

LENA[®]

Building brains through early talk

EHDI 2024



Using LENA as a Tool to Support Language Outcomes in Early Intervention

1

Speakers

Lauren Pontis, AuD, CCC-A

- Salaried employee of University of Colorado at Boulder
- Contracted as CHIP facilitator with Envision in Weld County, Colorado

Kelly Doolittle, MA

- Salaried employee of Colorado School for the Deaf and the Blind
- CHIP/Colorado Home Intervention Program Coordinator – Northern and Eastern Colorado

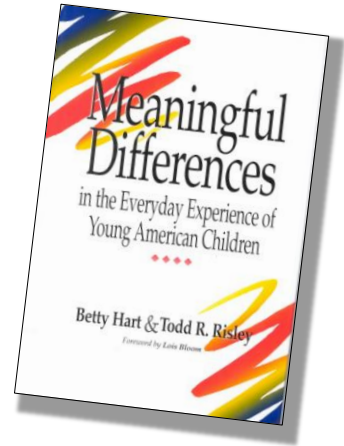
Kim Coulter, MA

- Salaried employee of LENA Foundation in Louisville, Colorado

2

The Talk Gap

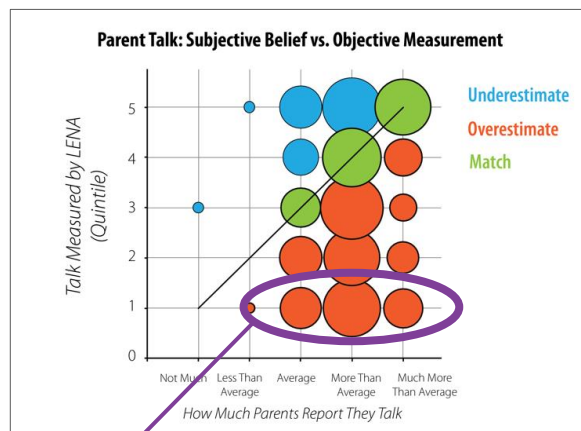
- Hart & Risley, 1995
- 10 years to complete
- “30-million-word” gap = *Opportunity Gap*
- Talk birth – 3 explains vocabulary & school gaps
 - Not race
 - Not parent education
 - Not SES



© LENA

3

We Talk Less Than We Think We Do



Those of us who talk the least overestimate the most

© LENA

Richards et al., *JEI* (2017)

4

“Talk Pedometer” Technology, but Much More



© LENA

5

LENA in a Nutshell

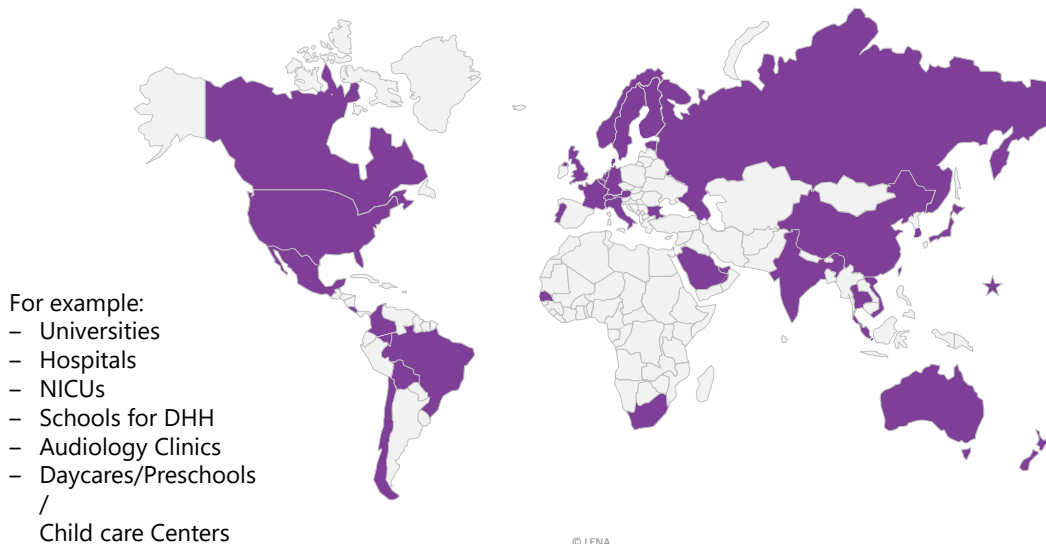
- Technology measures talk
 - Early childhood
 - Global “Gold Standard”
- Actionable real-time data



© LENA

6

400+ Professional Groups Using LENA Worldwide



7

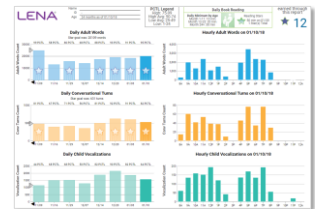
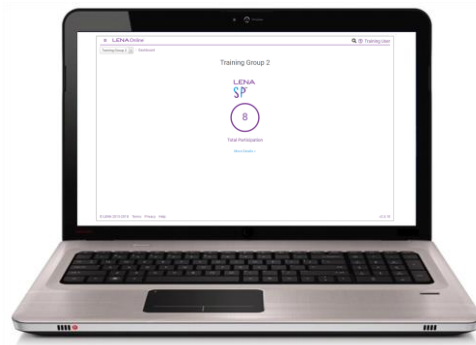
LENA Language Validations

- Chinese, Shanghai Dialect of Mandarin
 - 2015, Gilkerson et al.
- Dutch
 - 2017, Busch et al.
- French (Canadian) – English bilinguals
 - 2019, Orena et al.
- French (European)
 - 2015, Canault et al.
- Hebrew and Arabic
 - 2022, Levin-Asher et al.
- Italian
 - 2023, Bastianello et al.
- Korean
 - 2021, McDonald et al.
- Spanish
 - 2013, Weisleder and Fernald
- Swedish
 - 2017, Schwarz et al.

© LENA

8

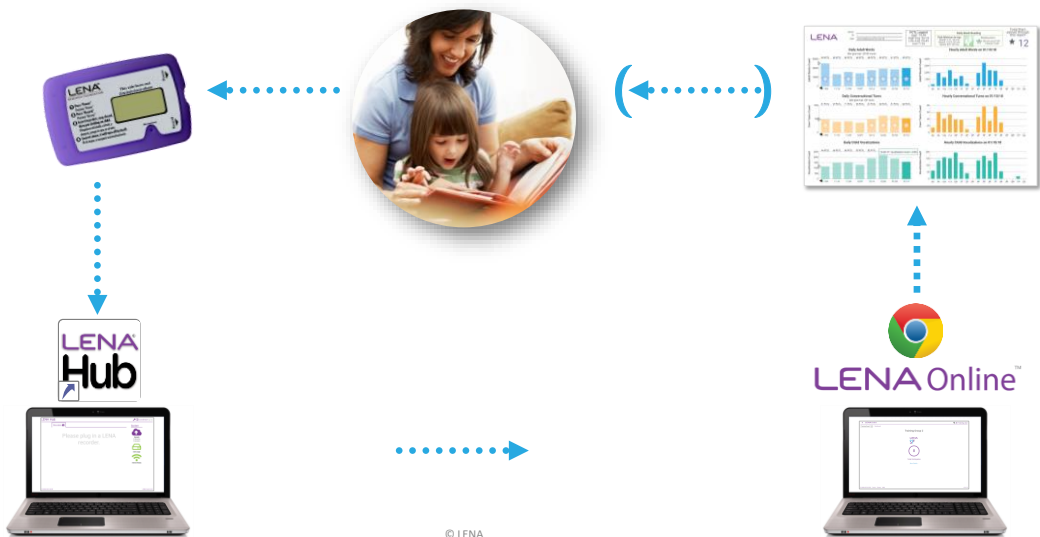
How Does LENA Work?



