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Changing Counseling Conversations About Hearing Loss: It's All About the brain



Carol Flexer, PhD; CCC-A; LSLS Cert. AVT
Distinguished Professor Emeritus, Audiology
Northeast Ohio Au.D. Consortium (NOAC), and
The University of Akron
www.CarolFlexer.com

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- The applicability and accuracy of the course content may vary by the clinical, geographical, and cultural context; you should evaluate the course accordingly.
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- Providers should always evaluate the limitations of diagnostic and screening tools, considering their potential for false results as well as any ethical implications.
- It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.



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Introduction

- **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, and the AG Bell Academy for Listening and Spoken Language.

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Topics Covered

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

Topic 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.

Learning Objectives

At the conclusion of this webinar, participants will be able to:

1. summarize what we now know about the development and integration of the auditory brain
2. explain how auditory brain development is the foundation of listening, language and literacy for all children
3. discuss the hearing health care provider's role in supporting a child's literacy development

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, at home, speak a language other than the community language – so, they are interested in their child speaking several languages.

Topic One: To Create a Context for Understanding Hearing -- Start with the Brain



The World Has Changed

- How did we used to talk about hearing loss, and what did we believe to be true?
- We used to believe and talk about hearing as if we heard with the ear – now we know that is not the case. 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

Three Core Concepts in Early Development

1 Experiences Build Brain Architecture

NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

Center on the Developing Child  HARVARD UNIVERSITY

The Challenge: How to take this knowledge of Neuroplasticity and Transform that Information into a Counseling Narrative that Explains Hearing

Let's begin with a brief summary of what we know about the "Auditory Brain."



Sample of references about auditory brain research

- Kral A. (2013). Auditory critical periods: a review from system's perspective. *Neuroscience*, 247: 117–33.
- Kral, A., Kronenberger, W. G., Pisoni, D. B., & O'Donoghue, G. M. (2016). Neurocognitive factors in sensory restoration of early deafness: A connectome model. *The Lancet Neurology*, 15(6), 610-621.
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- Kraus, N. (2018). Promoting sound health. *The Hearing Journal*, 71(11). 5.
- Moon, C., Lagercrantz, H., & Kuhl, P. K. (2013) Language experienced *in utero* affects vowel perception after birth: A two-country study. *Acta Pædiatrica*, 102,156-160.

The Brain

- The brain, unlike any other organ, is essentially unformed when one is born. Brain development is completely dependent on environmental experience.
- Clinical geneticist, Kyle Kai-How Farh, M.D., stated, “Everything that comes into our minds reduces to patterns of neural activities.”
- 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.

Basic Science: (Kral et al, 2012; 2013; 2015; 2016)

- The results of Dr. Kral's studies (along with the research of others) suggest that when the brain does not have access to intelligible speech during the early months and years of a child's life, meaningful auditory input does not coordinate activity between primary and secondary auditory cortex.
- Instead, secondary auditory cortex assists with the processing of other functions such as visual processing.

Secondary Auditory Cortex

The secondary cortex most likely serves two primary purposes:

- 1) to serve as a “launching pad” to distribute auditory information to the rest of the brain, and
- 2) to provide feedback from higher-order areas of the brain back to primary auditory cortex to sharpen the latter’s ability to focus (“tune in”) on the most relevant properties of the auditory signal and inhibit (“tune out”) the less important auditory information.

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** but a **neurological condition** that affects 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.

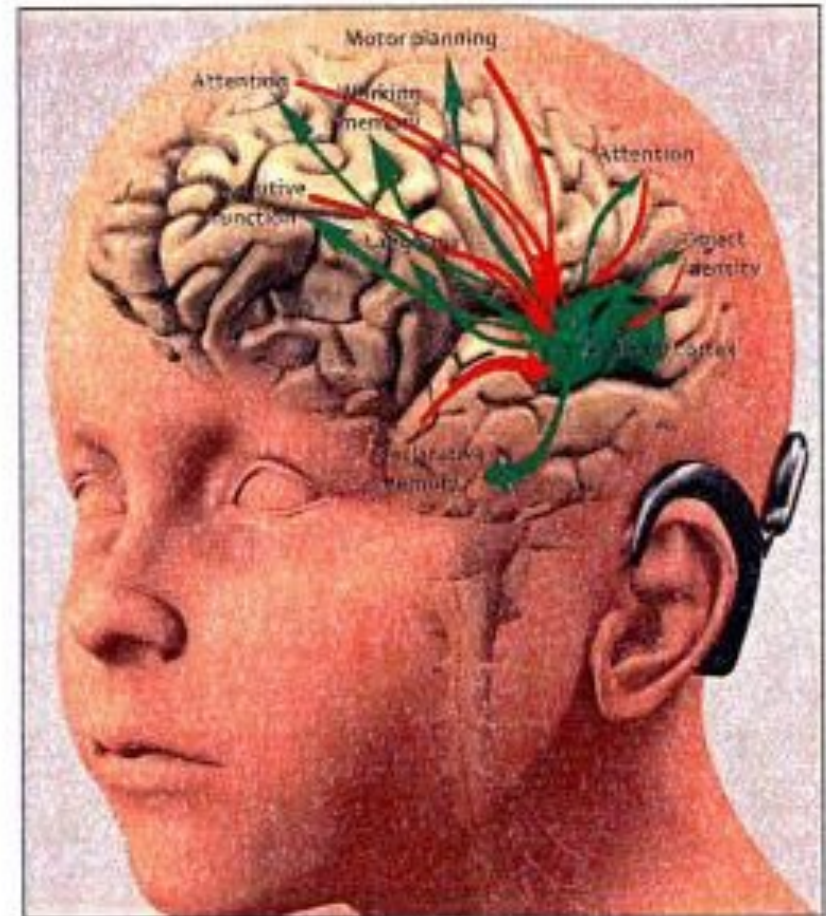
Auditory System Complexity (Kraus, 2018)

