

Changing Conversations from the Ear to the Brain

Three-Hour Virtual Workshop

March 6, 2026

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Introduction of the Speaker

Carol Flexer, PhD, CCC-A, LSLS Cert. AVT, received her doctorate in Audiology from Kent State University in 1982.

She is a Distinguished Professor Emeritus of Audiology, The University of Akron.

An international lecturer in pediatric and educational audiology and author of more than 155 publications including 17 books, Dr. Flexer is a past president of:

- The Educational Audiology Association
- The American Academy of Audiology
- The AG Bell Academy for Listening and Spoken Language

Themes for March 6, 2026

Theme One:

Discussion of the latest brain research highlighting the connection between the brain, hearing, and use of hearing technologies.

Theme Two:

Description of two family-friendly counseling narratives. The goal of this type of “brain” counseling is to emphasize the urgency of the child’s technology wear-time, which is a critical variable in obtaining a listening and spoken language outcome.

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Theme Three:

Sleep and Development

Theme Four:

Discussion of literacy and music focusing on auditory brain development.

Theme One – Auditory Brain Development

The Foundation of Listening, Language, Communication, Literacy, and Music

We Must Begin with the Critical Question

What is the Family's Desired Outcome? (Family Choice)

- The family's desired outcome guides us ethically and legally.
 - Ask the family: What is your long-term goal for your child and what does it take to get there?
 - How do you want to communicate with your child?
 - What language(s) do you know?
 - 95% of children with hearing loss are born to hearing and speaking families.
 - Many families speak a language at home that is different from the community language, so they may want their child to speak several languages.
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To Create a Context for Understanding Hearing

Start with the Brain.

The World Has Changed

How did we used to talk about hearing, and what did we believe to be true?

We used to talk about hearing as if we heard with the ear. Now we know that the **meaning of hearing occurs in the brain.**

The world has changed for hearing healthcare; we are in a new era.

Advances in knowledge about brain plasticity, auditory deprivation, and critical periods for language development have shifted the concentration of hearing management **from the ear to the brain.**

Brain Clip – General Brain Development

<https://www.youtube.com/watch?v=VNNsN9IJKws>



The Challenge

How do we take this knowledge of neuroplasticity and transform it into a counseling narrative that explains hearing?

Let's begin with a brief summary of what we know about the **auditory brain.**

Sample References About Auditory Brain Research

- Kral, A. et al. (2025). *Sensorimotor contingencies in congenital hearing loss: The critical first nine months.* Hearing Research.
- Kral, A. (2013). *Auditory critical periods: A review from a systems perspective.* Neuroscience.

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- Kral, A., & Sharma, A. (2012). *Developmental neuroplasticity after cochlear implantation*. Trends in Neurosciences.
- Kraus, N. (2018). *Promoting sound health*. The Hearing Journal.
- Moon, C., Lagercrantz, H., & Kuhl, P. (2013). *Language experienced in utero affects vowel perception after birth*.

The Brain

The brain, unlike any other organ, is essentially unformed when one is born. Brain development is completely dependent on environmental experience.

Babies are born with neurons, but **synapses are created by experiences**.

Clinical geneticist Kyle Kai-How Farh stated:

“Everything that comes into our minds reduces to patterns of neural activities.”

Dr. May, 2017, found that at the time human infants are born, the neural preparation for language is specialized to speech due to spoken language being heard in utero. At birth the human brain responds uniquely to speech.

Sound Processing Complexity (Kraus, 2018)

Sound processing is one of the most computationally demanding tasks the nervous system performs.

The auditory system responds to input more than **1,000 times faster** than the visual system.

Humans can hear faster than they can see, taste, smell, or feel.

Sensorimotor contingencies in congenital hearing loss: The critical first nine months (Andrej Kral et al., 2025, *Hearing Research*, Vol 467, 109401)

The First Year Shapes the Listening Brain

The first **9–12 months** are a period of rapid neural organization.

Sensory, motor, and communication systems develop together.

Infants learn through **action-feedback loops**:

Move → Hear → See → Feel

Repetition strengthens synchronized brain pathways.

Key message:

Early auditory access protects neural synchrony.

Key Point

The brain undergoes **time-sensitive neuroplastic changes**, and early sensory input is crucial for proper auditory development.