© LENA

9

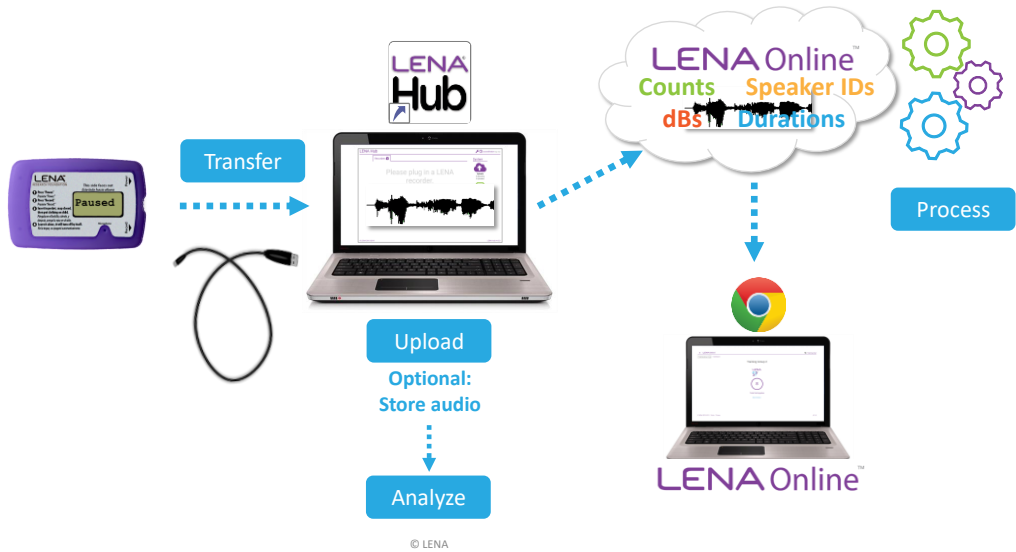
The LENA Recording Cycle



© LENA

10

SP Data Flow – Cloud Processing



11

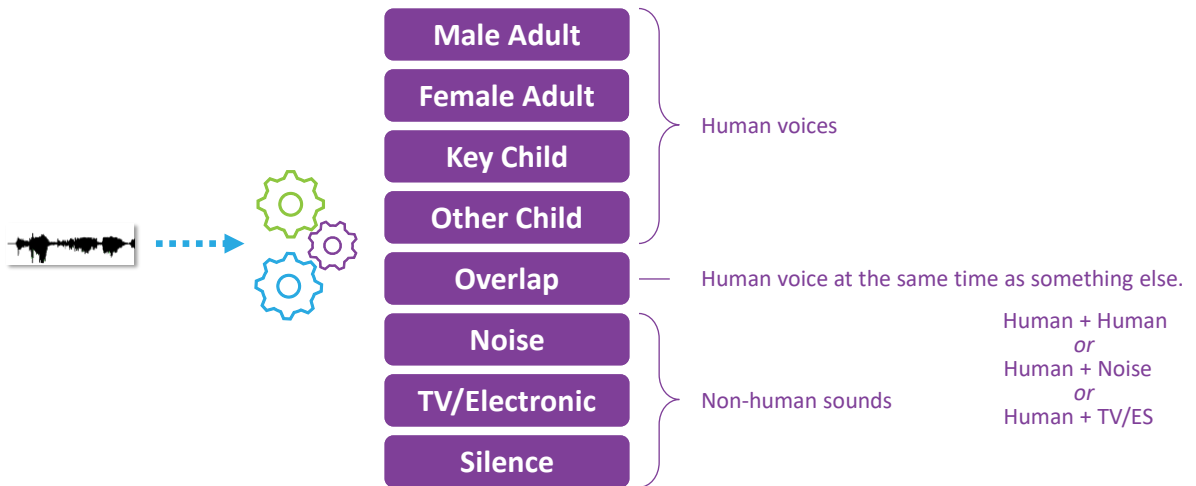
Introduction to Segmentation and the LENA Report



© LENA

12

LENA Audio Processing Flow



These labels apply at the segment level (~0.6-1 second).
Only one label applies at any point in time.

© LENA

13

LENA Audio Processing Flow

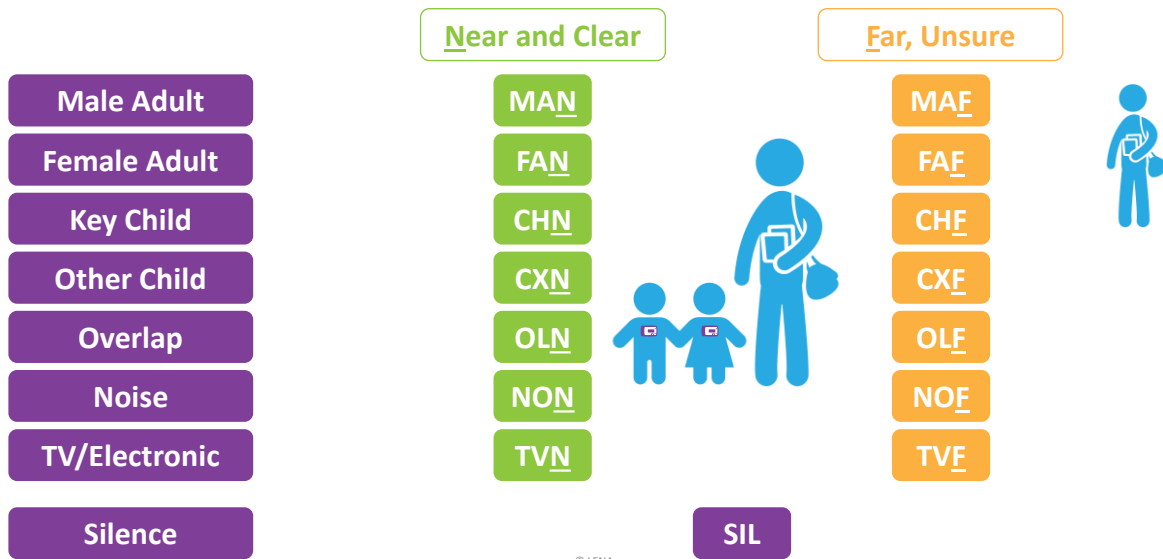
Male Adult	MA
Female Adult	FA
Key Child	CH
Other Child	CX
Overlap	OL
Noise	NO
TV/Electronic	TV
Silence	SIL

These labels apply at the segment level (~0.6-1 second).
Only one label applies at any point in time.