- The auditory system has more relays connecting the sensory organ to the brain than other sensory systems.
- The auditory system contains some of the longest axonal tracts.
- Axonal tracts directionally link each of the auditory relays between the ear, brainstem, midbrain and cortex.
- Babies are born with neurons, but synapses are created by experiences.

Sound Processing Complexity (Kraus, 2018)

- Sound processing is one of the most computationally demanding tasks the nervous system has to perform.
- The task relies on the exquisite timing of the auditory system, which responds to input more than 1,000 times faster than the photoreceptors in the visual system.
- Humans can hear faster than they can see, taste, smell or feel.

An illustration of the auditory portion of the human brain's connectome.



Auditory Brain Development: What is at Stake?

What's at stake are two related processes:

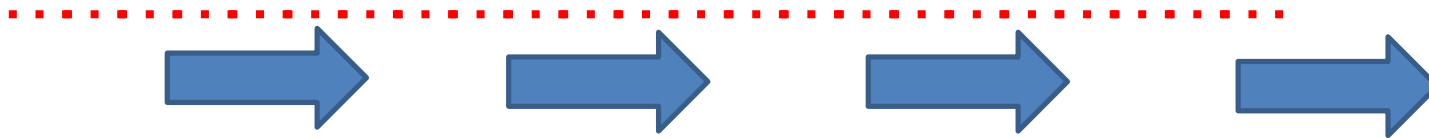
- the actual physiological development of the auditory brain by coupling the primary to the secondary auditory cortex for the distribution, connection and integration of synaptic pathways throughout the brain;
- and, the growth of the child's knowledge through the child's brain exposure to auditory information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



The Following slides describe a *Counseling Narrative*: 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.



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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?

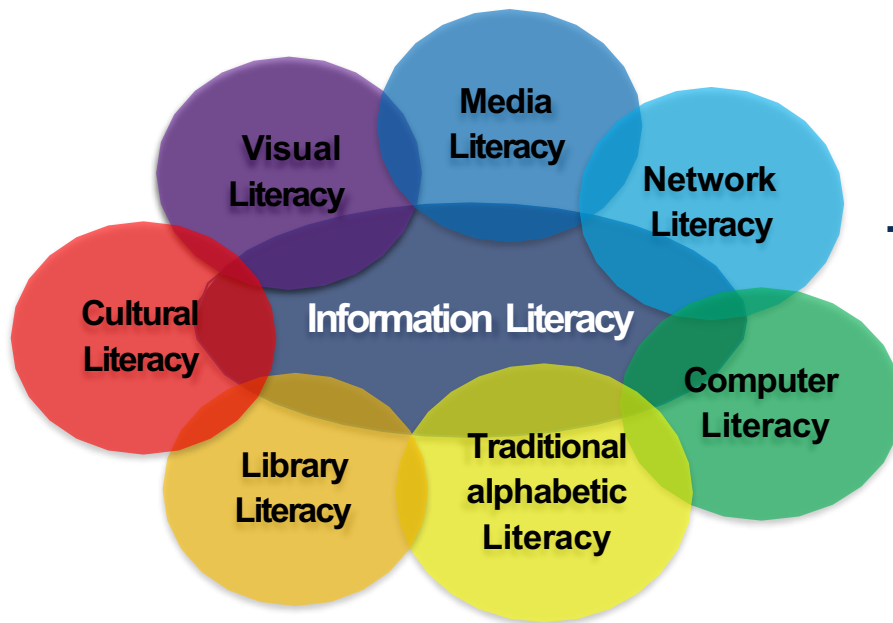
- Language is an organized system of **communication used to share information.**
- Spoken language consists of sounds, words and grammar used to express inner thoughts and emotions.
- Spoken language includes facial expressions, gestures, and body movements.
- Language organizes the ideas/knowledge in our head that we want to communicate to others.