Hearing loss is not just an auditory disorder; it is also a **neurological condition** affecting multiple brain regions, alters brain asymmetry, and may contribute to cognitive decline. The findings of auditory brain research enforces the importance of **early intervention, hearing aids, and cochlear implants** to potentially **slow down or prevent these structural changes**.

The brain's ability to adapt decreases as it matures. If auditory input is not restored early, the **synaptic plasticity needed for normal auditory function is lost**, making it difficult for the brain to process sound effectively later in life.

Auditory Brain Development: What Is at Stake?

Two processes are at stake:

- the actual physiological development of the auditory brain by coupling the primary to the secondary auditory cortex for the distribution, connection and integration of synaptic pathways throughout the brain;
- and, the growth of the child's knowledge through the child's brain exposure to auditory information during every waking minute.

When the child’s ear/doorway is severely obstructed, the wearing of optimally inserted and programmed technology is essential for both of these processes.

How do professionals actually start a counseling narrative about the auditory brain to create a context for understanding hearing?

Begin at the beginning!

Connect the dots between hearing, brain plasticity, technology, listening, talking and literacy development. How does information get into the child’s brain?

How do Children Learn Language and How to Listen, Talk, Communicate, and Read?

- Children learn language and how to listen, talk, and communicate by hearing and listening to the speech and spoken language of their parents, caregivers, and family members.
 - A child who is deaf or hard of hearing can also learn spoken language just like their hearing peers when they are identified early, consistently wear appropriate hearing devices such as hearing aids and/or cochlear implants and are taught to listen through special auditory-verbal teaching techniques that are guided by LSL Specialists.
 - A child who is deaf or hard of hearing can also learn to read just like their hearing peers when they are identified early, consistently wear appropriate hearing devices such as hearing aids and/or cochlear implants, and are taught to listen through special LSL teaching techniques that are guided by LSL Specialists.
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Theme Two: The Following slides describe *Counseling Narratives*: Right from the start, explain complex information about hearing in a comprehensible fashion – offer the big picture!

Families often do not know what we are talking about.....define terms.

What is Sound? (Boothroyd, 2019)

Sound is an “event”.

For example, you don't "hear" Mommy. You hear Mommy walking, talking, singing, tapping, dancing.

An event creates vibrations.

Vibrations (raw auditory data) are picked up by the "ear doorway" and are sent to the brain as energy for coding, and for perception as information.

What is Language?

Language is an organized system of communication used to share information.

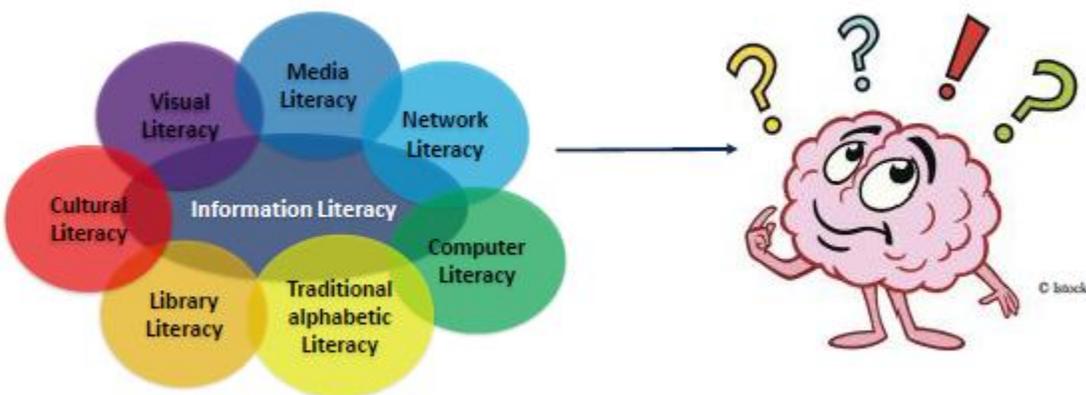
Spoken language consists of sounds, words and grammar used to express inner thoughts and emotions.

Spoken language also includes facial expressions, gestures, and body movements.

Language organizes the ideas/knowledge in our head that we want to communicate to others.

Counseling Narrative #1 – The Doorway

But, how Does Information Get into the Child's Brain?



The **five senses** capture environmental information and transform it into neural impulses read by the brain.

- Hearing
 - Sight
 - Smell
 - Taste
 - Touch
-

For example

The nose is the doorway for smell — but we **smell with the brain**.