© LENA

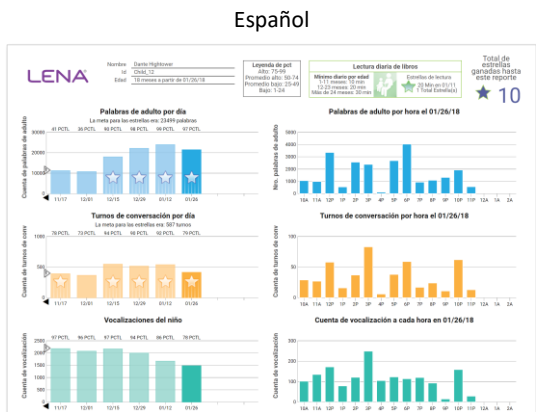
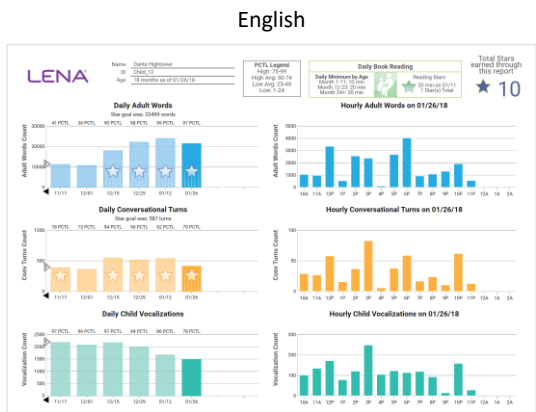
14

