LENA®

Clinical Applications of the Breakthrough LENA™ System

Monitoring Language in the Natural Environment of the Child

LENA Foundation, Boulder, CO

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Clinical Applications of LENA™
(Language Environment Analysis System)

The LENA language environment analysis system is a powerful new tool that can help pediatricians, speech language pathologists, and audiologists improve their diagnosis and treatment of language delay and disorders, and increase parent involvement and satisfaction.

Broadly speaking, the uses of LENA in clinical practice fall into four categories: 1) assessment and diagnosis, 2) monitoring fidelity of treatment, 3) audio environment analysis, 4) enhanced treatment through in-home feedback.

Assessment and Diagnosis

LENA is a very useful tool to aid professionals in the assessment and diagnosis of language delay and disorders. The tool provides—for the first time—a picture of the natural language environment of the child in terms of adult word counts, conversational turns, child vocalizations, and amount of TV exposure. LENA software also includes two instruments to assess a child's language development: the Automatic Vocalization Assessment (AVA) tool and the LENA Developmental Snapshot, a computer-administered questionnaire. Both assessment instruments have reliability similar to commonly used child language assessments such as the PLS-4, REEL 3, and CAT/CLAMS.

Before LENA, professionals had to base their diagnosis almost entirely on parent reports and clinical observations. With LENA, professionals can actually look into the child's language environment.

The following example shows how LENA can aid assessment and diagnosis.

Example 1: James

Assume you are an SLP in a private practice. A pediatrician has referred the parents of 20-month-old James to you for a language evaluation. Your professional evaluation of James indicates low-normal expressive language development at about the 20th percentile. The boy's parents are concerned because they feel they are above average in their communicative interactions with James. There are no indications of any specific disorder other than mild delay.

You have purchased the professional version of LENA and have been certified on the LENA System. You have the parents take the LENA Developmental Snapshot questionnaire on your office computer. The developmental snapshot score shows James to be in the 27th percentile in language development.

You then send the parents home with a LENA Digital Language Processor (DLP) recording device and a vest for James. You explain that you would like them to record for a full day and talk to their son as they would normally.

The parents record for a full day and drop the DLP off at your office. You connect the DLP to the USB port on your office PC and the LENA Pro software processes the recording. In addition to your clinical assessment, you have access to the following reports and information.

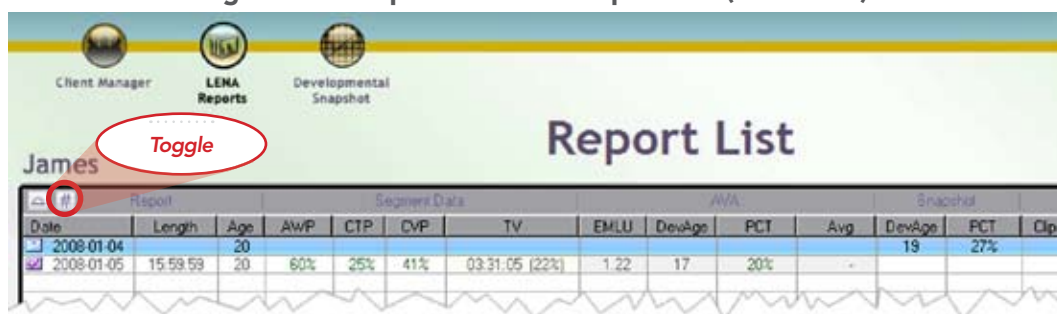**Figure 1. Example 1: James - Report List (Percentile)**

Figure 2. Example 1: James - Report List (Count)

The top Report List shows James' adult word percentage (AWP), conversational turns percentage (CTP), and child vocalizations percentage (CVP); these measurements are based on the normative data developed by the LENA Foundation. Moreover, the AVA based on the daylong recording shows James with an expressive language development at the 20th percentile and a language developmental ago of 17 months. His estimated mean length of utterance (EMLU) is 1.22. And James' LENA Developmental Snapshot is at the 27th percentile for total language.

By "toggling" from the percentile view to the count view the professional can see the actual numbers. For example, the bottom Report List shows the adult work count, conversational turns count, and child vocalizations count as actual numbers, and his snapshot score (SS) is 90.81.