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Counseling Narrative #1 – The Doorway

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



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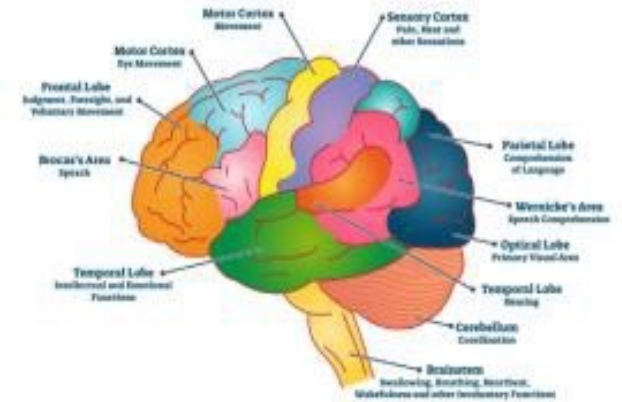
Five senses capture environmental information and transform that information into neural impulses read by the brain

- Hearing
- Sight
- Smell
- Taste
- Touch



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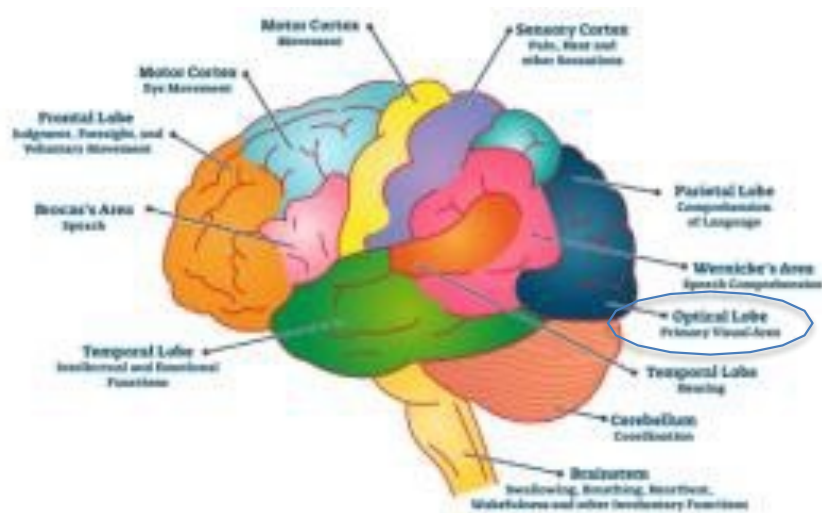
For example the Nose is the “Doorway” to the Brain for the Sense of Smell – but, we smell with the brain.



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Another example, the Eyes are the Doorway to the Brain for Visual Information.

But we see with the brain – not the eyes.



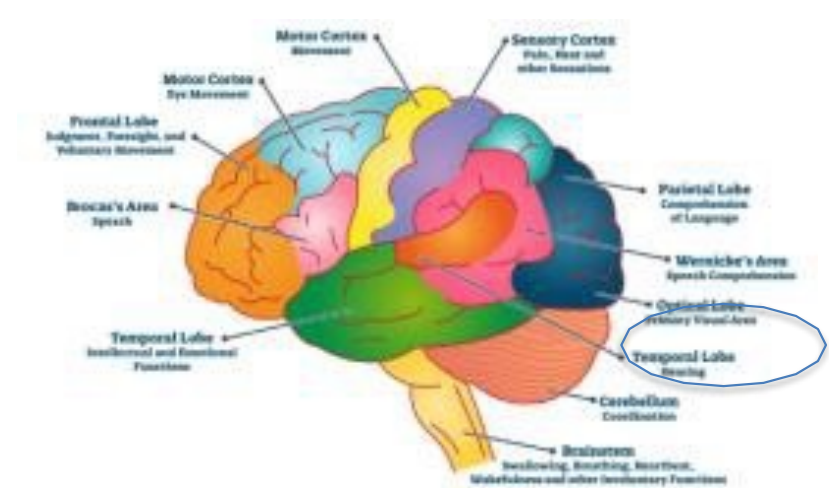
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The point: the Ear is the “Doorway” to the Brain for Sound -- Spoken Language/Information – Talking – Reading.

We hear with the brain – not with the ears!

The five sense organs are portals to the brain for environmental information.



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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.



Brain Integration in Real Life: Learning to Hear and then to Listen is a Multisensory Neuro-developmental Process



Counseling Narrative #2

Computer Keyboard Analogy



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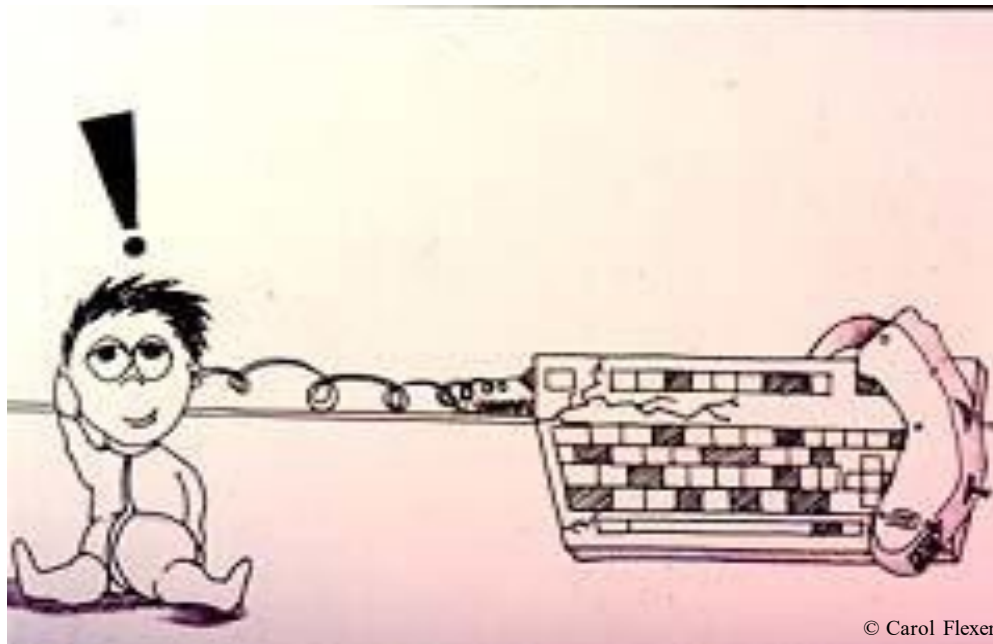
Input to the Brain

- 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.