LENA Audio Processing Flow

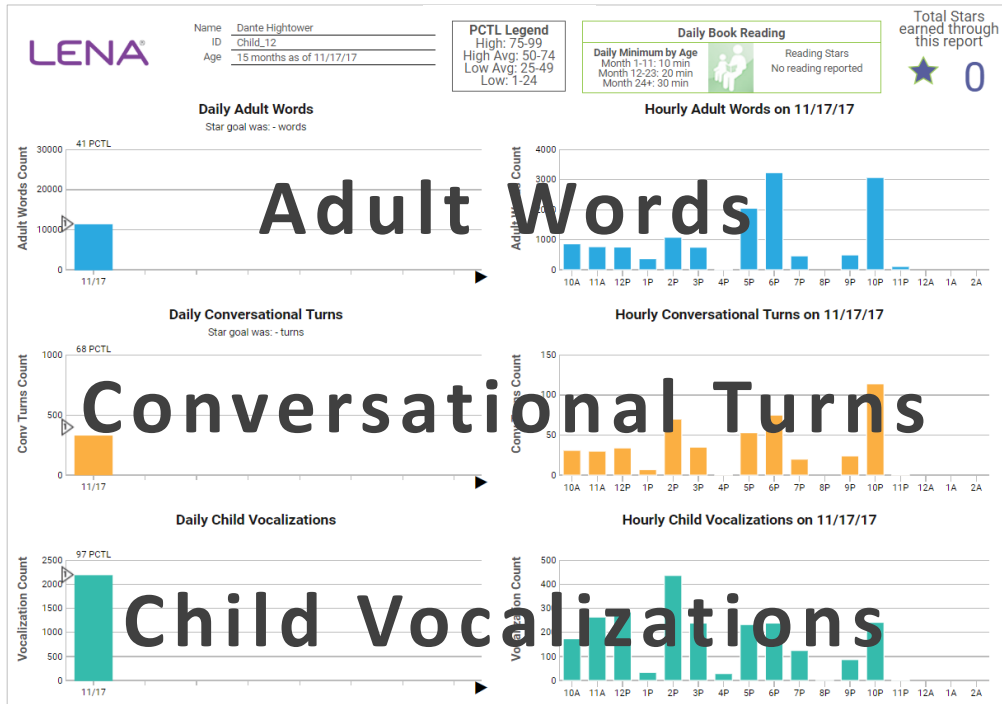


15

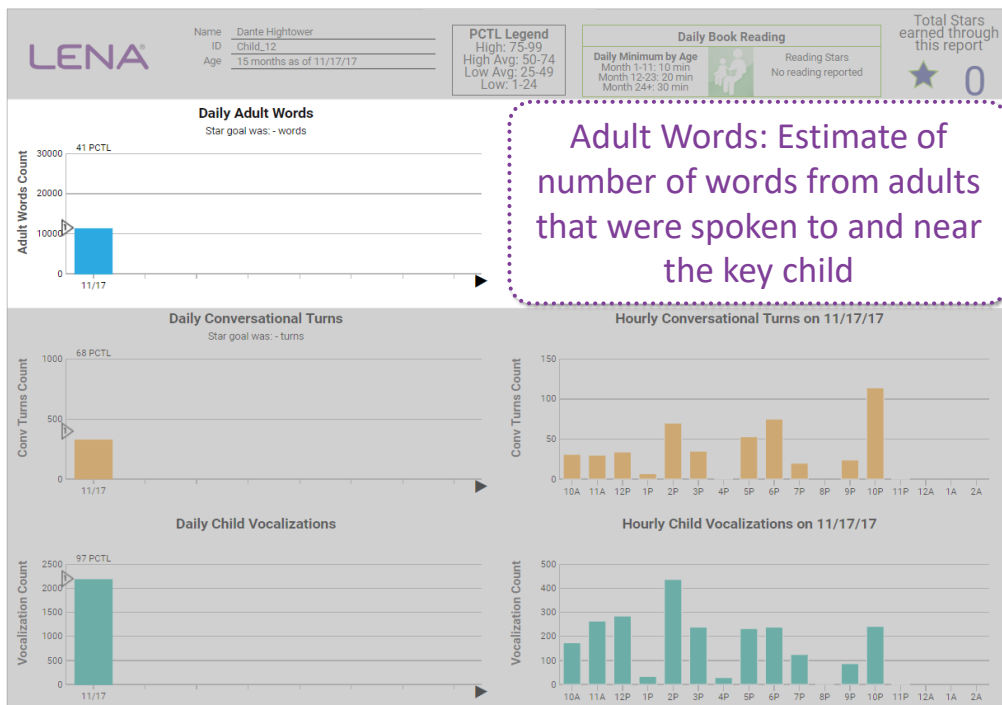
LENA SP Reports



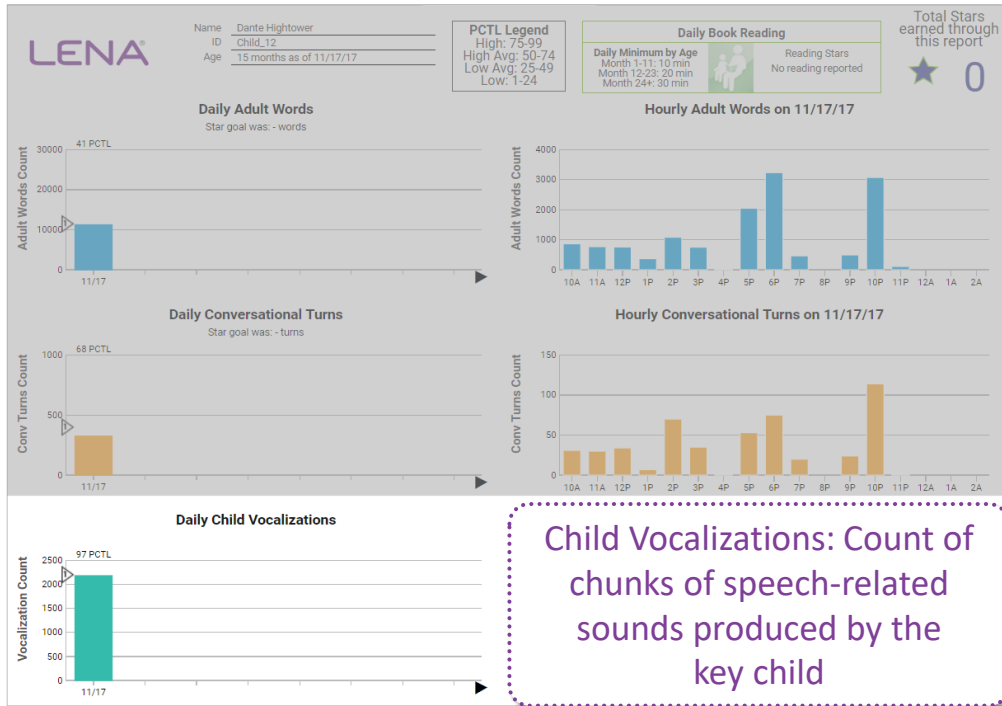
16



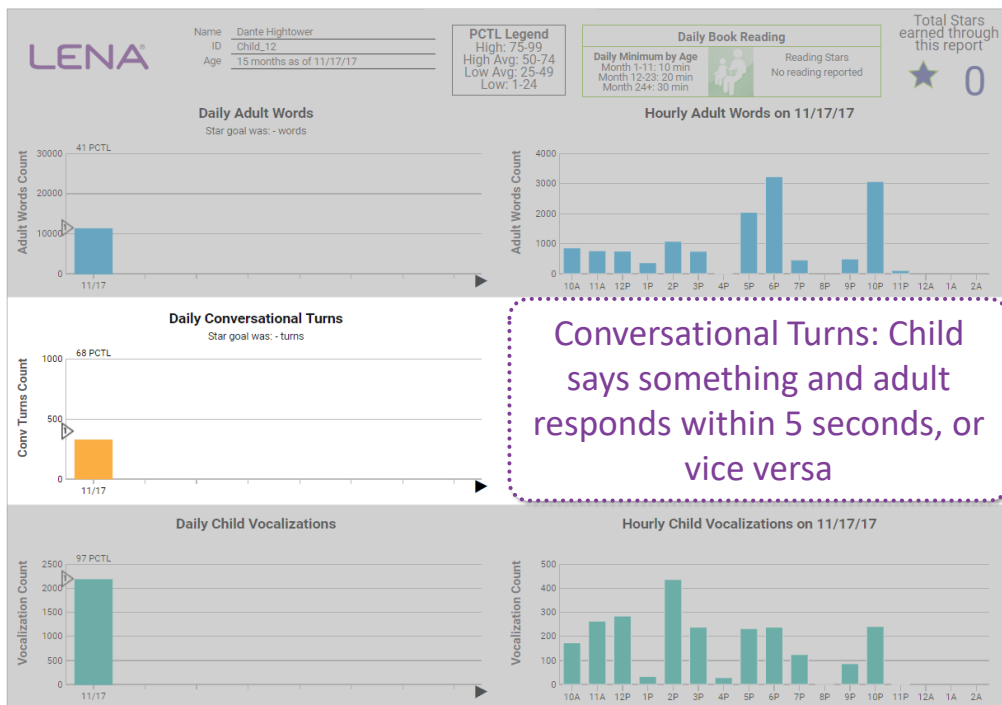
17



18

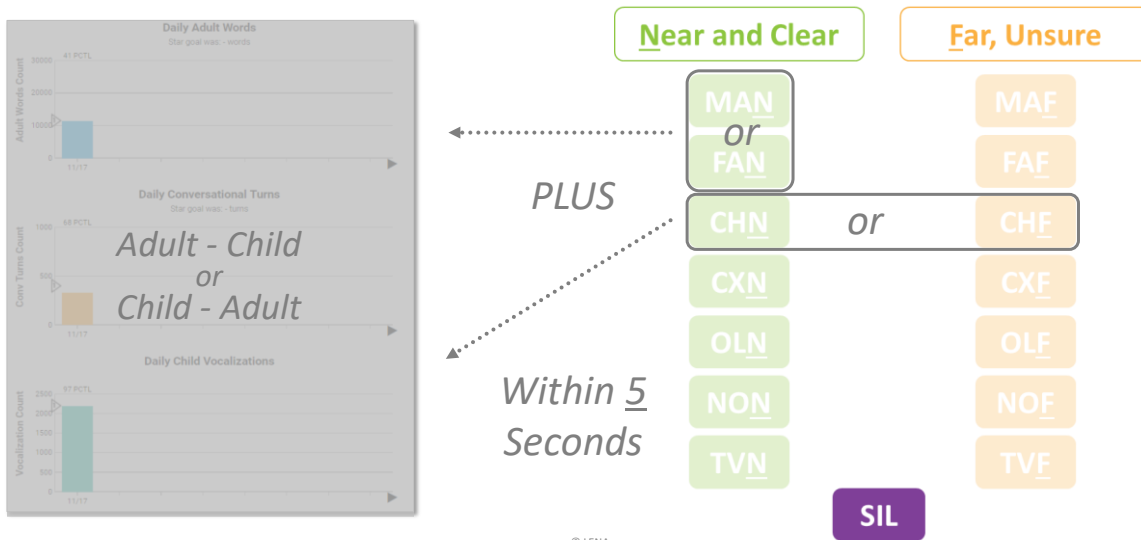


19



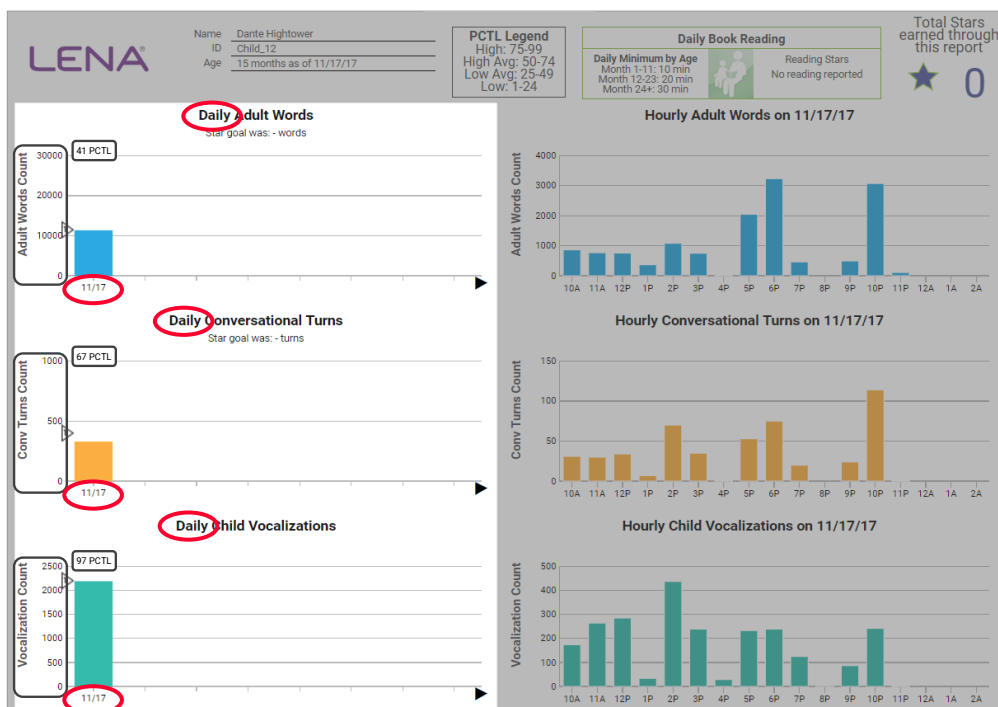
20

Segments in the LENA Reports

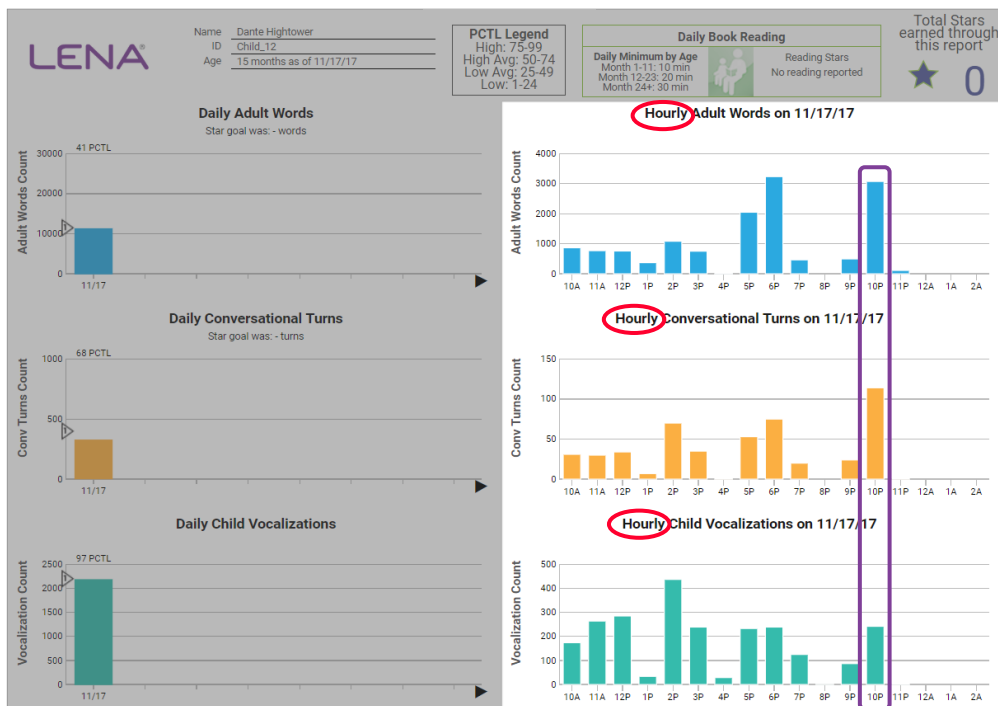


© LENA

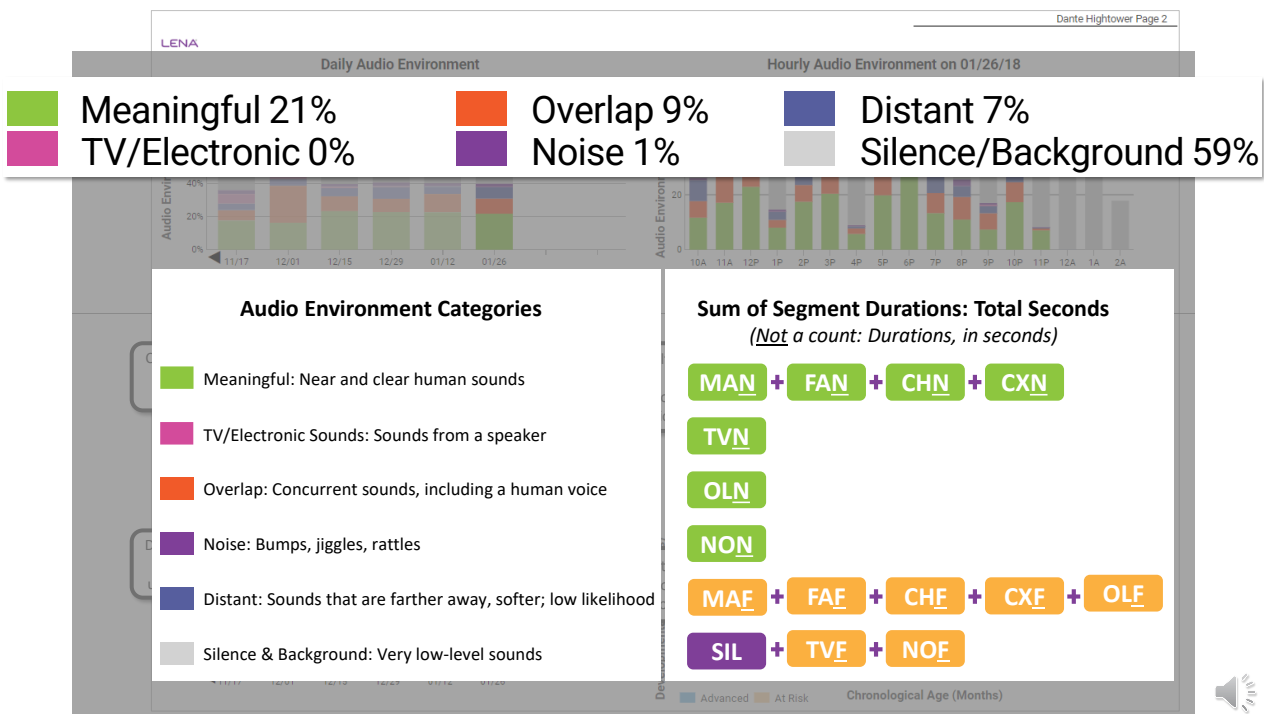
21



22



23

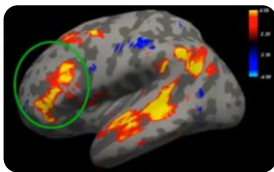


24



25

Research & Clinical Applications



26

Sample Use, Intervention/Deaf and Hard of Hearing