Figure 3. Example 1: James - Audio Environment Chart
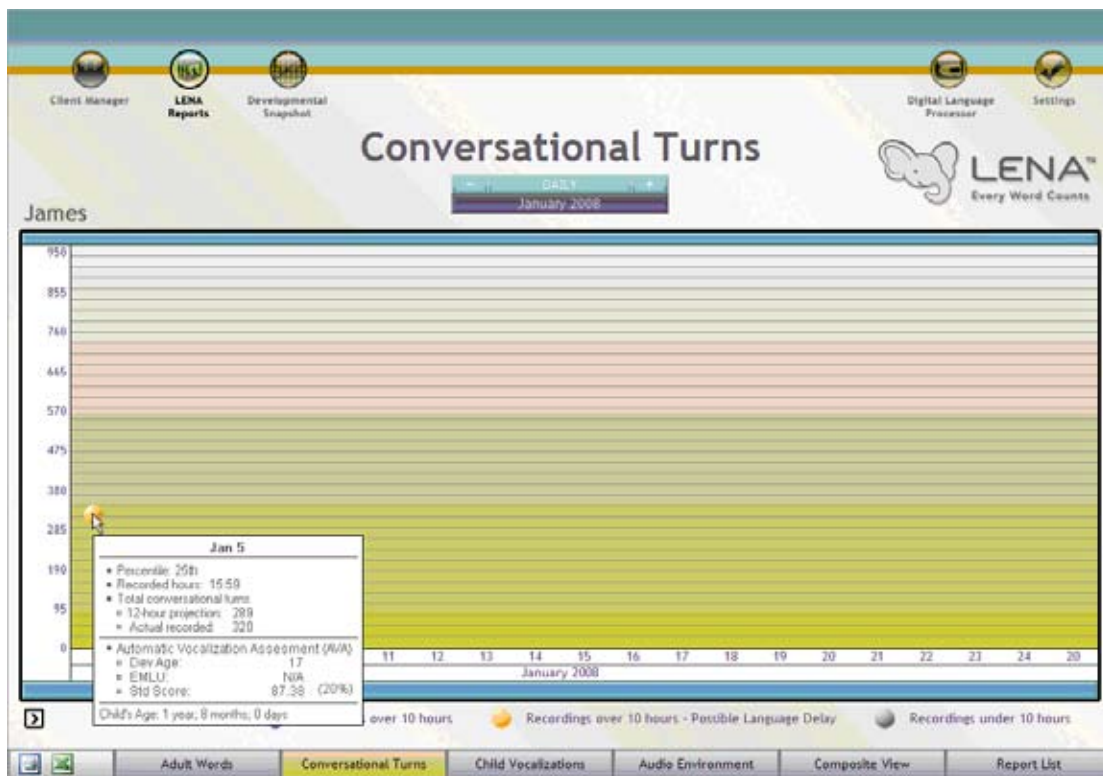

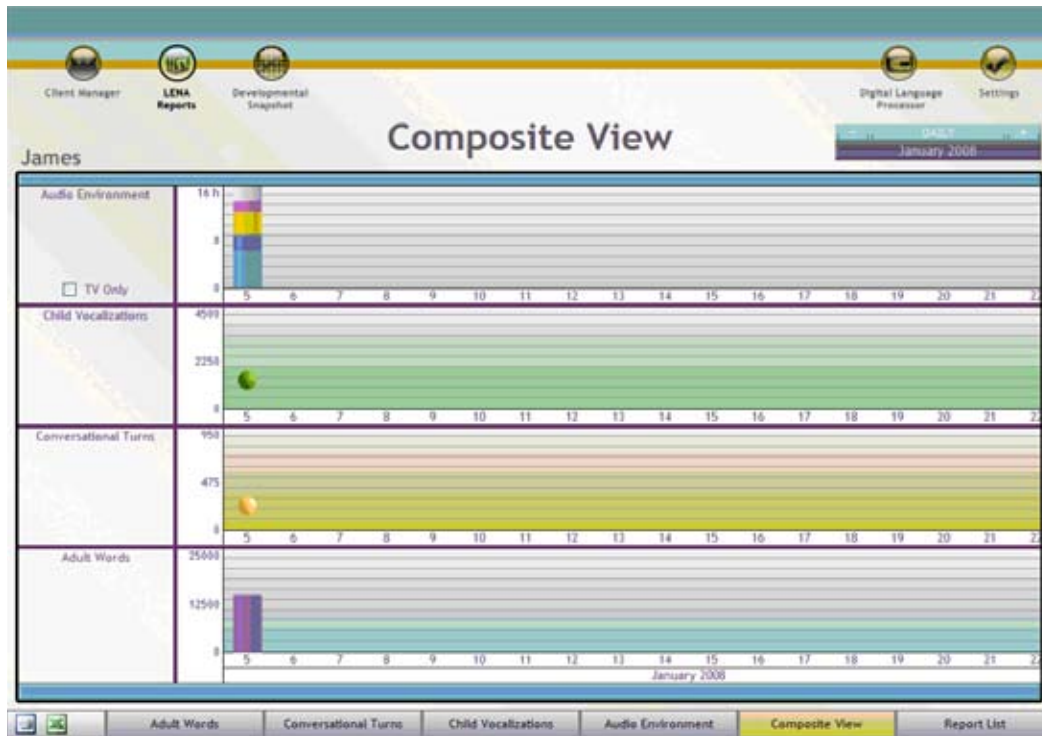**Figure 4. Example 1: James - Adult Word Count Chart**

James' adult word count is at the 60th percentile.

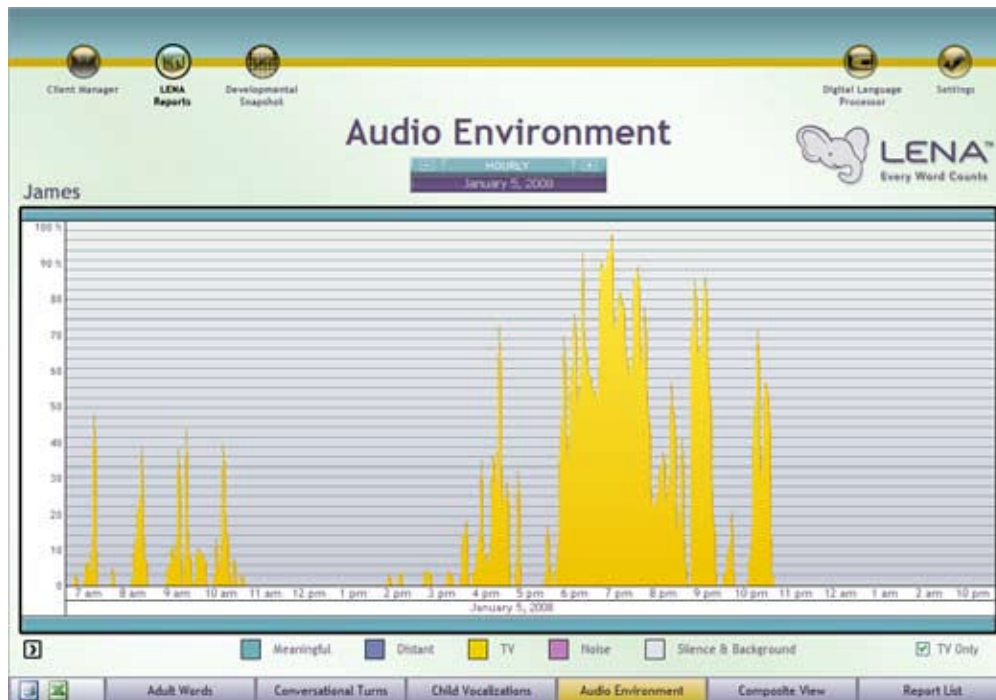**Figure 5. Example 1: James - Conversational Turns Chart**