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Well -- 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

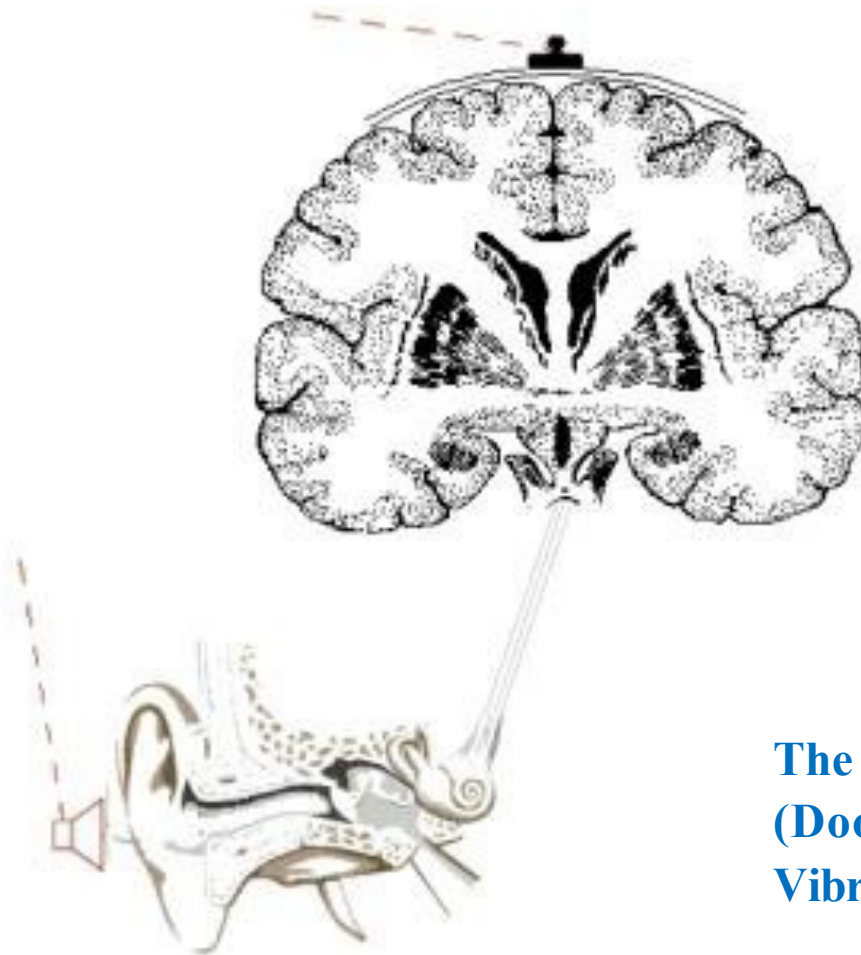
- **Hearing** is acoustic access to the brain – brain perception of auditory information; it includes improving the signal-to-noise ratio by managing the environment and utilizing hearing technology.
- **Listening** is attending to acoustic events with intentionality – activating the pre-frontal cortex.
- **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”.**

Participation: Brain Knowledge

Do you think most children and families really know the only purpose of wearing hearing technology is to deliver auditory information to their brain for the growth of knowledge?

1. Yes
2. No
3. Unsure

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

Audio Clip #1

Possible “oral” outcomes before early identification, early intervention, and cochlear implant technology