- CHIP helped inform development of LENA SP, additional data to include
- Switch to SP has simplified logistics
- Parental feedback
- LENA counts provide stretch goals

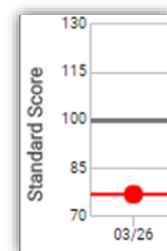


© LENA

27

Anecdote from EHDI

- Child has hearing loss
- Extremely low AVA score (speech complexity)
- Interventionist encouraged evaluation
- Child diagnosed with apraxia at ~1.5 years
- Completely changed approach to intervention
- Child speaking a lot more and more clearly as a result



© LENA

28

Words are good...

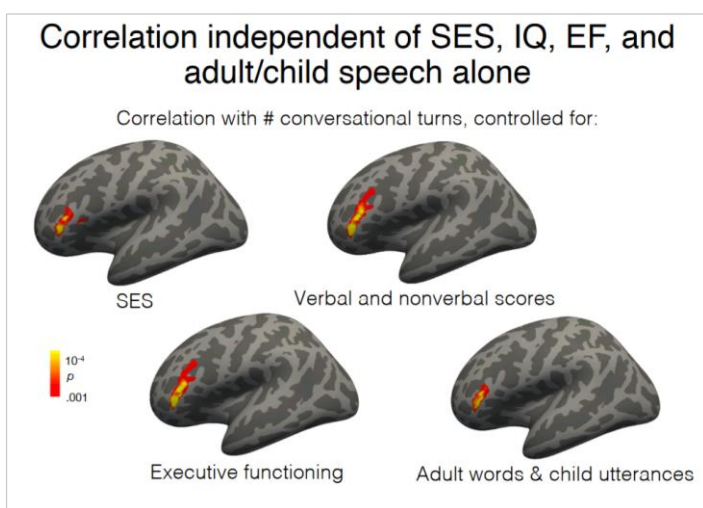


...and **Turns** are better!