James' conversational turns are at the 25th percentile.

Figure 6. Example 1: James - Composite View Chart

And James' child vocalizations are at the 41st percentile.

Figure 7. Example 1: James - TV Chart (Hourly)

The TV section of the Audio Environment view reveals that the TV was on for more than three hours throughout the day of James' recording—a fair amount of time.

As the figures above document, the AVA and LENA Developmental Snapshot assessments are consistent with your clinical evaluation that 20-month-old James has mild language delay. The adult word count indicates that the parents are talking to the child at a rate slightly above average; however, their conversational turns are slightly below average.

With these reports, any clinician would be more confident of his or her evaluation and would also have additional facts on which to base a prescription and treatment plan.

Monitoring Fidelity of Treatment

LENA can provide information from the natural language environment to aid professionals in their diagnosis, and it is an extraordinary tool for monitoring the fidelity of treatment. As you know, the scientific research shows talk is more important for improving language development in young children than any combination of DVDs, computers or TV. Increasing talk, especially conversational turns, is the single most recommended treatment for language delay and disabilities including delay caused by hearing impairment, autism and Down syndrome.

But how does the clinician really know if parents are implementing the treatment plan and talking more interactively with their child? Without LENA, one cannot be sure.

Example 2 below is a continuation of Example 1, and it shows how LENA can be used to monitor the fidelity of treatment and measure progress.

Example 2: James (continued)

Assume all the facts of Example 1. Armed with the information you have collected with LENA, you have James' parents come in for a counseling session to show them the information collected; they have good word counts but their conversational turns are low. You explain the importance of back-and-forth interactions and explain some techniques they can use to increase turns, including suggesting they read more books to James dialogically.

To monitor the fidelity of treatment and measure progress you suggest to James' parents one of two additional courses of action. The first approach is to continue to take home and drop off at your office the DLP, making one recording per week for the next eight weeks to monitor how well they are doing. The second approach is for them to purchase a parent version of the LENA System so they can get the feedback reports themselves and electronically send the processed data to your office PC over the Internet. However, the parents decide at this point that they do not want to invest in LENA and choose the first alternative: dropping off and picking up the DLP and recording weekly.

The results are shown in the following set of reports:

Figure 8. Example 2: James - Report List (Count)

Figure 9. Example 2: James - Report List (Percentile)

Figure 10. Example 2: James - Adult Word Count Chart

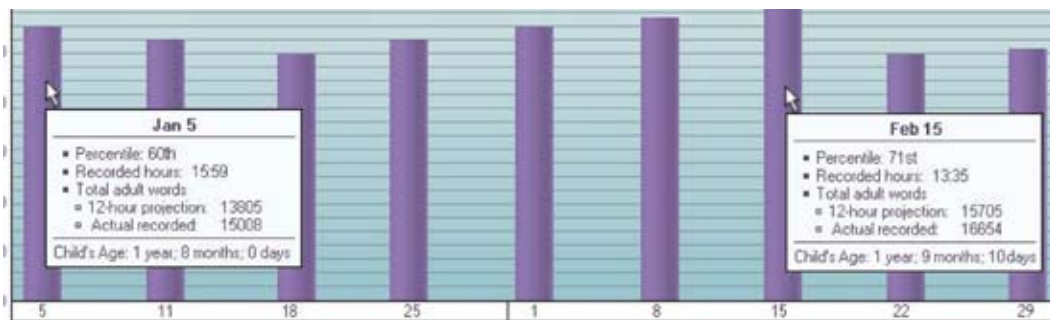**Figure 11. Example 2: James - Conversational Turns**
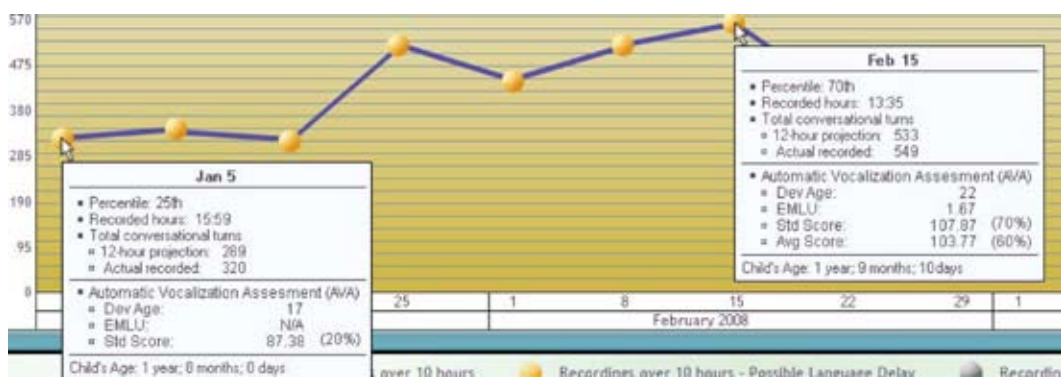
After three recordings, the AVA score is presented as a standard score (e.g., the score from February 15 is 107.87) and an average score (103.77). Even though AVA is a stable measure for child language development, the software calculates an average AVA from the last three recordings to reduce variability in the AVA scores among recordings.

