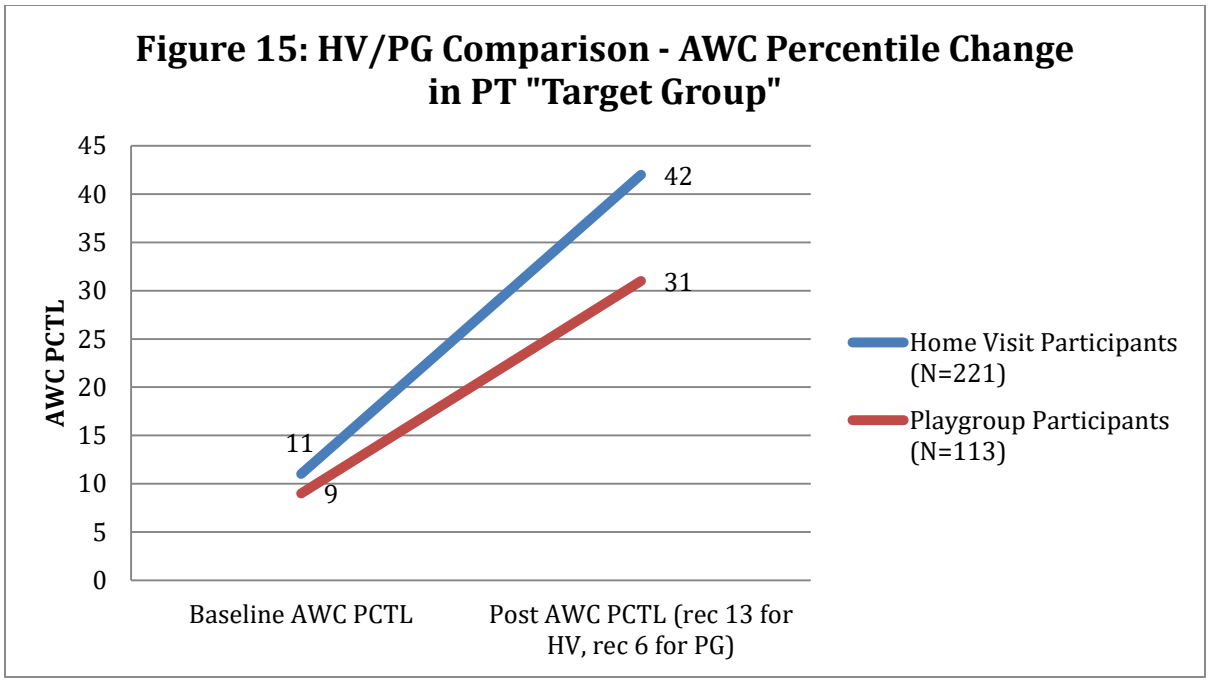
Equally important, the more personal, one-on-one approach that is associated with the Home

Visiting model seemed to have contributed to larger overall outcome increases for the PT Target Group (families starting below the 50th percentile at the baseline recording):

- In the HV model, the Target Group significantly gained the AWC from 8,007 to 12,123. This improvement was comparable to the Target Group in the PG model, which gained from 7,663 to 10,346 (see Figure 14).

- 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 Figure 15).

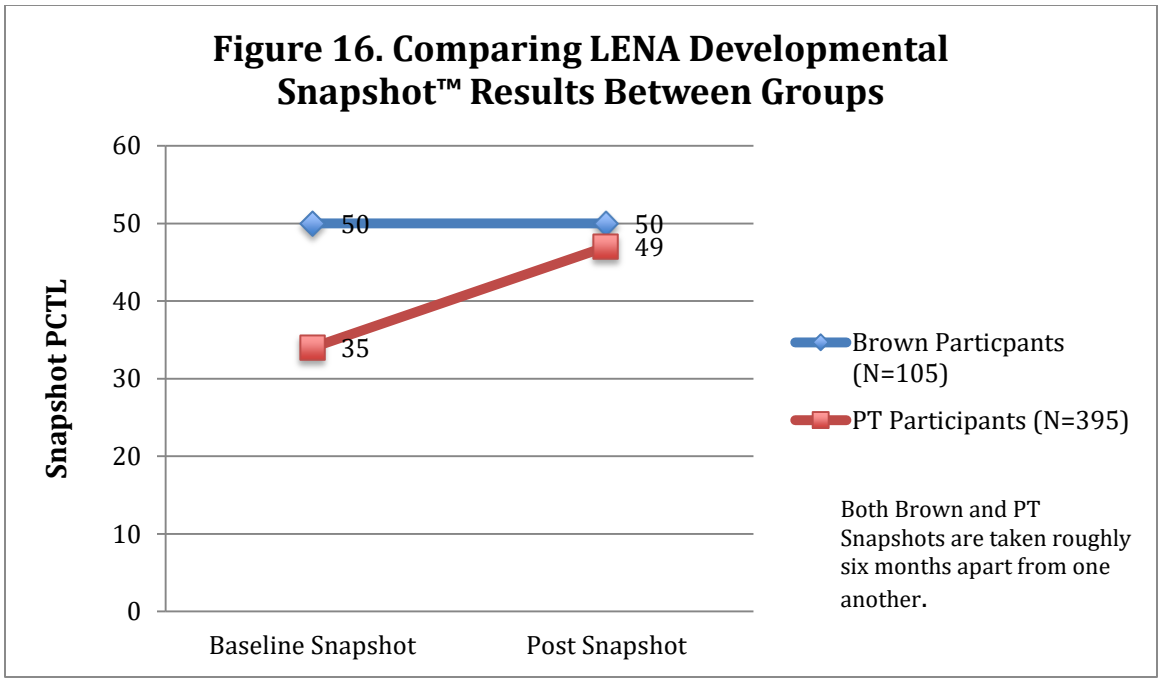




Full Sample comparison on LENA Developmental Snapshot: PT and Control Group

This study compared the LENA Developmental Snapshot™ for both PT and the Control Groups (see Figure 16):

- PT participants showed significant improvement between the baseline and the 6-month follow-up, an increase from 35th to 49th percentile on the Snapshot scores.
- 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.