© LENA

29

Sample Use, Research



© LENA

Romeo, R. (2018). *Beyond the 30 Million Word Gap: A Conversation with Rachel Romeo* [PowerPoint slides]. Retrieved from <https://bit.ly/2H9URkk>.

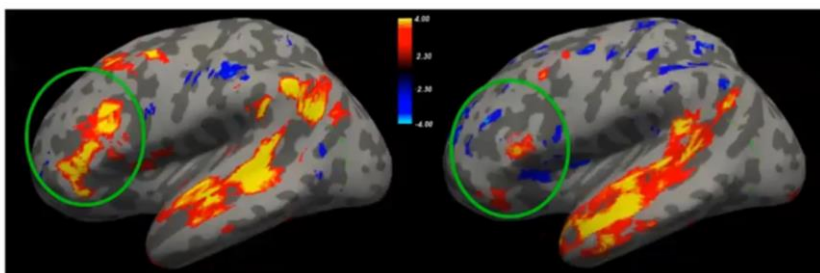
30

A Tale of Two Brains

fMRIs from two lower-SES female children (high-school education + \$50K total family income)

1,220 turns per day
Verbal score = 121

580 turns per day
Verbal score = 90

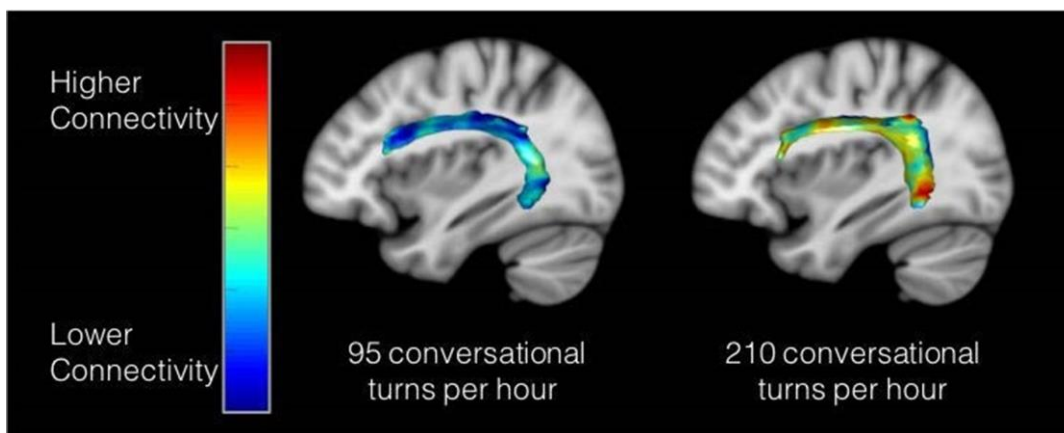


Romeo et al., Psychological Science, 2018

© LENA

31

Brain Structure also Linked to Turns

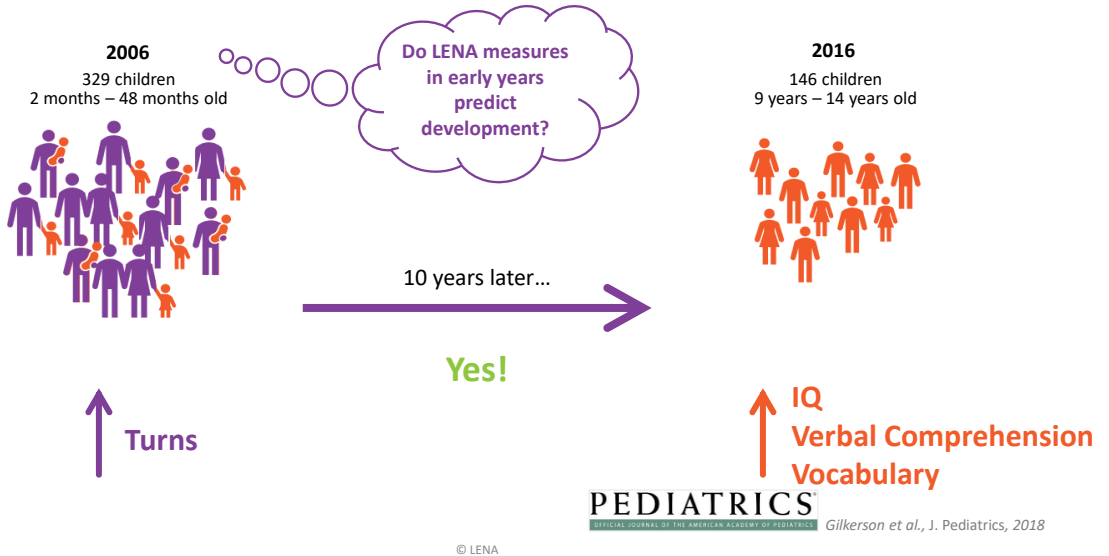


Romeo et al., The Journal of Neuroscience, 2018

© LENA

32

LENA 10-Year Longitudinal Study



33



Using LENA in the Colorado Home Intervention Program



Explaining LENA to families

34



35



CHIP Services are:

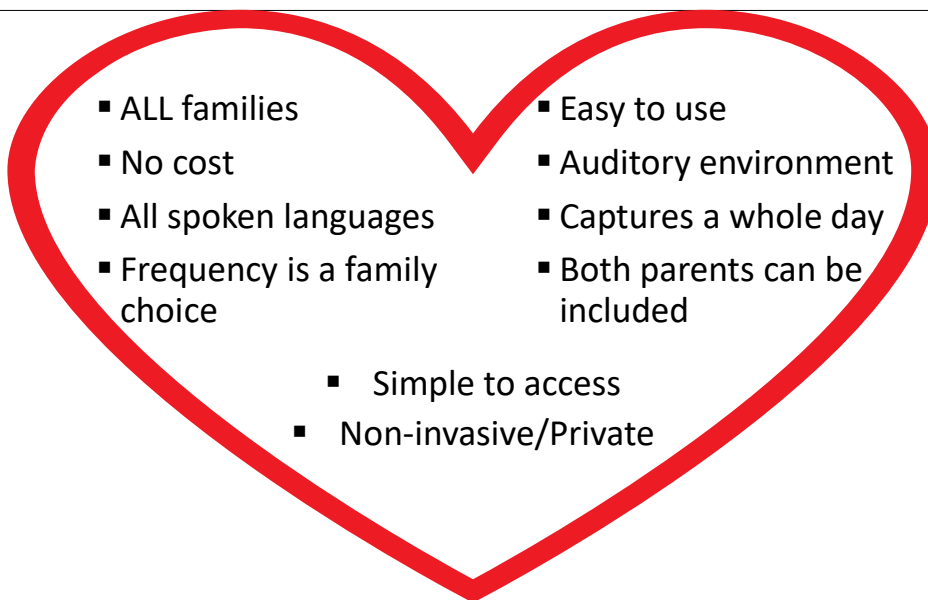


- In the home
- CHIP Facilitator
- Family Focused
- Language focused
- Use a coaching model
- Data driven**
- Play based
- Follow the IFSP
- Fun!