Figure 12. Example 2: James - Child Vocalizations
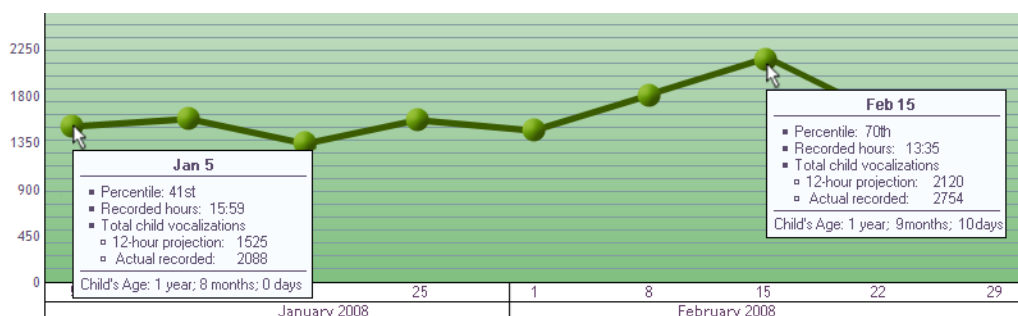
Figure 13. Example 2: James - Audio Environment
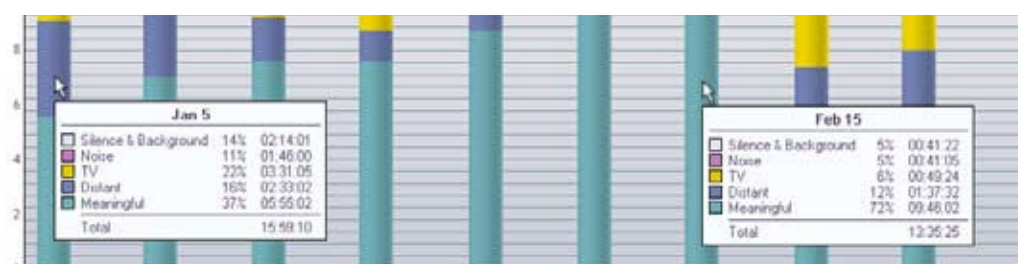
Audio Environment

At the conclusion of the 8-week period, you arrange another counseling session with James' parents. You ask how they felt they did, and they both say they feel they made progress: They had turned the TV off more, and their son seemed to be interacting more. You show them LENA reports that show excellent progress for the first six weeks with a slight drop off in the seventh and eighth recording day. You confirm that there was indeed progress—less TV and more conversational turns—and congratulate them. Moreover, both you and the parents are pleased with what appears to be a slight improvement in the boy's AVA score. Upon asking about the drop off in the last two weeks, James' parents confirm that they did let up a bit. However, they believe that they will be able to maintain their word counts and turns at a higher level, especially after seeing their progress. You suggest proceeding with a once-per-month schedule with the DLP. They agree, and you set up a follow-up appointment in six months.

The monitoring ability of LENA can be very helpful to enhancing parent satisfaction with your professional services and helping parents to continue to keep up their efforts by seeing success measured objectively.

Example 3: Thomas (an actual case study)

Shown below is an actual case study of Thomas (not his real name), who participated in the LENA Foundation normative study in 2006, and the LENA Foundation autism study in 2008. When Thomas was in the normative study he was around 12 months old, and his parents did not know he was autistic. The graph below shows that during this time the adult word counts were low, around the 14th percentile on average. After the normative study, in August 2007 when Thomas was 27 months old, he was diagnosed with autistic disorder. About seven months later, at 34 months of age, his parents enrolled him in the autism study. The chart below shows the adult word counts during the autism study, after the child had been diagnosed and was in treatment. Now we can see that now the adult word counts are around the 70th percentile. We may consider the increase in adult talk a treatment effect, since part of the therapy involved working with the mother to improve communication and language skills. This case study illustrates how LENA can help measure the effectiveness of a treatment program.