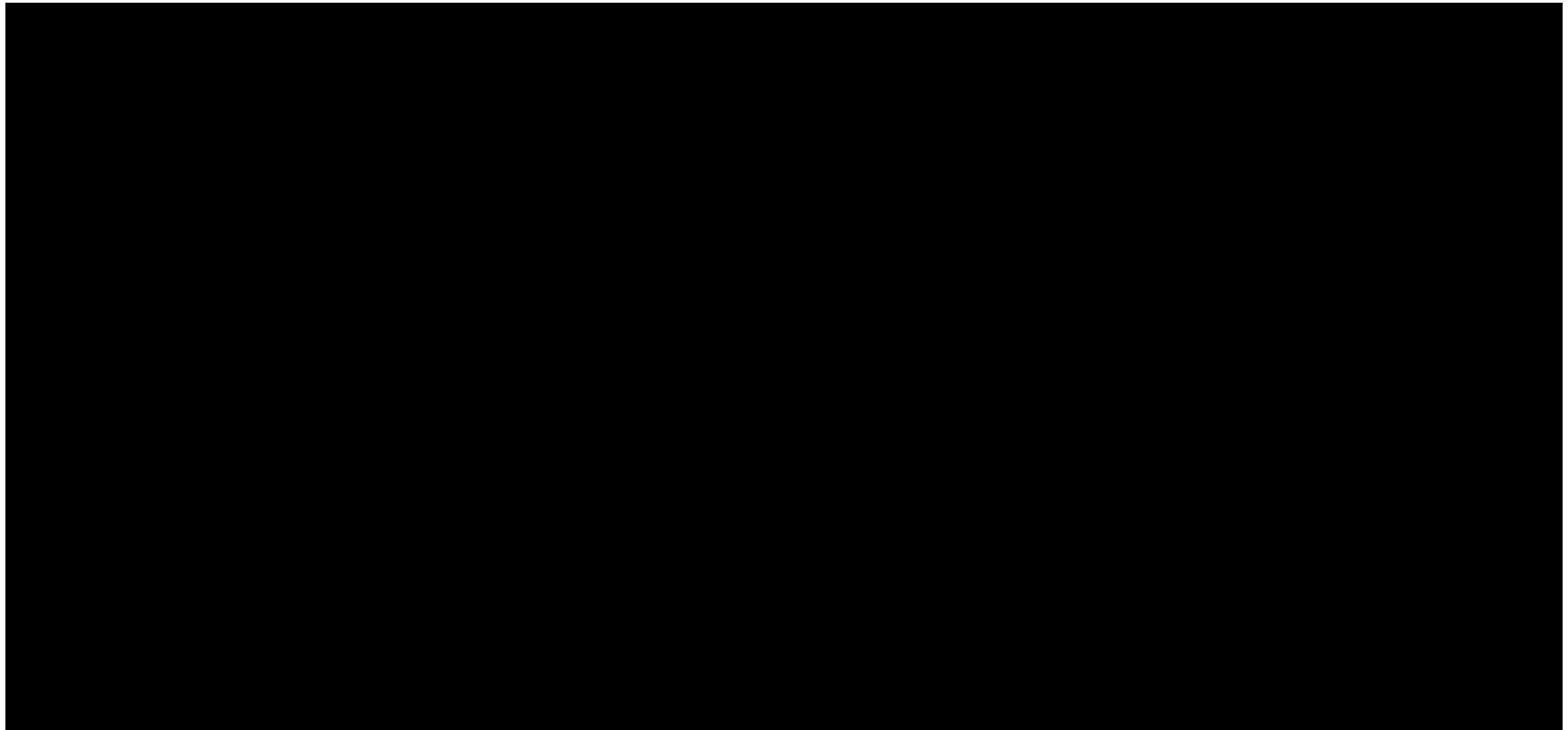
Audio Clip #2

Possible “oral” outcomes before early identification, early intervention, and cochlear implant technology



Video Clip

Possible Listening and Spoken Language (LSL)” outcomes today



Hear and Say Center: Brisbane, Australia
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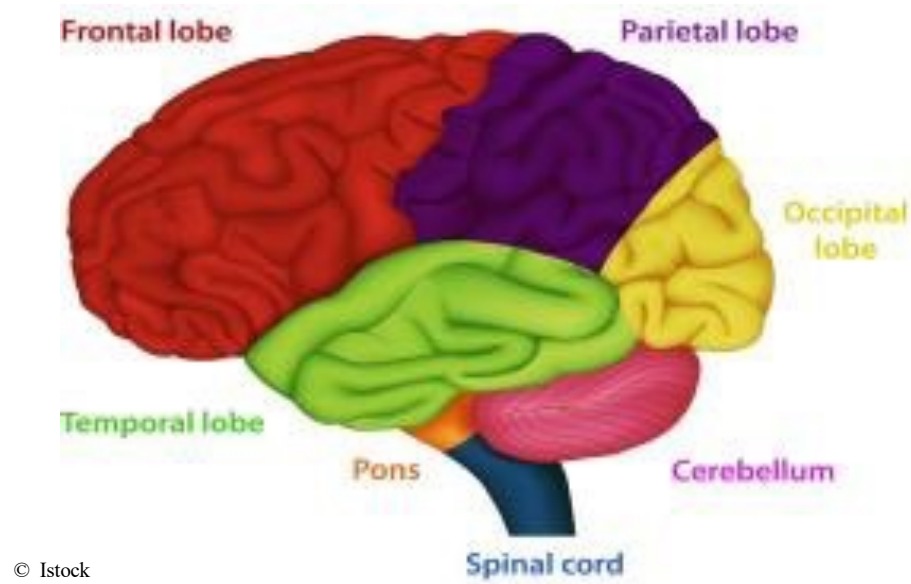
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So, what Does “Deaf” Look Like in 2025?

- Does 2025 “Deaf” look like 1990 “Deaf”?
- We have used the same words for decades, but the context and possibilities have changed, dramatically!