36



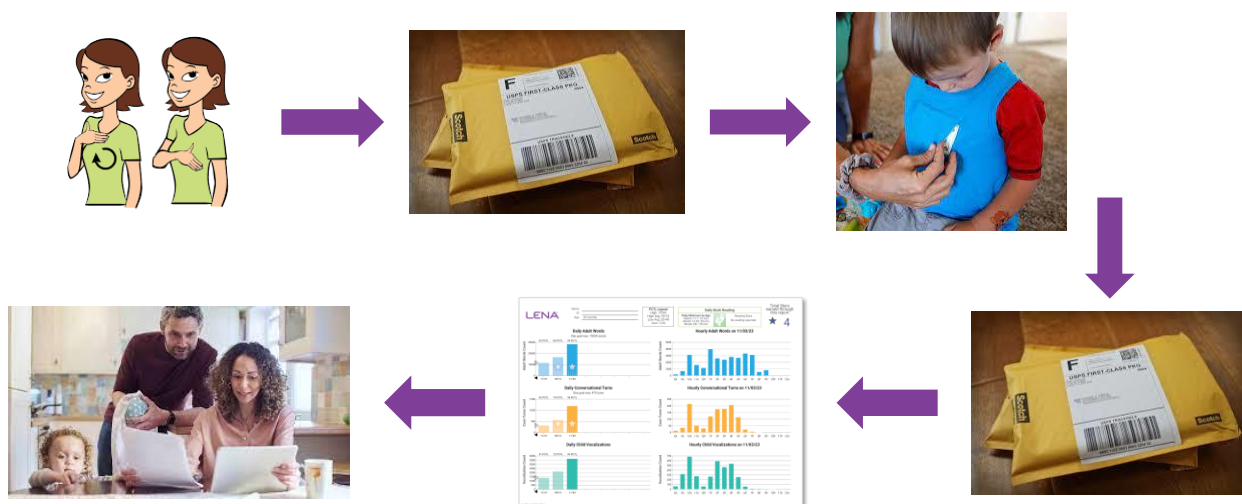
Why Families and CHIP LOVE LENA:



37



How it works for us:



38



Parent Testimonials

“ We have used the LENA assessment for our two kids with (unilateral) microtia and moderate hearing loss. I was so thankful this exists, because I have no experience with child development and didn't know what I should be looking for. **We discovered after our first assessment that we weren't talking to our newborn enough, and once we added the extra communication, we saw improvements on his speech development.** We love to check in and see our kids' progress! ”

- *Ali*

39



Parent Testimonials

“ Using LENA has given us the ability to paint a much larger picture of language exposure as well as expressive language for our D/HH son. He was born to two hearing parents, so amongst all the feelings of confusion, **having the data to see what we were doing right regarding language exposure, and where we needed to do better, was an incredible tool.** We've used it a handful of times, and each time the compiled data is insightful, helpful, and a snapshot into his world that I never had considered previously. ”

- *Sarah*

40



Parent Testimonials

“Our family has used a LENA device three times now with our son. It has been a wonderful opportunity to see the amount of words and conversational turns our son hears and speaks throughout the day. It shows us where he is at on a percentile rate, and it gives us the chance to analyze where we are doing well as a family and where we could improve. **The device is able to show us times of day that our son is more vocally active and times where his listening environment may have been more difficult.** It's also great because it allows us to compare to his previous assessments and make adjustments and see where we are improving or still need to improve.”

- *Teryn*

41



Parent Testimonials

“The device itself is **easy to use** and our son never has minded wearing it. I truly believe our son and family have benefited from being able to access this technology!”

- *Kenzie*

42



Parent Testimonials

“...[W]e try to do a LENA test every 3ish months because it is a great way for us to see how well our child has improved with not only his speech but **conversational turns, and complexity of his words**. Thanks to the LENA, we were able to see when he started to plateau in speech development, and we started speech therapy around 19 months old. Not only does the LENA allow us to look back at how well he has grown and developed, but it also **lets us know that speech therapy and our working with him at home is helping him accomplish his speech goals.**”

- Emily

43



CHIP Facilitator Testimonial



“ I find that data from LENA can really help to **motivate families** to increase conversational turns in their day-to-day routines! This tool is a great complement to the strategies that I practice with families during early intervention sessions. ”

- Lauren

44

A few of the many Benefits of using LENA with CHIP:

- Family awareness
- Provider awareness
- Easy to read graphs to mark progress over time
- Data to support IFSP/IEP goals and strategies
- Collaboration with Audiology, private providers etc
- Autism screener
- Support technology use
- Cochlear Implants – pre and post to track ongoing progress

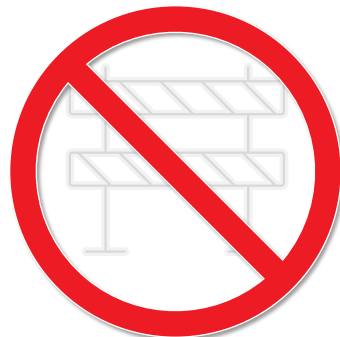
45



Occasional Roadblocks

- ✓ Conversation
- ✓ Showing and example report
- ✓ Parent to Parent support
- ✓ Education

- Hesitancy about being recorded
- Progress not being made
- Twins
- Day cares/confidentiality
- Use Errors



46



Case Studies

One Child's Data Over Time



University
of Colorado
Boulder

47



Vocal turn-taking in children with hearing differences



- Number of conversational turns with caregivers is strongly predictive of spoken language outcomes in hard of hearing children (Ambrose et al., 2015; VanDam et al., 2012)
- However, some evidence suggests that parents tend to engage in fewer conversational turns with DHH children than with children with typical hearing (Tait et al., 2007; Kondaurova et al., 2020; Kondaurova et al., 2022).

48



Case Study

- 24-month-old boy who has unilateral left microtia and aural atresia with associated unilateral left moderate to severe conductive hearing loss
- Working on consistent use of softband-retained bone conduction hearing device
- Spanish-speaking family
- Delayed gross motor milestones and delayed expressive and receptive language, receives physical therapy and CHIP early intervention services
- No known additional disabilities



Oticonmedical.com

49

Counseling following 1st LENA trial

- Family provided with written LENA report in Spanish
- CO-Hear coordinator joined early intervention provider to discuss results with family
- Family expressed interest in additional future LENA trials to monitor progress
- Focused sessions on strategies for increasing conversational turns

50



Counseling following 1st LENA trial

- Multiple resources shared with family throughout subsequent sessions:

["Your Child's Brain Needs Talk"](#)
(LENA Foundation)

["The 14 Talking Tips"](#)
(LENA Foundation)

["Constant Conversation"](#)
(John Tracy Clinic)

["Interactive Turn Taking"](#)
(SKI-HI Institute Curriculum)

Additional resources from LENA available [here!](#)

51



Counseling following 2nd LENA trial

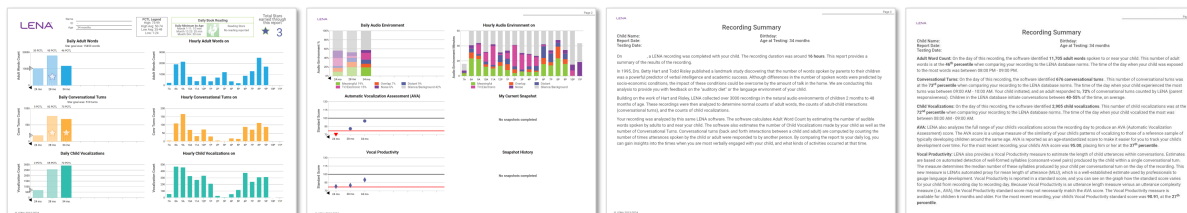
Family provided with written report in Spanish.