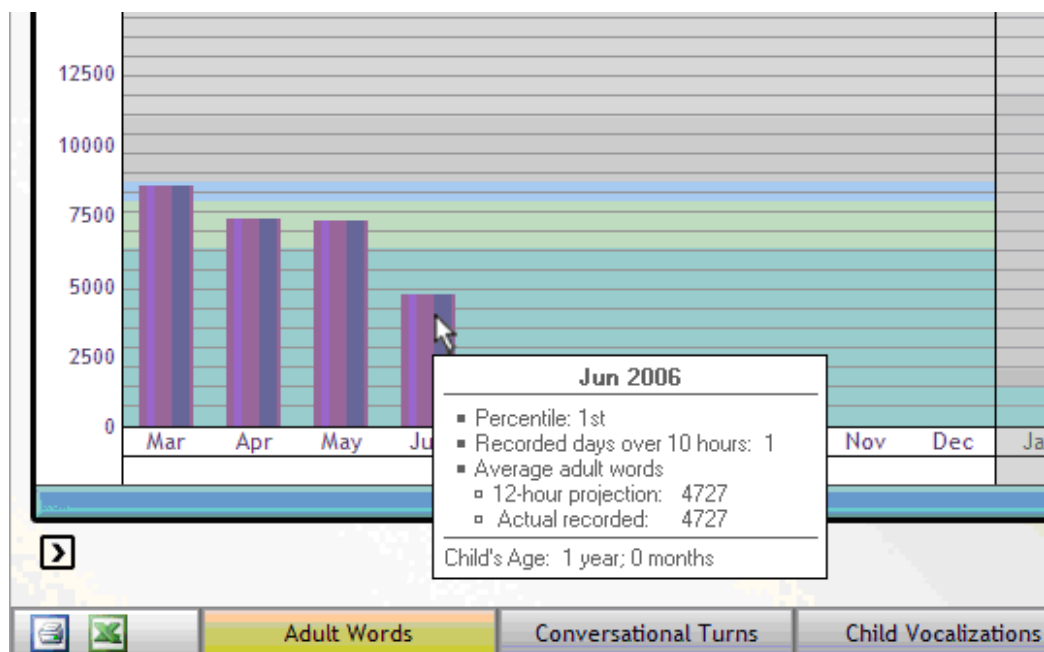**Figure 14. Example 3: Thomas - Adult Word Counts Before Treatment**

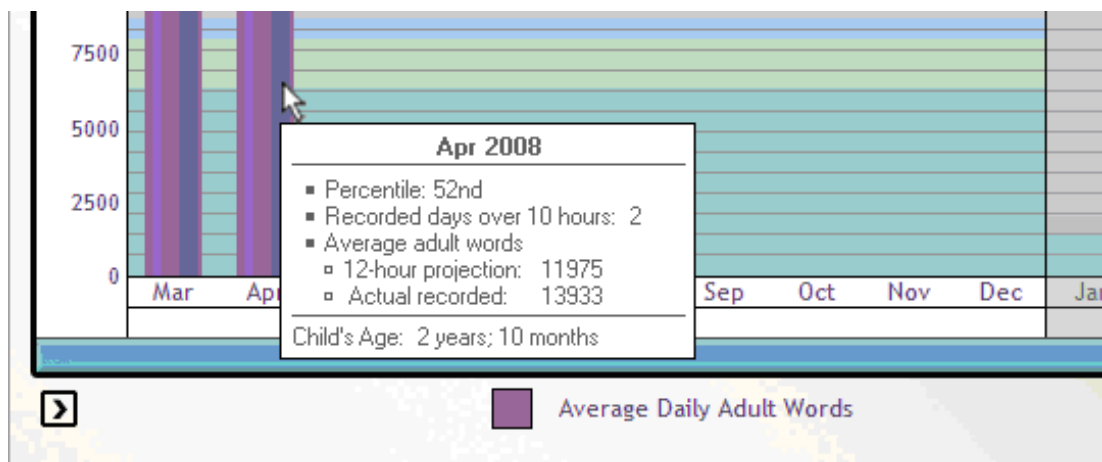**Figure 15. Example 3: Thomas - Adult Word Counts After Treatment**
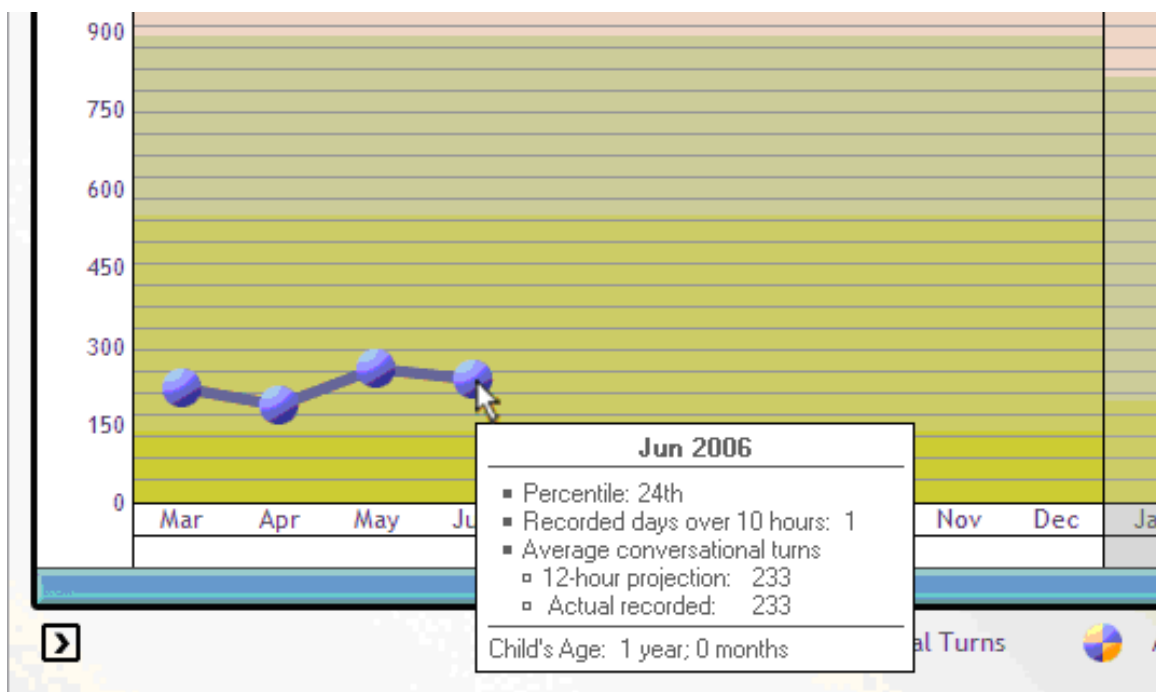
Figure 16. Example 3: Thomas - Turns Before Treatment
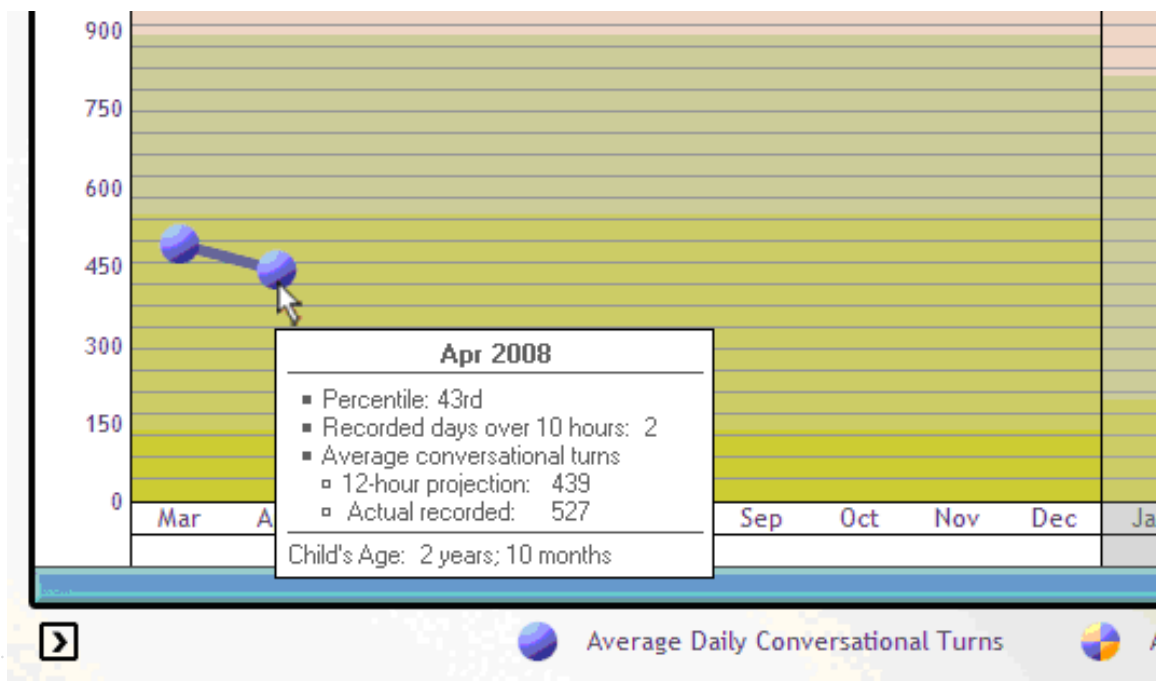