Do AWC or CT Increases Influence Snapshot Growth?

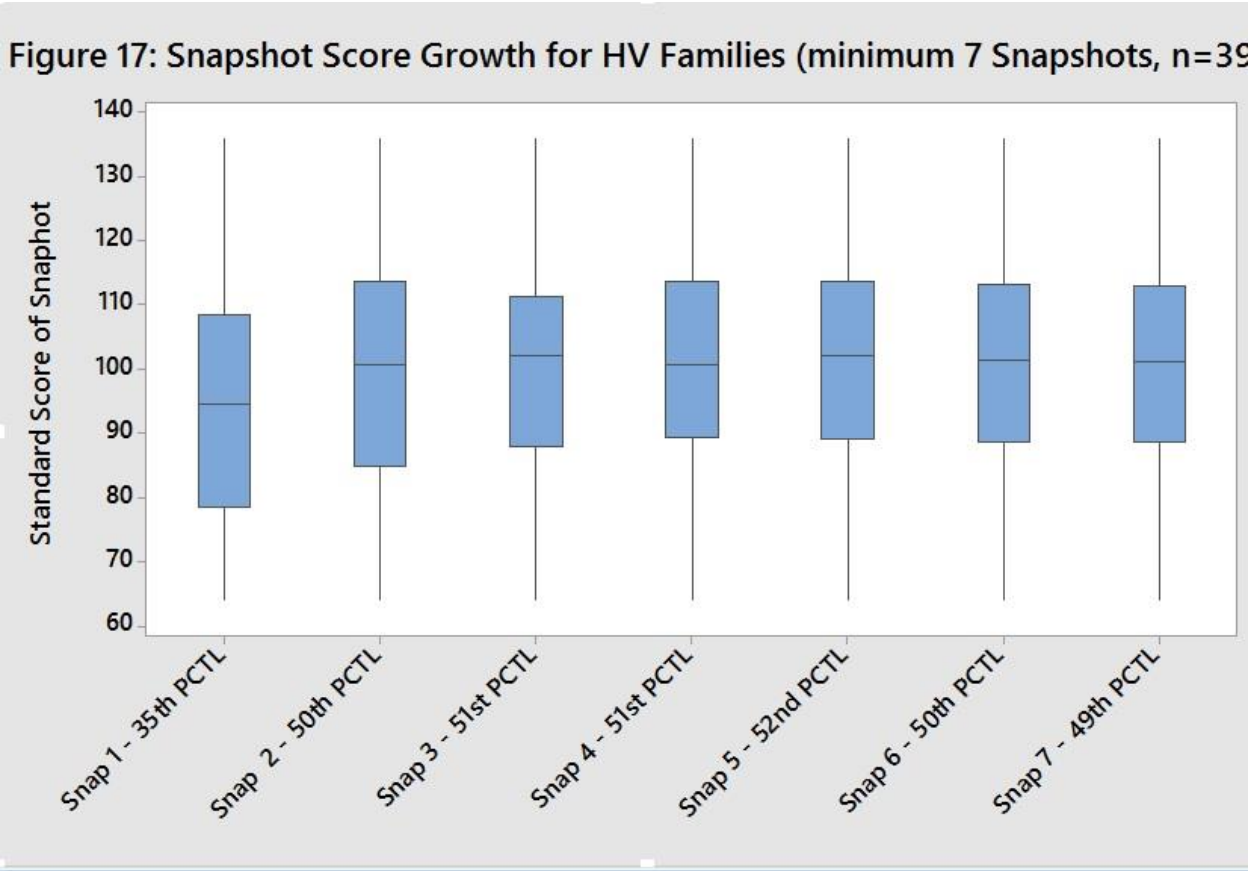
To answer this question, we looked at a subgroup of participants who increased either AWC or CT Percentile between their baseline and final recording average, then looked at their change in Snapshot score. For consistency, we looked at home visiting families who achieved at least 13 recordings to complete the program, and who achieved at least 7 Snapshots. This means, for this analysis, the Snapshot average is occurring roughly 6 months after the family enrolled, while the AWC/CT final average is occurring roughly 8 months after.

For families who increased AWC and had at least 7 Snapshots (n=135), they increased their average Snapshot percentile from the 36th percentile to the 51st percentile.
For families who increased CT and had at least 7 Snapshots (n=79), they increased their average Snapshot percentile from the 27th percentile to the 49th percentile.
Increases in Snapshot percentile, however, are not limited to families who improved their home auditory environment. When looking at families who completed PT but had a *negative* AWC change and at least 7 Snapshots (n=116), their average Snapshot percentile scores increased from a baseline average of the 38th percentile to a 7th Snapshot average at the 58th percentile. This indicates the possibility that, for families receiving a PT intervention, improvements in a child's development as measured by the Snapshot are independent of whether or not they increase their AWC or CT outcomes. In other words, having enrolled in PT may positively affect Snapshot growth.

The largest Snapshot gains occur between Snapshots 1 and 5

In the Home Visiting model, similar to AWC/CT, the largest growth in outcome metrics occurred earlier in the program – by Snapshot #3, when four individual coaching sessions

had already occurred for the parent(s) and child. The scores tended to plateau by the time the program enters the monthly recording stage. The biggest jump occurs in the first few weeks of the program, with families going from a baseline standard score average of 93.98 (34th PCTL) to 99.60 (47th PCTL), a 38% increase in percentile points. Figure 17 uses a slightly smaller sample size among HV Snapshot completers than Figure 16, examining the scores from Snapshot 1 to Snapshot 7 in the HV model.