Similarly, the eyes are the doorway for vision — but we **see with the brain**.

The ear is the doorway for sound — but we **hear with the brain**.

The point: the Ear is the “Doorway” to the Brain for Sound -- Spoken Language/Information – Talking – Reading. We hear with the brain – not with the ears! The five sense organs are portals to the brain for environmental information.

The Purpose of Technologies

The ONLY purpose of technologies (e.g. hearing aids, cochlear implants, remote wireless systems) is to get sound – auditory language information -- through the obstructed doorway to the brain. **There is no other purpose!**

The choice of hearing technology depends on what is happening in the child’s doorway.

Counseling Narrative #2 – The Computer Keyboard Analogy

- Data input precedes data processing
 - Hearing loss or poor acoustic environments can be thought of as analogous to having a malfunctioning computer keyboard that interferes with data entry to a child’s brain – the hard drive.
-

Hearing Technology Facilitates Input to the Brain

Amplification technologies (hearing aids, RM systems, cochlear implants) facilitate data entry to the child's brain by providing a more accessible keyboard.

A great keyboard does not "fix" the child's hard drive.

What Is Hearing?

- Hearing can be defined as "*brain perception of auditory information.*"
 - Hearing is a first-order event for the development of spoken language.
 - Anytime the word "hearing" is used, think "**auditory brain development**" using 1 billion neurons with a quadrillion connections -- and connections are made only through auditory experience!
 - Acoustic accessibility of *intelligible* spoken language is essential for brain growth.
 - **There are no "earlids" – the brain is available for auditory information 24/7.**
 - Signal-to-Noise Ratio (SNR) is the key to hearing intelligible auditory information – speech must be 10 times louder than background sounds. Download **SLM APP on iPhones or Tablets.**
-

Hearing vs Listening

Hearing is acoustic access to the brain – brain perception of auditory information; it includes improving the signal-to-noise ratio by managing the environment and utilizing hearing technology.

Listening is attending to acoustic events with intentionality – activating the pre-frontal cortex.

Understanding is learning the meaning of auditory information.

"Hearing" must be made available before "listening" can be taught and information learned.

We must know about the "hearing thing" before we can do the "listening thing".

Summary: The Hearing and Listening Mechanisms

The Listening Mechanism (Brain): Learns the meaning of the neural events through auditory exposure and practice

The Hearing Mechanism (Doorway): Takes in Vibrations

How Does this Input-Output Hearing and Listening Mechanism Actually Show-Up?

Spoken Communication: Past And Present

1. Audio clips of possible “oral” outcomes before early identification, early intervention, and cochlear implant technology
 2. Video clip of possible Listening and Spoken Language (LSL)” outcomes in this day and age
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So, what Does “Deaf” Look Like in 2026?

Does 2026 “Deaf” look like 1990 “Deaf”?

We have used the same words for decades, but the context and possibilities have changed, dramatically!

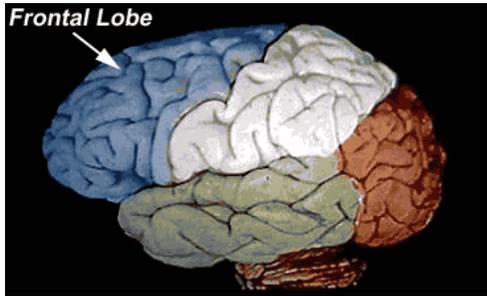
It’s All About The Brain

Hearing is not about the ears; it’s about the brain!

Hearing aids, RM systems and cochlear implants are not about the ears; they are about the brain!

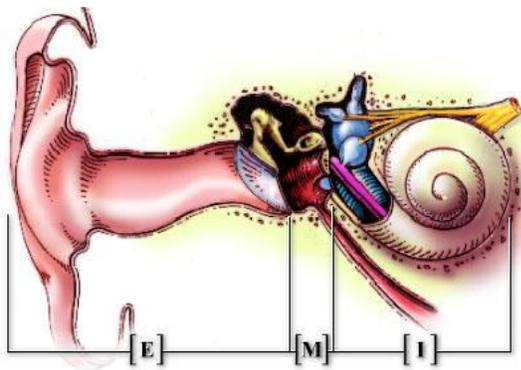
They are “Brain Access Tools.”

Start a conversation with The Real Ear: Hearing occurs in the Brain



This is the doorway to the brain.