Figure 17. Example 3: Thomas - Turns After Treatment

Figure 18. Example 3: Thomas - Report List (Count)

Date	Length	Age	AWC	CTC	CVC	TV		EMLU	DevAge	SS	Avg	DevAge	SS	Clip
2006-03-30	12:00:00	10	8579	216	1330	00:11:25	(1%)	-	12	105.22	-			
2006-04-24	12:00:00	11	7386	185	933	02:05:21	(17%)	-	12	100.26	-			
2006-05-24	12:00:00	12	7323	253	1180	02:22:37	(20%)	-	11	90.46	98.65			
2006-06-24	12:00:00	13	4727	233	1237	03:01:21	(25%)	-	11	88.25	92.99			
2008-03-12	15:54:37	33	20990	598	2410	00:51:39	(5%)	2.28	30	90.18	-			
2008-03-13	00:05:22	33	0	0	0	00:00:00	(0%)	2.28	30	90.18	-			
2008-03-14	15:03:20	33	14240	536	2868	00:29:00	(3%)	2.48	33	96.34	-			
2008-03-15	00:56:39	33	0	0	0	00:00:00	(0%)	2.48	33	96.34	-			
2008-03-21	15:59:59	33	19221	399	1807	02:08:39	(14%)	2.17	28	86.75	91.09			
2008-03-28	15:59:59	34	22196	421	1669	03:55:19	(24%)	2.48	33	96.48	93.19			
2008-04-05	15:59:59	34	14294	470	2180	03:54:51	(24%)	1.13	12	110.09	97.77			
2008-04-13	15:59:59	34	9657	408	2498	02:50:44	(18%)	1.38	16	126.07	110.88			

Figure 19. Example 3: Thomas - Report List (Percentile)