TV/Electronic Minutes and AWC/CT Changes

Based on a comparison of the means (paired t-test) for TV/Electronic Minute Averages For Home Visiting, Playgroup, and the Control Group Families, we found interesting patterns on AWC/CT Changes. However, all except three of the associational patterns were not statistically significant as shown in Table 8:

- HV families who had a negative AWC change showed an increase in TV/Electronic Minute Average, and the association is statistically significant.

- HV families who had a positive AWC change showed a slight decrease in TV/Electronic Minute Average, though the association was not statistically significant.
- HV families who had a positive CT percentile change showed a decrease in TV/Electronic Minute Average, though the association was not statistically significant.
- HV families who had a negative CT percentile change showed an increase in TV/Electronic Minute Average, which was found to be statistically significant.

- Playgroup families who had a negative AWC change showed an increase in TV/Electronic Minute Average, though the association was not statistically significant.
- Playgroup families who had a positive AWC change showed a slight decrease in TV/Electronic Minute Average, though the association was not statistically significant.
- Playgroup families who had a positive CT percentile change showed a decrease in TV/Electronic Minute Average, though the association was not statistically significant.
- Playgroup families who had a negative CT percentile change showed an increase in TV/Electronic Minute Average, though the association was not statistically significant.

- Control group families who had a negative AWC change showed an increase in TV/Electronic Minute Average, though the association was not statistically significant.
- Control group families who had a positive AWC change showed an increase in TV/Electronic Minute Average, which was found to be statistically significant.
- Control group families who had a positive CT percentile change showed an increase in TV/Electronic Minute Average, and the association was statistically significant.
- Control group families who had a negative CT percentile change showed an increase in TV/Electronic Minute Average, though the association was not statistically significant.

Table 8. TV/Electronic Minutes and AWC/CT Changes (as defined by the LENA Digital Language Processor Device) for Different Groups

Home Visiting – Families Who Had A Negative AWC Change as of Recording 13

Data	TV/Elec Minute Baseline	Recording 13 TV/Elec Minute Average
N (sample size)	187	187
Mean TV/Elec Minutes	101.25	115.17
Std. Deviation	82.56	84.85
Std. Error of Mean	6.03	6.20

Two-tailed P-Value	0.056
Statistical Significance	Considered to be statistically significant

Home Visiting – Families Who Had A Positive AWC Change as of Recording 13

Data	TV/Elec Minute Baseline	Recording 13 TV/Elec Minute Average
N (sample size)	239	239
Mean TV/Elec Minutes	107.99	107.14
Std. Deviation	87.66	97.36
Std. Error of Mean	5.67	6.29
Two-tailed P-Value	0.912	
Statistical Significance	Not considered to be statistically significant	

Home Visiting – Families Who Had A Positive CT Percentile Change as of Recording 13

Data	TV/Elec Minute Baseline	Recording 13 TV/Elec Minute Average
N (sample size)	179	179
Mean TV/Elec Minutes	104.53	97.64
Std. Deviation	85.74	83.09
Std. Error of Mean	6.40	6.21
Two-tailed P-Value	0.368	
Statistical Significance	Not considered to be statistically significant	

Home Visiting – Families Who Had A Negative CT Percentile Change as of Recording 13

Data	TV/Elec Minute Baseline	Recording 13 TV/Elec Minute Average
N (sample size)	247	247
Mean TV/Elec Minutes	105.4	120.10
Std. Deviation	85.37	97.13
Std. Error of Mean	5.43	6.18
Two-tailed P-Value	0.049	
Statistical Significance	Considered to be statistically significant	

Playgroup – Families Who Had A Negative AWC Change as of Recording 6

Data	TV/Elec Minute Baseline	Recording 6 TV/Elec Minute Average
N (sample size)	47	47
Mean TV/Elec Minutes	87.94	109.26
Std. Deviation	79.81	85.61
Std. Error of Mean	11.64	12.48
Two-tailed P-Value	0.179	
Statistical Significance	Not considered to be statistically significant	

Playgroup – Families Who Had A Positive AWC Change as of Recording 6

Data	TV/Elec Minute Baseline	Recording 6 TV/Elec Minute Average
N (sample size)	127	127
Mean TV/Elec Minutes	104.81	93.65
Std. Deviation	83.61	65.75
Std. Error of Mean	7.41	5.83
Two-tailed P-Value	0.142	
Statistical Significance	Not considered to be statistically significant	

Playgroup – Families Who Had A Positive CT Percentile Change as of Recording 6

Data	TV/Elec Minute Baseline	Recording 6 TV/Elec Minute Average
N (sample size)	174	174
Mean TV/Elec Minutes	100.25	97.87
Std. Deviation	82.71	71.74
Std. Error of Mean	6.27	5.43
Two-tailed P-Value	0.733	
Statistical Significance	Not considered to be statistically significant	

Playgroup – Families Who Had A Negative CT Percentile Change as of Recording 6

Data	TV/Elec Minute Baseline	Recording 6 TV/Elec Minute Average
N (sample size)	69	69
Mean TV/Elec Minutes	85.10	103.61
Std. Deviation	65.22	76.70
Std. Error of Mean	7.85	9.23
Two-tailed P-Value	0.120	
Statistical Significance	Not considered to be statistically significant	