Outer (external), Middle and Inner Ear



Theme Three – Sleep is Related to the Development of Executive Functions and Learning in All Children

Sleep is critical.

Lack of sleep deteriorates a wide swathe of brain performance related to executive functions and learning: Working memory function

Long-term memory storage

Memory retrieval

The Importance of Sleep

Sources: American Academy of Sleep Medicine and American Academy of Pediatrics:

Children in households with bedtime rules and children who get adequate sleep, score higher on a range of developmental assessments.

Results indicate that among sleep habits, having a regular bedtime was the most consistent predictor of positive developmental outcomes at 4 years of age.

The Importance of Sleep

Scores for receptive and expressive language, phonological awareness, literacy and early math abilities were higher in children whose parents reported having rules about what time their child goes to bed.

Having an earlier bedtime also was predictive of higher scores for most developmental measures.

According to the American Academy of Sleep Medicine, preschool children should get a minimum of 11 hours of sleep each night.

The Importance of Sleep

Getting less than this recommended amount of sleep is associated with lower scores on phonological awareness, literacy and early math skills.

Studies show that many children are not getting the recommended amount of sleep, which may have negative consequences for their development and school achievement.

The Importance of Sleep

Across all ages, a late bedtime and having a parent present when the child falls asleep had the strongest negative association with reported sleep patterns.

A late bedtime was associated with longer sleep onset latency and shorter total sleep time, whereas parental presence was associated with more night wakings.

The Importance of Sleep

Those children (ages 3+) without a consistent bedtime routine also were reported to obtain less sleep.

Furthermore, a TV/iPad/screen in the bedroom (ages 3+) and regular caffeine consumption (ages 5+) were associated with shorter total sleep time

The Importance of Sleep

US-based recommendations for sleep suggest that young children should:

fall asleep independently;

go to bed before 9:00 PM and obtain at least 10-13 hours of sleep per night;

have an established bedtime routine that includes reading as part of their bedtime routine;

refrain from caffeine;

and sleep in bedrooms without access to screens.

How much sleep is needed at each age and stage? (American Academy of Sleep Medicine and American Academy of Pediatrics)

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Age	Recommended	May be appropriate	Not recommended
Newborns 0-3 months	14 to 17 hours, including naps	11 to 13 hours 18 to 19 hours	Less than 11 hours More than 19 hours
Infants 4-11 months	12 to 16 hours, Including naps	10 to 11 hours 16 to 18 hours	Less than 10 hours More than 18 hours
Toddlers 1-2 years	11 to 14 hours, including naps	9 to 10 hours 15 to 16 hours	Less than 9 hours More than 16 hours
Preschoolers 3-5 years	10 to 13 hours, including naps	8 to 9 hours 14 hours	Less than 8 hours More than 14 hours
School-aged Children 6-13 years	9 to 12 hours	7 to 8 hours 12 hours	Less than 7 hours More than 12 hours
Teenagers 14-17 years	8 to 10 hours	7 hours 11 hours	Less than 7 hours More than 11 hours
Young Adults 18-25 years	7 to 9 hours	6 hours 10 to 11 hours	Less than 6 hours More than 11 hours

Summary and Key Points about Sleep

These sleep ranges are associated with optimal health, including improved attention, behavior, learning, memory, emotional regulation, quality of life, and mental and physical health.

Consistent bedtimes and wake-up times (even on weekends) are important.

Good "sleep hygiene" — such as a relaxing bedtime routine, limiting screens before bed, and ensuring a cool, dark, quiet sleep environment — is highly recommended.

Theme Four – Connect the Dots between Hearing (the Auditory Brain) and Literacy and Music

Neurocircuitry Related to Reading

Reading is probably the most complex task humans perform using the most parts of the brain.

Speech is biologically programmed using specific parts of the brain; children learn to speak naturally.

Reading is not natural; it requires explicit instruction in the code. We are not “hard-wired” for reading; we need to create the wiring.

The brain has not evolved to have “built-in” specialized regions for reading; we need to create the regions.

Therefore, reading is an exercise in plasticity.

Listening is the Foundation of Reading

It takes approximately 20,000 hours of listening to speech before a child’s brain has clear mental referents for each of the speech sounds.

This listening ability is necessary to enjoy rhyming and to develop phonological awareness skills.

We should be reading chapter books to children by age 4.

The Goal is grade-level literacy by the end of third grade!