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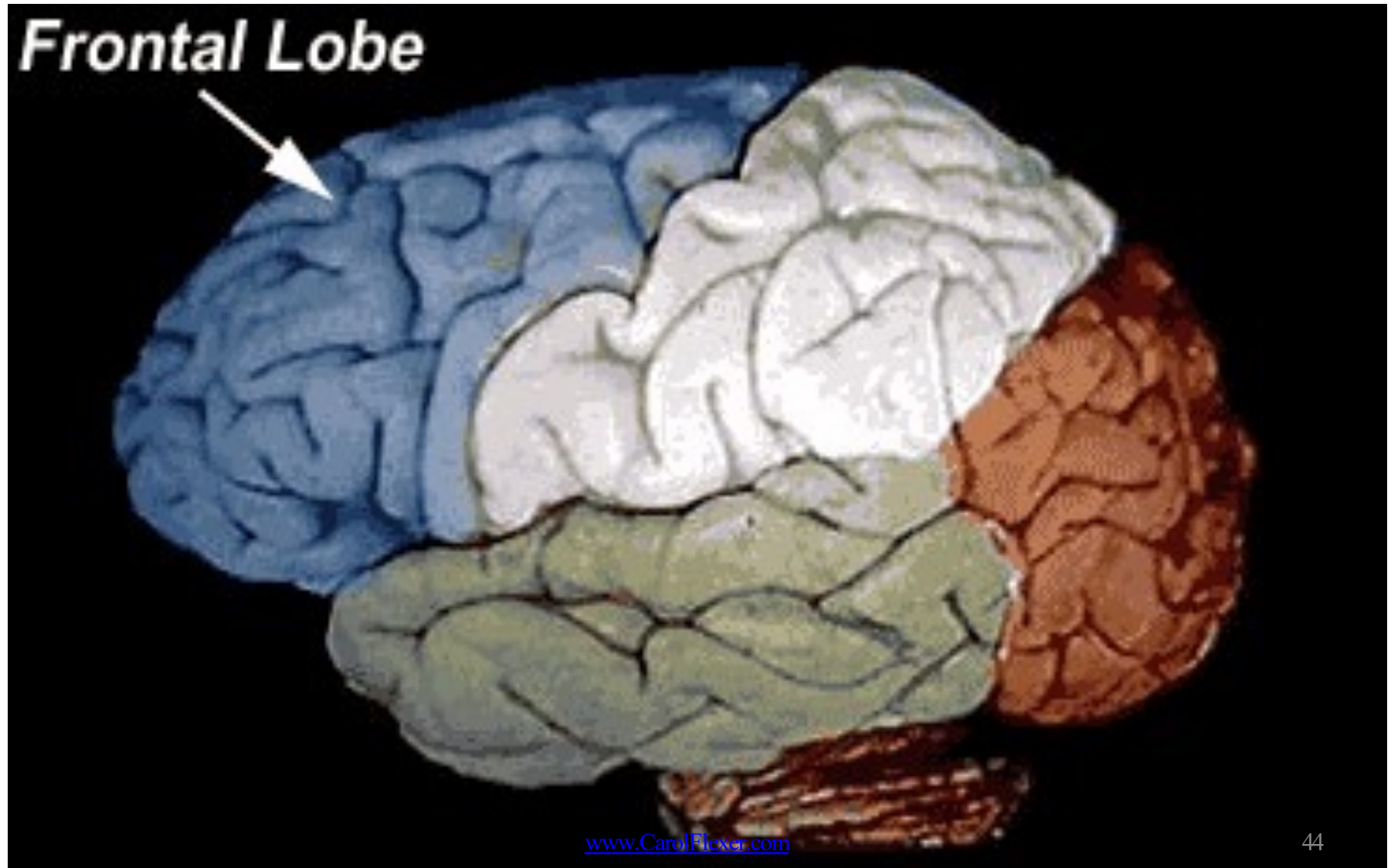
It's All About The Brain

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!

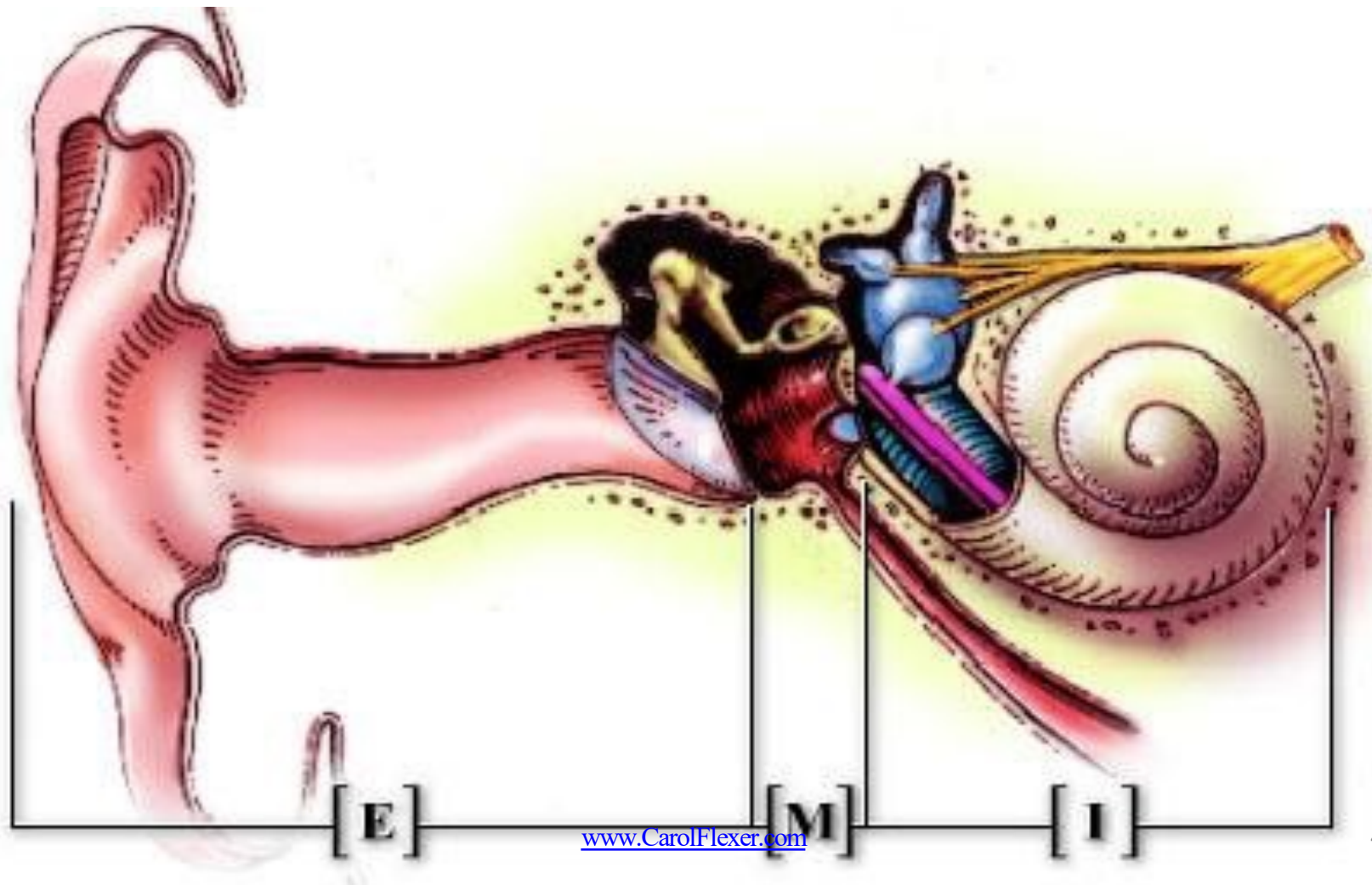
They are “Brain Access Tools.”