Brown LDS – Families Who Had A Negative AWC Change as of Recording 6

Data	TV/Elec Minute Baseline	Recording 6 TV/Elec Minute Average
N (sample size)	42	42
Mean TV/Elec Minutes	95.00	108.00
Std. Deviation	75.91	75.30
Std. Error of Mean	11.71	11.61
Two-tailed P-Value	0.336	
Statistical Significance	Not considered to be statistically significant	

Brown LDS – Families Who Had A Positive AWC Change as of Recording 6

Data	TV/Elec Minute Baseline	Recording 6 TV/Elec Minute Average
N (sample size)	63	63
Mean TV/Elec Minutes	79.49	109.65
Std. Deviation	62.38	87.01
Std. Error of Mean	7.85	10.96
Two-tailed P-Value	0.018	
Statistical Significance	Considered to be statistically significant	

Brown LDS – Families Who Had A Positive CT Percentile Change as of Recording 6

Data	TV/Elec Minute Baseline	Recording 6 TV/Elec Minute Average
N (sample size)	45	45
Mean TV/Elec Minutes	82.30	122.16
Std. Deviation	61.22	90.18
Std. Error of Mean	9.02	13.29
Two-tailed P-Value	0.008	
Statistical Significance	Considered to be statistically significant	

Brown LDS – Families Who Had A Negative CT Percentile Change as of Recording 6

Data	TV/Elec Minute Baseline	Recording 6 TV/Elec Minute Average
N (sample size)	59	59
Mean TV/Elec Minutes	88.34	98.72
Std. Deviation	73.57	74.48
Std. Error of Mean	9.57	9.69
Two-tailed P-Value	0.382	
Statistical Significance	Not considered to be statistically significant	

Demographic Group Comparison on Adult Word Count (AWC)

Different demographic groups showed different degrees of progress made on AWC between the baseline and the post program recording (or the last recording for the Control Group) (see Table 9):

- For Spanish-speaking families, PT PG showed an improvement of 13%, while the PT HV group showed an improvement of 4%. However, the Control Group declined by 4%.

- For English-speaking families, PT PG showed an improvement of 22%, the PT HV group showed an improvement of 1%, and the Control Group showed an improvement of 5%.

- For single parent families, PT PG showed an improvement of 26%. The PT HV group showed a 2% decline, while the Control Group showed a 1% decline.

- For dual parent families, PT PG showed an improvement of 14%, the PT HV group showed an improvement of 5%, and the Control Group showed an improvement of 2%.

- For primary caregiver with a high school diploma or less, PT PG showed an improvement of 17%, and PT HV showed an improvement of 6%. However, the Control Group declined by 3%.

- Overall, PT PG showed positive results for all five demographic groups. PT HV showed positive results in 4 of the 5 demographic groups. In contrast, the Control Group showed declines in AWC in 3 of the 5 demographic groups.

Table 9. Comparison on Adult Word County (AWC) by Demographic Groups

Spanish Speaking Families	PT HV (n=264)	PT PG (n=103)	Brown LDS (n=23)
Baseline Average AWC	12323	10909	14011
Final Rec "Mean3" Average AWC	12885	12418	13332
Change	+4%	+13%	-4%
English Speaking Families	PT HV (n=146)	PT PG (n=62)	Brown LDS (n=78)
Baseline Average AWC	13721	10778	12095
Final Rec "Mean3" Average AWC	13845	13187	12718
Change	+1%	+22%	+5%
Single Parent Families	PT HV (n=110)	PT PG (n=58)	Brown LDS (n=13)
Baseline Average AWC	13406	10072	12802
Final Rec "Mean3" Average AWC	13076	12690	12665
Change	-2%	+26%	-1%
Dual Parent Families	PT HV (n=295)	PT PG (n=115)	Brown LDS (n=89)

Baseline Average AWC	12679	11145	12711
Final Rec "Mean3" Average AWC	13360	12746	12969
Change	+5%	+14%	+2%
Primary Caregiver Education HS Diploma Or Less	PT HV (n=218)	PT PG (n=84)	Brown LDS (n=27)
Baseline Average AWC	12120	10140	13453
Final Rec "Mean3" Average AWC	12898	11858	12981
Change	+6%	+17%	-3%

Demographic Group Comparison on Conversational Turns (CT)

Different demographic groups showed different degrees of progress made on CT between the baseline and the post program recording (or the last recording for the Control Group) (see Table 10):

- For Spanish-speaking families, PT PG showed an improvement of 14%. However, the PT HV group showed a decline of 26%, while the Control Group declined by 27%.
- For English-speaking families, PT PG showed an improvement of 19%, the Control Group remained the same, while the PT HV also showed a 11% decline.
- For single parent families, PT PG showed an improvement of 48%, and the Control Group showed an improvement of 15%. However, the PT HV group showed a 35% decline.
- For dual parent families, PT PG showed an improvement of 12%. However, PT HV showed a decline of 16%, while the Control Group declined by 4%.
- For primary caregiver with a high school diploma or less, PT PG showed an improvement of 23%, while both the PT HV and the Control Group declined by 21%.
- Overall, PT PG showed positive results for all five demographic groups, while PT HV showed declines in CT across all five demographic groups. The Control Group showed declines in 3 of the 5 demographic groups.