Date	Length	Age	AWP	CTP	CVP	TV		EMLU	DevAge	PCT	Avg	DevAge	PCT
2006-03-30	12:00:00	10	17%	26%	61%	00:11:25	(1%)	-	12	63%	-		
2006-04-24	12:00:00	11	9%	19%	28%	02:05:21	(17%)	-	12	50%	-		
2006-05-24	12:00:00	12	9%	30%	41%	02:22:37	(20%)	-	11	25%	46%		
2006-06-24	12:00:00	13	1%	24%	41%	03:01:21	(25%)	-	11	21%	31%		
2008-03-12	15:54:37	33	95%	56%	54%	00:51:39	(5%)	2.28	30	25%	-		
2008-03-13	00:05:22	33	-	-	-	00:00:00	(0%)	2.28	30	25%	-		
2008-03-14	15:03:20	33	67%	47%	71%	00:29:00	(3%)	2.48	33	40%	-		
2008-03-15	00:56:39	33	-	-	-	00:00:00	(0%)	2.48	33	40%	-		
2008-03-21	15:59:59	33	92%	30%	32%	02:08:39	(14%)	2.17	28	18%	27%		
2008-03-28	15:59:59	34	97%	32%	27%	03:55:19	(24%)	2.48	33	40%	32%		
2008-04-05	15:59:59	34	67%	48%	53%	03:54:51	(24%)	1.13	12	74%	44%		
2008-04-13	15:59:59	34	35%	38%	64%	02:50:44	(18%)	1.38	16	95%	76%		

Figure 20. Adult Word Count Before and After Diagnosis
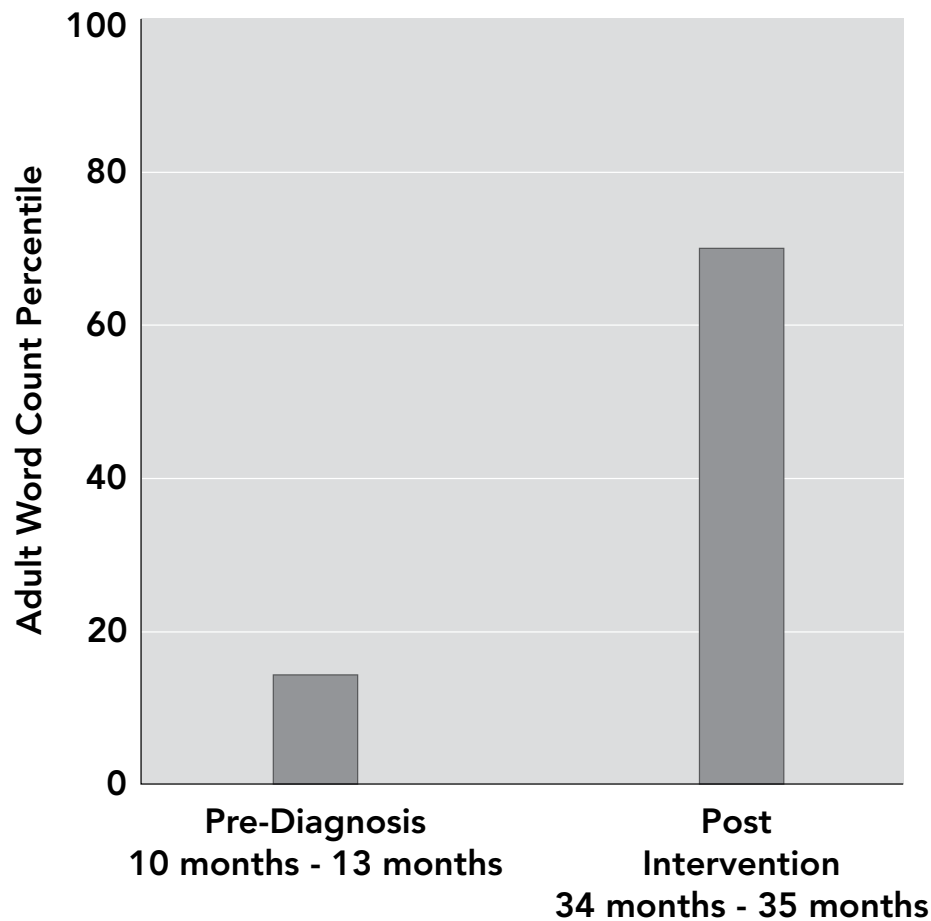
Percentiles are based on the LENA Foundation normative study utilizing over 35,700 hours of recording from329 families of typically developing

Enhanced Treatment Through In-Home Feedback

In the example above, Thomas' parents chose to monitor progress by running the DLP back and forth between their home and the SLP's office. This method works but is a bit difficult. Clearly the better way to monitor progress would be for the parents to purchase the parent version of LENA. In this case, parents are able to get feedback on their word counts and turns directly, and the processed LENA data files can be automatically sent through a secure website to the SLP's office computer.

LENA DataLink

Figure 21. LENA DataLink Flow Chart

2 *The participant can then send the processed data to the professional, via the Internet, or LENA Flashdrive with LENA DataLink.*

3 *The professional can import the participant's data from the Internet or LENA Flashdrive with the DataLink feature of the LENA software.*

LENA DataLink

1 *Participant records with the DLP as instructed by speech language professional.*

When recording is complete, the participant connects the DLP to his or her computer, which automatically begins processing the data.

Participant

LENA

Speech Language Professional

4 *View the imported data as reports within the LENA software.*

LENA Pro

More important, if parents have their own LENA system they can use it as often as they choose. The more feedback the better to enhance treatment and improve the language environment of the child. In fact, the conclusion from the many thousands of feedback studies is the more feedback the better. Our research also shows that parents tend to significantly overestimate how much they talk with their children. The impact of parents having their own LENA and getting feedback can be fairly dramatic in terms of enhancing treatment.

Example 4: Sarah (autism)

Below is a case study of Sarah (not her real name), who is being treated for autism. Shown is the adult word count of a treatment day compared to a non-treatment day. The parent did not have the benefit of feedback from the LENA system. The SLP can see the increase in adult word counts during treatment and how the adult word counts continue at a relatively high level after therapy. LENA shows the effectiveness of the therapy and the follow through by the caregiver. LENA then monitors the amount of adult talk during non-therapy days and the SLP can point this out to the parent.