Family was encouraged to keep up the amazing work!



52

The Full LENA Report



53

LENA SP Report, p. 1

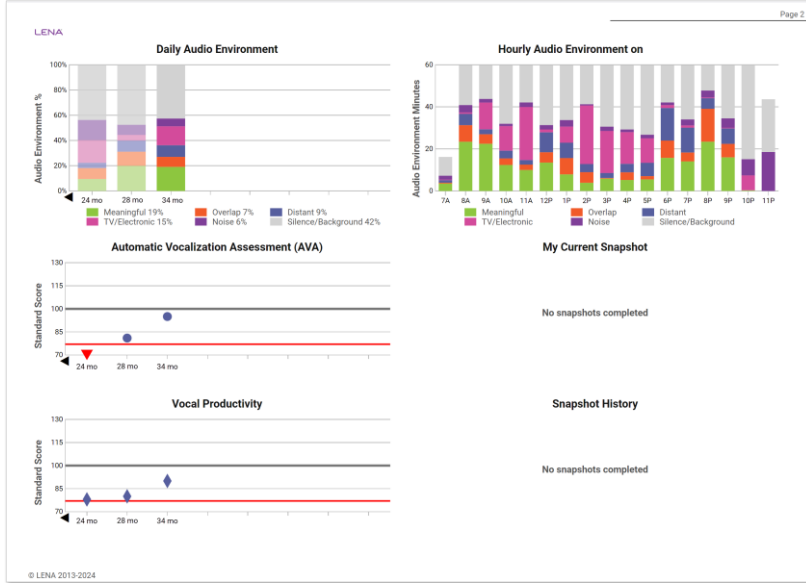


54





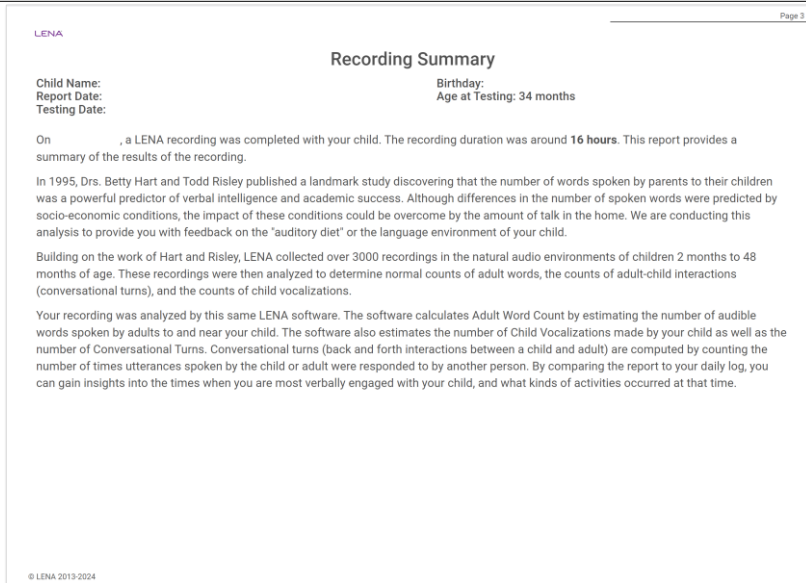
LENA SP Report, p. 2



55



LENA SP Report, p. 3



56



LENA SP Report, p. 4

LENA Page 4

Recording Summary

Child Name: Birthday:
Report Date: Age at Testing: 34 months
Testing Date:

Adult Word Count: On the day of this recording, the software identified **11,705 adult words** spoken to or near your child. This number of adult words is at the **46th percentile** when comparing your recording to the LENA database norms. The time of the day when your child was exposed to the most words was between 08:00 PM - 09:00 PM.

Conversational Turns: On the day of this recording, the software identified **676 conversational turns**. This number of conversational turns was at the **73rd percentile** when comparing your recording to the LENA database norms. The time of the day when your child experienced the most turns was between 09:00 AM - 10:00 AM. **Your child initiated, and an adult responded to, 72% of conversational turns counted by LENA** (parent responsiveness). Children in the LENA database initiate conversations between **40-55%** of the time, on average.

Child Vocalizations: On the day of this recording, the software identified **2,905 child vocalizations**. This number of child vocalizations was at the **72nd percentile** when comparing your recording to the LENA database norms. The time of the day when your child vocalized the most was between 08:00 AM - 09:00 AM.

AVA: LENA also analyzes the full range of your child's vocalizations across the recording day to produce an AVA (Automatic Vocalization Assessment) score. The AVA score is a unique measure of the similarity of your child's patterns of vocalizing to those of a reference sample of typically developing children around the same age. AVA is reported as an age-standardized score to make it easier for you to track your child's development over time. For the most recent recording, your child's AVA score was **95.00**, placing him or her at the **37th percentile**.

Vocal Productivity: LENA also provides a Vocal Productivity measure to estimate the length of child utterances within conversations. Estimates are based on automated detection of well-formed syllables (consonant-vowel pairs) produced by the child within a single conversational turn. The measure determines the median number of these syllables produced by your child per conversational turn on the day of the recording. This new measure is LENA's automated proxy for mean length of utterance (MLU), which is a well-established estimate used by professionals to gauge language development. Vocal Productivity is reported in a standard score, and you can see on the graph how the standard score varies for your child from recording day to recording day. Because Vocal Productivity is an utterance length measure versus an utterance complexity measure (i.e., AVA), the Vocal Productivity standard score may not necessarily match the AVA score. The Vocal Productivity measure is available for children 6 months and older. For the most recent recording, your child's Vocal Productivity standard score was **90.91**, at the **27th percentile**.

57

Summary

- LENA is a helpful tool in EI setting for providing families with data and actionable steps for increasing spoken language development
- Rapid and sustained progress is possible!
- Consider tying conversational turn taking and LENA data into IFSP outcomes

58

References

- Ambrose SE, Walker EA, Unflat-Berry LM, et al. (2015). Quantity and quality of caregivers' linguistic input to 18-month and 3-year-old children who are hard of hearing. *Ear and Hearing*, 36(1), 48S–59S.
- Kondaurova MV, Smith NA, Zheng Q, et al. (2020). Vocal turn-taking between mothers and their children with cochlear implants. *Ear and Hearing*, 41(2), 362–373.
- Kondaurova, MV, Zheng, Q, VanDam, M, Kinney, K. (2022).Vocal turn-taking in families with children with and without hearing loss. *Ear and Hearing*, 43(3), 883-898.
- Tait M, De Raeve L, Nikolopoulos TP (2007). Deaf children with cochlear implants before the age of 1 year: Comparison of preverbal communication with normally hearing children. *International Journal of Pediatric Otorhinolaryngology*, 71, 1605–1611.
- VanDam M, Ambrose SE, Moeller MP (2012). Quantity of parental language in the home environments of hard-of-hearing 2-year-olds. *Journal of Deaf Studies and Deaf Education*, 17(4), 402–420.

59

Thank you!



Have questions? Feel free to reach out!

lauren.pontis@colorado.edu

www.colorado.edu/SLHS

kdoolittle@cldb.org

www.CSDB.org

kimcoulter@lena.org

www.LENA.org



60