Table 10. Comparison on Conversational Turns (CT) by Demographic Groups

Spanish Speaking Families	PT HV (n=264)	PT PG (n=103)	Brown LDS (n=23)
Baseline Average CT PCTL	50th PCTL	34th PCTL	58th PCTL
Final Rec "Mean3" Average CT PCTL	37th PCTL	39th PCTL	42nd PCTL
Change (in percentile points)	-26%	+14%	-27%

English Speaking Families	PT HV (n=146)	PT PG (n=62)	Brown LDS (n=78)
Baseline Average CT PCTL	53rd PCTL	42nd PCTL	45th PCTL
Final Rec "Mean3" Average CT PCTL	47th PCTL	50th PCTL	45th PCTL
Change (in percentile points)	-11%	+19%	+0%
Single Parent Families	PT HV (n=110)	PT PG (n=58)	Brown LDS (n=13)
Baseline Average CT PCTL	53rd PCTL	25th PCTL	39th PCTL
Final Rec "Mean3" Average CT PCTL	34th PCTL	37th PCTL	45th PCTL
Change (in percentile points)	-35%	+48%	+15%
Dual Parent Families	PT HV (n=295)	PT PG (n=115)	Brown LDS (n=89)
Baseline Average CT PCTL	50th PCTL	42nd PCTL	47th PCTL
Final Rec "Mean3" Average CT PCTL	42nd PCTL	47th PCTL	45th PCTL
Change (in percentile points)	-16%	+12%	-4%
Primary Caregiver Education HS Diploma Or Less	PT HV (n=218)	PT PG (n=84)	Brown LDS (n=27)
Baseline Average CT PCTL	47th PCTL	30th PCTL	47th PCTL
Final Rec "Mean3" Average CT PCTL	37th PCTL	37th PCTL	37th PCTL
Change (in percentile points)	-21%	+23%	-21%

AWC Progress Made by Participants with Lower Baseline

Significant improvement in AWC was shown by participants who started with a low baseline at the first recording and who completed the Providence Talks program (Table 11):

- For Providence Talks HV participants who started at the bottom third of all PT participants and who completed the program, their AWC scores improved from the 7th percentile (or 7,114 word count) to the 39th percentile (or 11,839 word count). This improvement constituted an increase of 457% growth in AWC percentile points. As suggested in the third bullet point below, this improvement far outpaced that shown by the comparable Control Group.

- For Providence Talks PG participants who started at the bottom third of all PT participants and who completed the program, their AWC scores improved from the 6th percentile (or 7,095 word count) to the 23rd percentile (or 10,496 word count). This improvement constituted an increase of 283% growth in AWC percentile points.

- For the Control Group participants who started at the bottom third of all participants and who completed the 6th recording, their AWC scores improved from the 8th percentile (or 7,281 word count) to the 32nd percentile (or 11,521 word count). This improvement constituted an increase of 300% growth in AWC percentile points.

Table 11. AWC for Participants with Lower Baseline

Bottom Third (33rd PCTL or less at Baseline)	PT HV (n=173)	PT PG (n=98)	Brown LDS (n=44)
Baseline AWC Average	7,114	7,095	7,281
Baseline AWC Percentile Average	7th PCTL	6th PCTL	8th PCTL
Final Recording "Mean3" AWC Average	11,839	10,496	11,521
Final Recording AWC Percentile Average	39th PCTL	23rd PCTL	32nd PCTL
Change in AWC	+66%	+48%	+58%
Change in AWC Percentile Points	+457%	+283%	+300%

CT Progress Made by Participants with Lower Baseline

Measurable improvement in CT was shown by participants who started with a low baseline at the first recording and who completed the Providence Talks program (Table 12):

- For Providence Talks HV participants who started at the bottom third of all PT participants and who completed the program, their CT scores improved from the 14th percentile to the 27th percentile. This improvement constituted an increase of 93% growth in CT percentile points. As suggested in the third bullet point below, this improvement was comparable to that shown by the comparable Control Group.

- For Providence Talks PG participants who started at the bottom third of all PT participants and who completed the program, their CT scores improved from the 10th percentile to the 23rd percentile. This improvement constituted an increase of 130% growth in CT percentile points.

- For the Control Group participants who started at the bottom third of all participants and who completed the 6th recording, their CT scores improved from the 12th percentile to the

27th percentile. This improvement constituted an increase of 125% growth in CT percentile points.

Table 12. CT for Participants with Lower Baseline

Bottom Third (33rd PCTL or less Baseline)	PT HV (n=144)	PT PG (n=77)	Brown LDS (n=35)
Baseline CT Percentile Average	14th PCTL	10th PCTL	12th PCTL
Final Recording "Mean3" CT Percentile Average	27th PCTL	23th PCTL	27th PCTL
Change in CT Percentile Points	+93%	+130%	+125%

Parental Efficacy Based on Self-Reported Parent Ladder Instrument

The Parenting Ladder is a parental self-assessment 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. On Table 13 below, the "Mean PL Score" refers to the summed final score on each of the completed instruments for each of the parental groups.

Comparing means (paired t-test) for PL instrument scores between baseline and subsequent sessions:

- HV parents reported a statistically significant increased in their level of efficacy.
- PG parents also reported a statistically significant increased in their level of efficacy.
- The Control Group parents reported an increase in their level of efficacy, but it was not statistically significant.
- These patterns suggested the potential for the two models in PT as a strategy to promote parental engagement.

Table 13. Parent Ladder Instrument Mean Scores for HV, PG, and Control Groups Home Visiting

Data	Parenting Ladder Baseline (home visiting)	Week 6 Parenting Ladder (home visiting)
N (sample size)	162	162
Mean PL Score	41.65	44.46
Std. Deviation	4.68	3.45
Std. Error of Mean	0.36	0.27
Two-tailed P-Value	< 0.0001	
Statistical Significance	Considered to be statistically significant	

Playgroup

Data	Parenting Ladder Baseline (playgroup)	Week 6 Parenting Ladder (playgroup)
N (sample size)	117	117
Mean PL Score	42.08	43.73
Std. Deviation	3.86	3.83
Std. Error of Mean	0.35	0.31
Two-tailed P-Value	< 0.0001	
Statistical Significance	Considered to be statistically significant	