Figure 22. Study of the Impact of Treatment
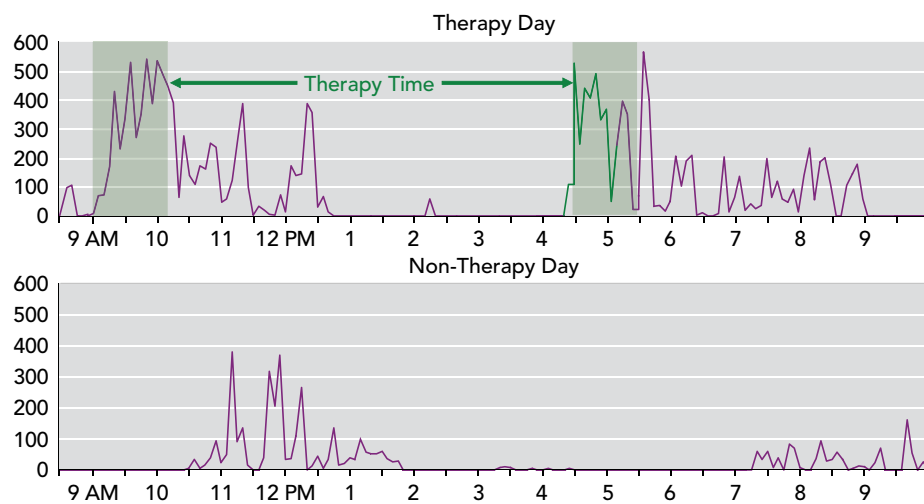
Example 5: Impact of Feedback

Below are the actual results of providing 16 parents with a LENA system. In the study shown parents were given a LENA DLP to record for a full day once per month for five months and were not shown the results. Initially there was no feedback. Then the parents were given a LENA System to use. Overall, Adult Word Count increased 55 percent on average after parents started receiving LENA feedback.

Figure 23. Impact of Feedback
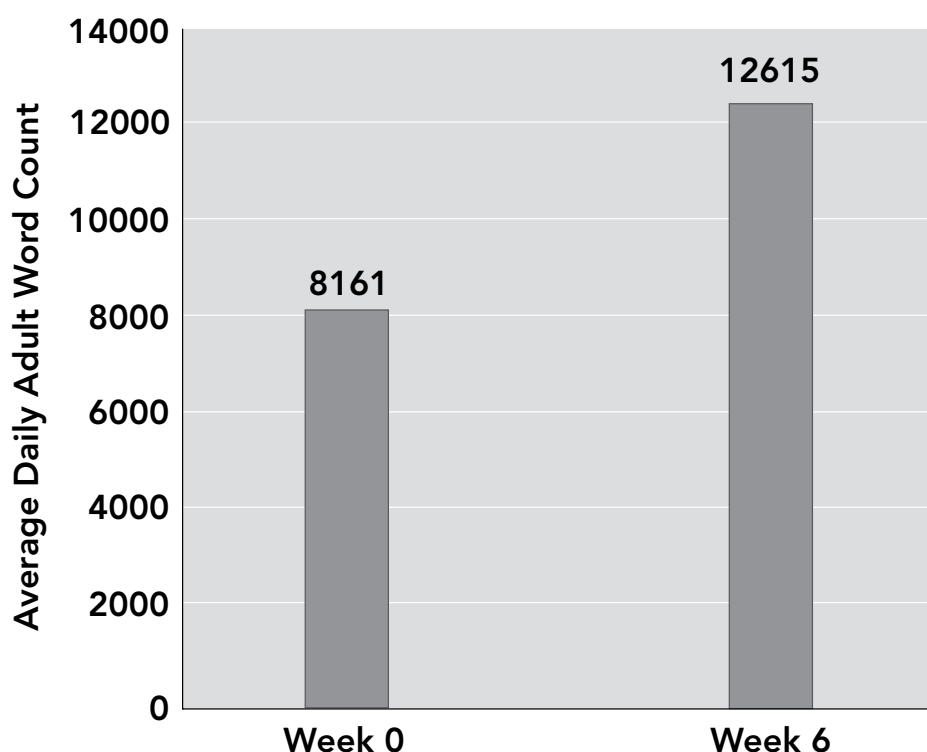
Average Adult Word Count for 27 US families participating in the LENA study. Increase of 55% in Adult Word Count, roughly from 23rd to 63rd percentile.

As every speech language professional knows, the key to improving and accelerating child language development is to improve the home language environment. This can only be done by involving parents and caregivers and helping them to change their behavior toward the child by increasing the amount they talk and interact with the child. The parent version of LENA makes this possible.

Conclusion

As you see with the examples of James, Thomas, and Sarah, LENA is a powerful new tool that pediatricians, speech language pathologists, and audiologists can use to improve the diagnosis and treatment of a variety of language delay and language disability problems.

The LENA System offers the speech language professional the opportunity to:

- Capture the natural language environment of the child in terms of adult word count, conversational turns, child vocalizations, and amount of TV exposure
- Monitor the fidelity of treatment and measure progress with reports and graphs that are in-depth, intuitive, and easy to understand
- Take advantage of the monitoring ability of LENA to fully understand the complexities of the child's audio environment
- Use valuable feedback on parents word counts and conversational turns to enhance treatment

We encourage you to investigate LENA further by visiting either the LENA Pro site at www.lenafoundation.org or the LENA Parent site at www.lenababy.com.