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



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



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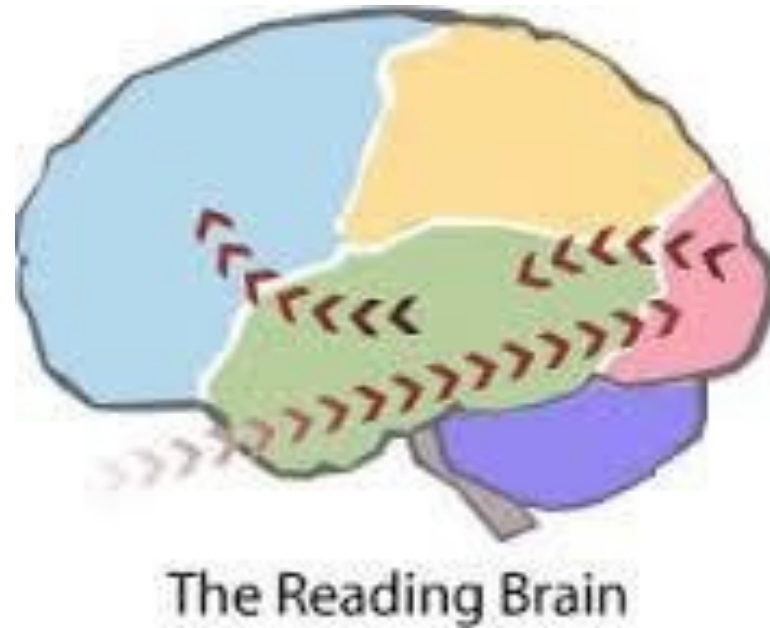
Listening is the Foundation of Reading

- 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!**



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!

What about Music?

What does music have to do with brain development?



Brain Talks about Music – the Brain LOVES Music!

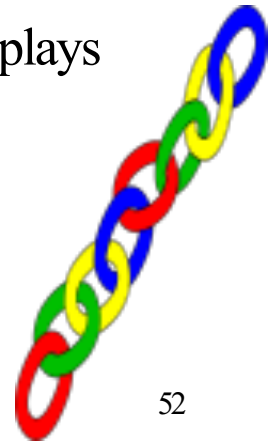
By music, we mean adult-directed singing (a person, not a screen) with the child throughout the day – active not passive.

- 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”.
- Discuss rhythm and literacy research.

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 to 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?
- 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.

Summary and Conclusion

- 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.



Summary and Conclusion

- 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”*.



Participation: One Action

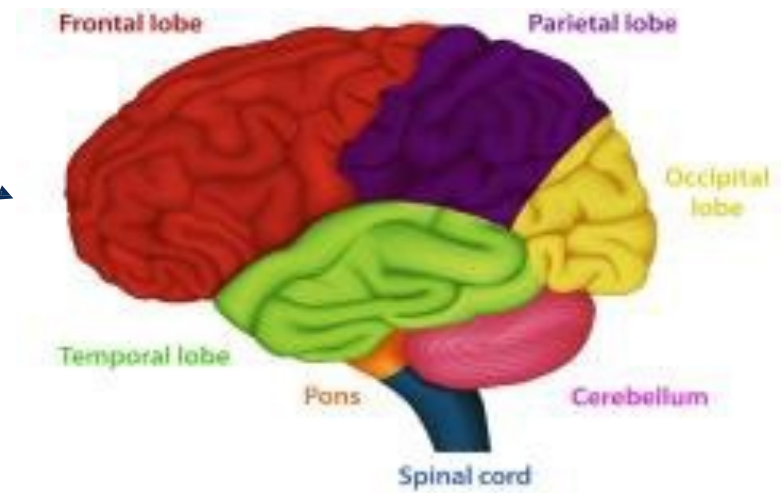
Based on what you have learned in this webinar, what do you plan to DO new, better, or different?