Brown LDS

Data	Parenting Ladder Baseline (comparison group)	2nd Parenting Ladder (comparison group)
N (sample size)	37	37
Mean PL Score	43.22	43.43
Std. Deviation	4.29	3.76
Std. Error of Mean	0.71	0.61
Two-tailed P-Value	0.699	
Statistical Significance	Not considered to be statistically significant	

Conclusions

Providence Talks clearly improved the home auditory environment for parents and primary care takers who started with a lower level of Adult Word Count and Conversational Turns. Further, Providence Talks benefited from its design variation. Providence Talks implemented two delivery models, namely, the Home Visiting model and the Playgroup model. While the Home Visiting model showed measureable benefits for some of its participants, the Playgroup model seemed to show growth for several demographic groups, particularly for single parent families and primary caregivers with a high school diploma/GED or less. Clearly, the decline in AWC and CT for the Control Group suggests the natural tendency in widening the "word gap" in the absence of purposeful intervention.

As referenced earlier, the shorter duration and increased frequency of intervention in the Playgroup model may be playing a role in the higher percentage of overall participants making AWC and CT outcome gains when compared to the Home Visiting model. There are other variables which are affecting the difference between PG and HV: When looking at what Providence Talks considers to be the minimum number of recordings that allow a family to "graduate" a particular model (10 in HV, 5 in PG) the median baseline is 13% lower in the Playgroup model, suggesting a larger room to grow and a stronger likelihood of making AWC/CT outcome gains, at least for the families that seem inclined to finish the program.

It should be noted that, based on self-assessment tools (the Parenting Ladder and the LENA Developmental Snapshot™), parents and children in both models tended to increase their self-efficacy and developmental age, respectively.

More importantly, as noted earlier, these increases in both areas are occurring regardless of whether or not the family is making outcome gains in AWC or CTs. This is important to note because it suggests that the Providence Talks intervention is having a strong impact on the families it's serving, even if that impact is not always resulting in short-term changes in AWC/CT. For the families who are increasing both their child's developmental age, along with their own self-efficacy and an improved language environment, Providence Talks is making an impact on multiple levels.

An increased, targeted effort to recruit families who stand the most to gain in improving a language environment through AWC/CT using the available demographic data would be a useful next step forward for the program, given the level of strong outcome gains experienced in both models for target group participants starting below the 50th percentile, and participants with significantly low baselines, starting at or below the 33rd percentile. Taking into account 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.

Future Research Agenda: Studying the effects of Providence Talks on reading achievement

The evaluation reported here looked at the immediate, short-term effects of Providence Talks. The next step is to examine whether early gains in a child's auditory environment continue past a family's enrollment with PT to have a positive impact on their readiness to enter kindergarten, and in particular, their readiness to learn to read. To facilitate this longitudinal analysis, BUET has received formal approval on a data sharing agreement from the RI Department of Education. BUET plans to submit a proposal to various foundations for potential funding for the longitudinal study.

In order to examine the long-term effects of PT, BUET will evaluate graduates of PT on two levels. First, BUET will compare children who completed the Providence Talks program to their peers who did not, including those who were enrolled in the control group for the short-term Providence Talks evaluation; and second, BUET will do a detailed, qualitative analysis comparing children who completed the Providence Talks program to their peers who completed the recordings in the Language Development Study control group.

For the first part of the analysis that looks at children who completed the PT program to their peers who did not, BUET will use individual districts' kindergarten entry assessments and normalize them so they can be compared across districts. These assessments will be combined with other outcomes such as attendance and grade-retention. BUET is also looking into assessments that are being used in 1st and 2nd grades that can be accessed in order to track

academic progress in those grades as well. These assessments could include reading programs that are used citywide by the Providence Public School District (PPSD). For 3rd grade, BUET will include reading proficiency results.

In order to compare PT graduates with similar peers, BUET will compare students similar to each other across a variety of demographics. Some of the characteristics BUET will take into consideration include: school district, gender, race/ethnicity, English language learners (ELL), and free or reduced-price lunch recipients. For example, BUET will compare ELL Hispanic students in Providence who completed PT to other ELL Hispanic students in Providence who never participated in PT.

Table 14 shows the number of children who are currently projected to enter kindergarten each fall from the 3 different groups involved in the current evaluation. This past fall (September 2017), 19 children who have graduated from the PT Home Visiting model entered kindergarten, with 0 children from either the Playgroup model or Language Development Study control group.

Table 14. Number of children projected to enter Kindergarten each year

	Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022
PT Home Visiting	19	58	130	183	155	76
PT Playgroup	0	10	65	120	81	13
LDS Control Group	0	0	22	48	62	9

BUET will also perform a second analysis that is a more detailed, qualitative analysis with a few families from each group (PT Home Visiting, PT Playgroup, and LDS Control Group). During the original intervention, Providence Talks and LDS focused on the number of words being said and the number of conversations happening, but were not able to look at the quality of the conversations or the home environment as it supported things like reading and intellectual discovery. For this evaluation, BUET will ask a few families each year (about 60) to participate in a detailed analysis where we will visit them twice a year and administer a parent engagement survey and a reading assessment of the child. For each family that participates, BUET will offer them a $20 Walmart gift card as a thank you for each visit.

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Appendix A

The Evolution of the Study Design

When originally proposed in Spring 2014, the Brown University Evaluation Team (BUET) wanted to do a randomized control trial (RCT) of Providence Talks (PT) where each of the participants would be randomly assigned to either a control group, where they would be recorded with a DLP on a few occasions but not receive any of the intervention, or the treatment group which would receive the full PT curriculum. RCTs are a useful and established form of research because both groups are drawn from the same population and are therefore comparable. The problem with an RCT is that it means a group of people are not receiving treatment, and if there is a strong belief in the treatment, there can be an ethical question about this. This is exactly what happened in our case. There is evidence that PT may be very helpful in closing the academic achievement gap early on so the nonprofit organizations working with PT objected to excluding any eligible families from the treatment, even though PT is not a proven concept. Therefore, a watered down curriculum called "Providence Reads" was created, on top of which, families had to decide whether they wanted to participate in this pseudo-RCT, and if they did not elect to be a part of it, they were automatically enrolled in the full PT program.