Vocabulary is one of the biggest predictors of kindergarten success...therefore, early intervention is not about the child, it is about the family learning about vocabulary development.

Number of English Words Understood by Typically Developing Children

Age	# of Words
2	300 words
2.5	500 words
3	900 words
4	1,500 words
5	2,500 words
6	13,000 words
7	20,000 words

Six Principles of Language/Knowledge Learning (Golinkoff, 2017)

Children learn what they hear most – frequency matters

Interactive and responsive environments build language learning – social interaction matters

Children learn words for things and events that interest them

Children learn best in meaningful contexts, as opposed to those devoid of meaningful engagement

Vocabulary and grammatical development are reciprocal processes – speak in sentences

Children need to hear diverse words and language structures

Key Study By Hart And Risley Showing How Much Auditory Stimulation Is Needed for Language and Literacy Development

Meaningful Differences in the Everyday Experience of Young American Children

It is generally agreed that these 5 areas need to be addressed to develop and enhance literacy:

Phonemic/phonological Awareness (ability to recognize and work with sounds in spoken language)

Phonics (decoding sounds and letters)

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Reading Fluency (automaticity in recognizing words)

Vocabulary (word meaning)

Comprehension (background knowledge, prediction, imagery, asking questions, compare and contrast, metacognitive awareness)

Robertson, L. (2014). *Literacy and deafness: Listening and spoken language* (2nd ed.). San Diego, CA: Plural Publishing, Inc.

Simple Summary: Decoding + Comprehension = Reading

Decoding skills, such as phonological and phonemic awareness, phonics, and print knowledge, allow information to “get to the brain”.

Language Comprehension, such as vocabulary, grammar and narrative skills allows the brain to learn to make sense of the information once it gets to the brain.

- Therefore, to read, children must have phonemic awareness – knowledge of the sound structure of words for coding.
 - Children also need vocabulary, language, and background knowledge in order to understand what they read.
-

The Key is – Teach Sounds

Motherese, rhyming, and singing teach children sounds, and how to hear and understand sounds – not letters.

The key is the sound first.

Phonemic awareness is a weak point for our children – teach it early and often!

Everyone has a speaking voice and a singing voice. Ask the child with CI to use their singing voice, not their monotone, speaking voice. A singing voice has a much broader range.

How to Teach Phonological Awareness

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The best way to teach phonological awareness to young children is through fun books, games, and songs in addition to a wide variety of hands-on activities.

Teachers and parents can encourage play with words as part of their overall literacy programs.

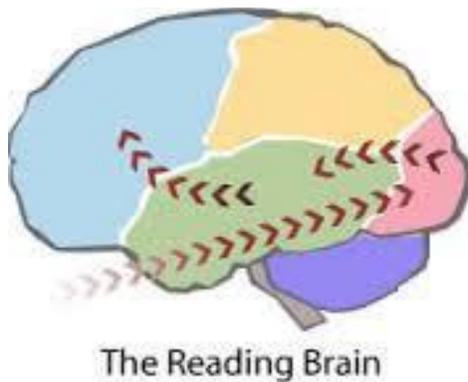
[Nursery rhymes](#), songs, poems, and read-alouds that manipulate sounds are all effective methods to develop phonemic awareness.

Professionals -- Coach Families to Read, Read, Read to children!

Creating Neural Pathways for Reading: An Exercise in Plasticity, because

Reading is not Natural

Exposure to storybooks is the biggest factor in a preschooler's vocabulary.



Why Read Aloud?

Exposure to storybooks is the biggest factor in a preschooler's vocabulary.

More parent-child conversations occur during read alouds than during any other activity.

Children who receive read-alouds show gains of more than twice as many new words.

Reading aloud to children before age 6 effects language, literacy and reading development.

Website: Growing Book by Book

Think about reading aloud as a conversation, not as a task to be completed.

You can never read too much!

Tip: Name the Characters in the Books

For infants, finding books that name different characters may lead to higher-quality shared book reading experiences and results in more learning and brain development benefits.

It's possible that books that include named characters result in more talking by the parent.

Some Books to Facilitate Phonological Awareness

Jesse Bear, What Will you Wear? By Nancy White Carlstrom

Silly Sally by Audrey Wood

Is Your Mamma a Llama? by Deborah Guarino

Polar Bear, Polar Bear, What Do you Hear? by Bill Martin, Jr.