BUET piloted this RCT for a few months starting in October 2014. At the end of January 2015, 25 families chose to participate in this study: 13 were enrolled in Providence Talks and 12 were enrolled in Providence Reads (group assignment was decided based on flipping a coin). With that few children enrolled in the RCT, it was hard to make any conclusions about the efficacy of PT. Also, the Providence Reads curriculum was so similar to Providence Talks that it wasn't going to capture the full effect of Providence Talks. By mid-2015, the pseudo-RCT was abandoned as ineffectual.

In the summer of 2015, a new management team took over Providence Talks and in the fall there was a refocus on the fidelity of the PT program and how it was being delivered by the nonprofit organizations. In Spring, 2016, a totally new plan for the evaluation of PT was devised and adopted by BUET. Instead of recruiting a control group in Providence among families eligible to participate in PT, BUET would recruit similar families outside of Providence who were not eligible to participate in PT. By recruiting ineligible families, BUET was not under any pressure or obligation to provide the families with any sort of intervention, so they could be a more pure control group. Furthermore, since the proposed impact study was not a Randomized Controlled Trial, Brown would be able to conduct an evaluation that utilizes all Providence Talks data since the beginning of the program (or the program's expansion), analyzing trends and utilizing comparisons with the comparison group, who did not receive any sort of coaching-based intervention (including recording reports or book donations) that regular Providence Talks participating families received. It was also proposed that these families receive a cash incentive for participation, otherwise there would be little to no motivation for a family to participate. Another advantage to recruiting families for the control group outside of Providence was that it allowed PT to continue its focus on achieving City-wide scale and serving all families who were interested in, and eligible for the Program. Figure A-1 shows the differences in services for the regular

PT participating families and the control group families.

Figure A-1. Comparison of Services for PT Families and Control Group Families

Service	LENA Recording	Recording Report	Home Visit Coaching Session	Book Donation	Cash Incentive
PT Family	✓	✓	✓	✓	✗
Control Group Family	✓	✗	✗	✗	✓

In order to capture any potential natural change in the control group families, it was decided that the control would complete fewer recordings, but over the same 8-month period at the regular Providence Talks families. The first 4 are grouped more closely together and are the same schedule at the PT families. Then there's an approximately 4 month break before the 5th recording, and then the last recordings for both groups are done 8 months after the family enrolls in their respective program. Control Group Families were given a $20 Walmart gift card as an incentive after each recording they completed. Also, at the completion of the study, families were provided with a report of their results and how they compared to other typical families. Figure A-2 shows a comparison of the recording schedules.

Figure A-2. Comparison of Recording Schedules

Month	Providence Talks	Comparison Group
1	Rec 1-2	Rec 1-2
2	Recs 3-4	Rec 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	

The original proposal focused on recruiting families from three of the state's other "core cities" which were comparable to Providence: Central Falls, Pawtucket, and Woonsocket. Early on in the project it became clear that Woonsocket was too far away to regularly include their families in the study (travel and the time to travel was going to cost too much), so it was dropped and we focused on Central Falls and Pawtucket. Some assumptions made in the beginning were:

- We needed 160 families to complete all six recordings in order to have the necessary "power" to see a difference between the control group and PT (see the discussion on "Power Calculation" earlier in the report)

- Only half of the families who started to study would actually complete all six recordings so we needed 320 families to enroll in the study
- We could work through one or two nonprofit organizations in Central Falls and Pawtucket to enroll these 320 families
- The incentive of earning $120 in Walmart gift cards would be enough to make lots of families want to enroll.

For this evaluation, BUET created the Language Development Study where we told families that we were doing a study looking at the language development of young children between 2-30 months of age. We did not want to link it to Providence Talks because we were trying to recruit as pure a control group as possible where the families were not aware of exactly what we were measuring. We were honest with all the families in telling them that we were purposefully vague because we did not want to influence results and that the DLPs measured things like when their child spoke, when they had a conversation with their child and similar things. Most families assumed we were measuring when their child spoke as opposed to an adult, which worked fine for us. The biggest problem we had recruiting families was convincing them that we could not listen to their conversations through the Digital Language Processors (DLPs) regardless of how much we tried to reassure them to the contraty. And unlike Providence Talks, we could not frame the DLPs as "word pedometers" because we did not want our families to know what we were measuring.

In order to recruit families, BUET wanted to use a similar model as PT and work through nonprofit organizations, and, as mentioned above, we thought we could do it with just a few NPO partners. After all, PT has been successful by working with just six nonprofit organizations. However, it soon became apparent that this evaluation was going to be much more difficult in part because of the DLPs, and in part because we did not have any connection to these families before we started recruiting. A few months into recruiting, we expanded our focus to include East Providence and New London, CT, and then later on, Groton, CT as well and reached out to as many nonprofit organizations as we could. In the end, BUET worked with several nonprofit organizations in Central Falls, Pawtucket, East Providence, and New London, CT, including: Progreso Latino, Children's Workshop, Children's Friend (both Early Head Start and WIC), Central Falls Public School District, Heritage Park YMCA, Nowell Leadership Academy, Darlington Daycare Center, Blackstone Valley Community Action Program, Food on the Move, East Providence Public Libraries, New London Public Library, and Child & Family Agency of Southeastern CT.

It was necessary to work with so many NPOs because we would only get a couple families from each. Also starting in August 2016, we started advertising the study on FaceBook which included a link for families to leave us their name, phone number, child's birthdate, and city of residence. Another strategy we employed for recruiting families was to use the families who were already enrolled. If they referred another family who then completed at least one recording, the family who referred them would receive another $20 gift card. When enrollment closed on March 31, 2017, 517 families had voluntarily given us their name and phone number to say they were interested in enrolling in the Brown University Language Development Study. We completed 165 orientations, 152 families enrolled after completing the orientation (completed at least 1

valid recording), and only 12 families have currently dropped out after enrolling (as of 5/25/17) giving us a 92% retention rate.

This really became a marketing campaign. Originally, we had a flyer that was a full 8 ½ x 11 inch sheet of paper that had 5 short paragraphs at the top explaining our study and giving our contact information and then a cut away part on the bottom so we could get vital information from families. This turned out to be too much information for busy families to read over, so Providence Talks helped us create a postcard that really emphasized the $120 Walmart gift card incentive, explained the program in a few sentences, and gave our contact information (one side was in English and the other side was in Spanish). Originally they were intended to be mailed out to families in Central Falls and Pawtucket. Providence Talks purchased a mailing list of families in these two cities and twice sent out a few hundred post cards. From those mailings, we received two phone calls of interested families, so that was not a strategy that worked for us. What did work was sitting in the lobby at daycares and talking to parents as they picked up their kids. We also set up a weekly appointment and a WIC office in Central Falls and Pawtucket where we could sit in the lobby and talk to moms as they came in for services. Everything was in English and Spanish. We also offered all organizations that worked with us $20 for each family we recruited through them who completed at least one recording as an incentive for them to help us. Recruiting families was much more difficult than we originally anticipated.

To ensure that the comparison group is comprised of families with similar demographic data, Providence Talks utilized the RI Kids Count 2016 Factbook for demographic Census data and Reading/Language data between the population in Providence, and these municipalities. See Figure A-3. and Figure A-4[17] for a comparison between Providence and the three other core cities in various indicators:

Figure A-3.

Indicator	Children living in families below the federal poverty threshold	Children in Single-Parent Families	Births to Mothers with less than a HS Diploma	WIC Participation	Children in Families Receiving Cash Assistance
Providence	39%	46%	22%	63%	9%
Central Falls	41%	49%	36%	65%	8%
Pawtucket	33%	43%	16%	56%	6%
East Providence	18%	31%	8%	47%	2%

[17] http://www.rikidscount.org/DataPublications/CommunitySnapshots.aspx

New London, CT[18]	43%	55%			5%
Groton, CT	12%	33%			3%

Figure A-4.

Indicator	Chronic early absence in grades K-3	Identified as low income in public school	ELL Students (7% statewide)	Schools Identified For Intervention	Student Mobility Rate
Providence	21%	86%	22%	55%	24%
Central Falls	20%	81%	27%	75%	27%
Pawtucket	10%	69%	10%	6%	19%
East Providence	12%	56%	3%	18%	12%
New London, CT	16%[19]	73%[20]	24%[3]	n/a	n/a
Groton, CT	7%[2]	42%[3]	3%[3]	n/a	n/a

Should this strategy move forward, the Providence Talks team would be able to utilize the resource of our current centralized hotline to engage families who call to enroll in the program but who do not live in Providence (roughly 50% of calls so far). Additionally, Mayor Elorza meets monthly with the Mayors of the other 3 cities giving us the opportunity to engage them in supporting our recruitment efforts with the hope that we can build enough evidence to bring this kind of program to their constituents.

[18] From Community Facts from American Fact Finder from US Census for New London and Groton town, estimates for 2015. Accessed on 10/3/17. https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

[19] EdSight Chronic Absenteeism Trend Reports by Grade for New London and Groton, School Year 2015-2016. Calculated assuming the same enrollment numbers in each grade and using a basic average for grades K-3. Accessed on 10/3/17. http://edsight.ct.gov/SASPortal/main.do

[20] EdSight Profile and Performance Reports for New London and Groton, School Year 2015-2016. Accessed on 10/3/17. http://edsight.ct.gov/SASPortal/main.do

Appendix B

Statistical Significance Tests on Difference of Means: Changes in Standard Score of AWC Between Baseline and Final Average

A paired t-test was run to determine whether there was a statistically significant difference in effect (comparing x2 – x1 in intervention and comparison). A minimum of 13 recordings for home visiting and 6 recordings for the comparison group was required. An Anderson-Darling test was run to determine a normal distribution within the data.

x2: Final recording averages for AWC converted to standardized scores for both the home visiting intervention group (recording 13) and comparison (recording 6)
x1: Baseline recording averages for AWC converted to standardized scores for both the home visiting intervention group and comparison (recording 1)

Group	**PT Intervention HV (min 13)**	**Brown Comparison Group (min 6)**
Mean	0.965	-6.44
Standard Deviation	31.58	33.93
Std. Error of Mean	1.57	3.61
N	404	88

The data resulted in a two-tailed P-value of 0.0619, indicating statistical significance at the 90% confidence level, but not the 95% confidence level. At the very least, this indicates the data is highly suggestive of a significant difference in effect on AWC between the home visiting intervention model and the comparison group model.

Outliers

If we remove the one major statistical outlier in the comparison group (standard score change of +125.68, and the only significant outlier between the two groups) we get a much more significant result, with a P-value of 0.0192:

Group	**PT Intervention HV (min 13)**	**Brown Comparison Group (min 6)**
Mean	0.965	-7.95
Standard Deviation	31.58	30.97
Std. Error of Mean	1.57	3.32
N	404	87

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