Time for Bed By Mem Fox

Chicka Chicka Boom Boom by Bill Martin, Jr.

Sheep in a Jeep by Nancy E. Shaw

In The Tall, Tall Grass by Denise Fleming

Miss Mary Mack by Mary Ann Hoberman & Nadine Bernard Westcott

Good Night Moon by Margaret Wise Brown

What about Music?

What does music have to do with brain and literacy development?

Music

By music, we mean adult-directed singing out loud with the child throughout the day – an active and interactive conversation.

The Brain LOVES Music! Let's coach families to include music activities, daily.

Music is a whole brain work-out!

The brain loves music – the words stimulate the left hemisphere and rhythm stimulates the right hemisphere, and the corpus callosum is “exercised” by cross-over – called interhemispheric transfer.

Music enhances “paralinguistics”-- emotion.

Rhythm is foundational for literacy development.

Begin Early through MOVEMENT & MUSIC

A child's perception of rhythm is linked to their body movements.

Movement helps a baby develop a Basic Beat foundation of both music and communication.

Move while you sing to the baby, making the connection between rhythm and movement.

Make music interactive by adding actions and fun routines.

Why is *Basic Beat* so important?

Beat Synchronization in preschoolers

Children who can synchronize to a beat tend to be better at reading –related skills, such as:

- Phonological awareness
 - Short term auditory working memory
 - Rapid naming
 - Encoding of speech sounds
-

**Summary Ideas about Music and the Developing Brain (Laurel Trainor --
<http://trainorlab.mcmaster.ca/>)**

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Infants' brains become specialized for what they are hearing.

Active participation is better than passive listening.

By the end of the first year after birth, infants are becoming specialized for the rhythmic and tonal structure of the music they hear.

Listening to auditory stimuli effects movement; music and movement are intimately connected.

Across cultures, infants experience concurrent movement and singing in everyday life.

Synchronizing rhythmically with others is important for social development.

Recommendations from audiologists about literacy and music-- in addition to 10-12 hours per day of technology use:

A literacy recommendation should be emphasized, e.g. read 10 “baby” books each day to your baby....or 30 minutes per day.

A singing out loud and “dancing” recommendation also should be emphasized as a holistic brain development activity that stimulates language development, literacy development and social development. Sing out loud and move and dance to music with your baby/child

Join a music class

Listening and Spoken Language Development is built on Auditory Brain Access Putting it All Together – “The Logic Chain”

The Logic Chain is a model that summarizes what we know, at this point in time, about the ingredients necessary to create a listening, speaking, and reading brain.

The Logic Chain represents a system of foundational structures that must ALL be in place to optimize the attainment of a listening, spoken language and literacy outcome; no link can be skipped.

Family-focused Listening and Spoken Language (LSL) intervention plays an integrated role – but not the only role.

The Logic Chain Model Begins with the Brain

We now know all links must be evaluated and managed to create a SYSTEM for the attainment of a listening and spoken language outcome – if that is the outcome the family desires.

Auditory Brain Development and Integration

Early and Consistent Use of Hearing Technologies

General Infant/Child Language Development in the Family's Home Language

Family-Focused LSL Early Intervention

LSL Early Intervention for Literacy Development

Audiologists are Pivotal!

Until Audiologists do their job, no one else can do theirs.

Acoustic access to the brain, including access to incidental (free) information (the way 90% of knowledge is obtained by young children), is the biggest challenge for today's children with doorway problems -- worldwide.

We must have very high expectations for **brain access of auditory information**.

If a child is not progressing as expected, suspect the equipment first.

Audiologists must work collaboratively with other professionals and ***provide evidence of auditory brain access, appropriate technology function and use, and language enrichment***.

What to do if the child's listening and spoken language development is not progressing as expected, if LSL is the family's desired outcome....

Suspect technology first and the child last – collaborate with the audiologist! Is the child hearing well enough – is the child's brain receiving enough auditory information, often enough to advance cognition and learning?

Is the child hearing high frequencies?

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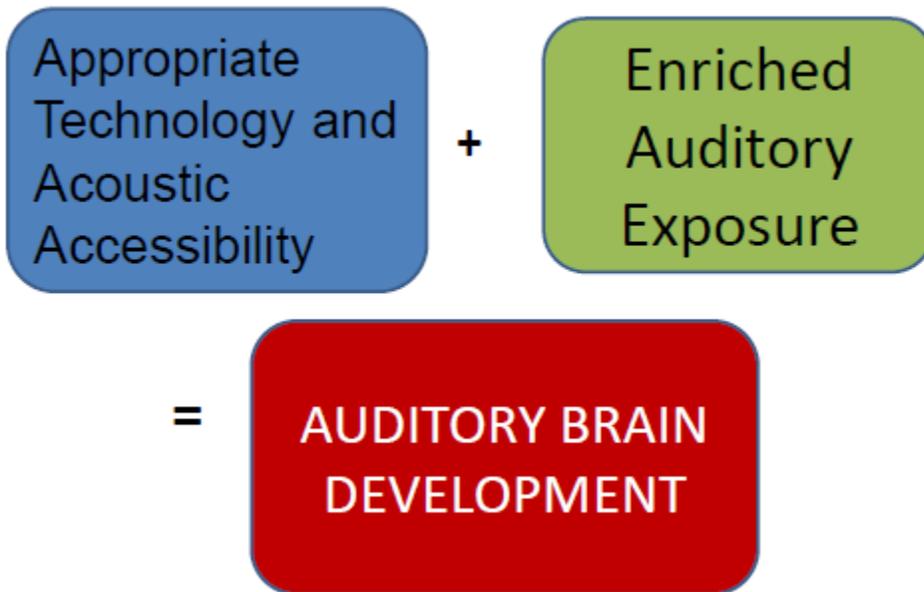
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Is the child wearing technology consistently – 10-12 hours per day – wear-time is a critical variable in auditory brain development. If a child is wearing technology for only 4 hrs/day, it will take 6 years for the child to receive the auditory exposure that a child with typical hearing receives in one year.

Is the child in an enriched auditory-linguistic environment? The more families talk and have conversations with their child, the better their auditory brain development and the better their listening, spoken language, and cognitive outcome.

What is “hearing age”? This is a complex and layered concept.



To Summarize

Hearing loss is a neuro-biological emergency, and we must act urgently to avoid auditory sensory deprivation!

For families choosing a listening and spoken language (LSL) outcome for their children who are deaf or hard of hearing (status of the doorway), the appropriate hearing technologies for breaching that doorway must be fit and managed as soon as possible after birth by a pediatric audiologist.

Fitting hearing technologies is the first line of treatment for auditory sensory deprivation.

To Summarize

Brain access devices must be worn at least 10 hours per day, and families are encouraged to speak their home language, beginning in infancy. Use a remote microphone system at home as well as at school.

Children need to be immersed in a conversation-enriched (talking, reading aloud, and musical) environment in order to nourish their brain with knowledge for spoken language and literacy development. The neurological concept is, “*experience dependent plasticity*”.

Call to Action!

Protect the first year – no delays in fitting technology!

Insist on full-time technology wear.

Coach intentional listening interactions.

Embed sound into movement and daily life. Because every repetition matters

Every loop wires the brain

And every child deserves a synchronized start!

Participation: One Action

Based on what you have learned this morning, what do you plan to DO new, better, or different?

Resources

Hearing First

<https://hearingfirst.org/>

This website offers many ideas for the advancement of listening, talking and pre-literacy skills. Their suggestions are helpful and appropriate for all children, not only for children with hearing loss.

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BabyBeats

Search for 'Advanced Bionics' in the iTunes® or the Google Play store.

Look for the BabyBeats app and download. This App is free!

Supporting Success for Children with Hearing Loss – Karen Anderson

<http://successforkidswithhearingloss.com/>

Teacher Tools is designed to support all aspects of instruction by addressing underlying skills and word knowledge that support all curriculum content. There are articles related to current topics and trends, sections on developing instructional skills, student self-advocacy, self-concept and a forum for discussion of current issues and concerns. A Teacher Tools membership includes materials such as worksheets and activities appropriate for all school age levels and an extensive information resource library.

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Children with Hearing Loss: Developing Listening and Talking Birth to Six Fourth Edition Cole, E., & Flexer, C.

The fourth edition of *Children with Hearing Loss: Developing Listening and Talking, Birth to Six* provides updated information from the previous three editions. It focuses on brain-based listening and spoken language by featuring auditory brain development, audiologic technologies, auditory skill development, spoken language development, as well as family-focused intervention for young children with hearing loss whose parents have chosen to have them learn to listen and talk.