Thank you for Listening!



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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.



HEARING FIRST
Powering Potential

Awareness | Education | Community



**Are you interested in powering the listening,
spoken language and literacy potential of children
with hearing loss?**

<http://offer.hearingfirst.org/resources/>

BabyBeats

Search for ‘Advanced Bionics’ in the iTunes® or the Google Play™ store.

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



BabyBeats™

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.

General References

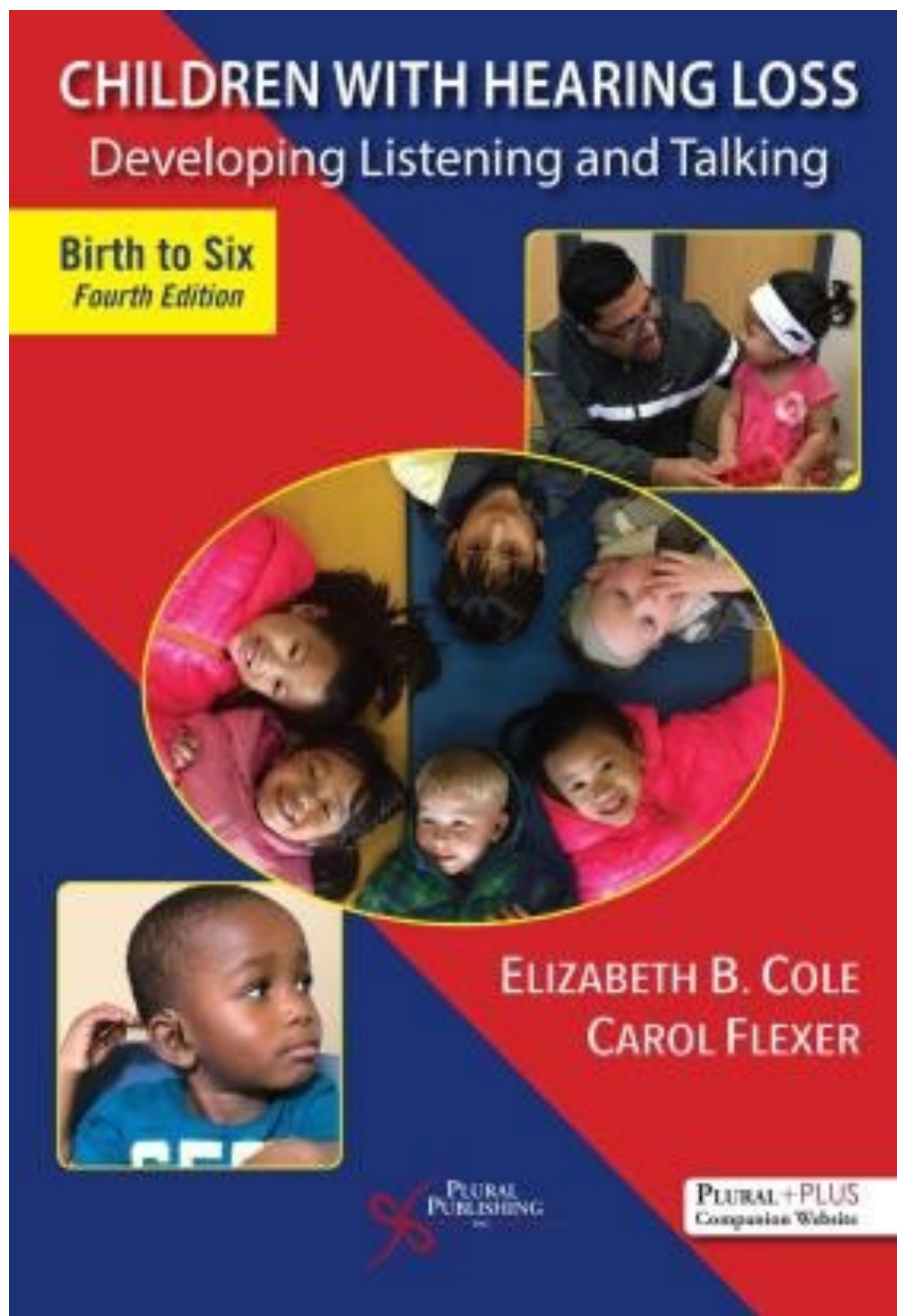
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- Moon, C., Lagercrantz, H., & Kuhl, P. K. (2013) Language experienced *in utero* affects vowel perception after birth: A two-country study. *Acta Pædiatrica*, 102,156-160.

References for Research about Outcomes

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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.

Pediatric Audiology

Diagnosis, Technology, and Management

Jane R. Madell
Carol Flexer
Jace Wolfe
Erin C. Schafer

Third Edition
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Pediatric Audiology Casebook

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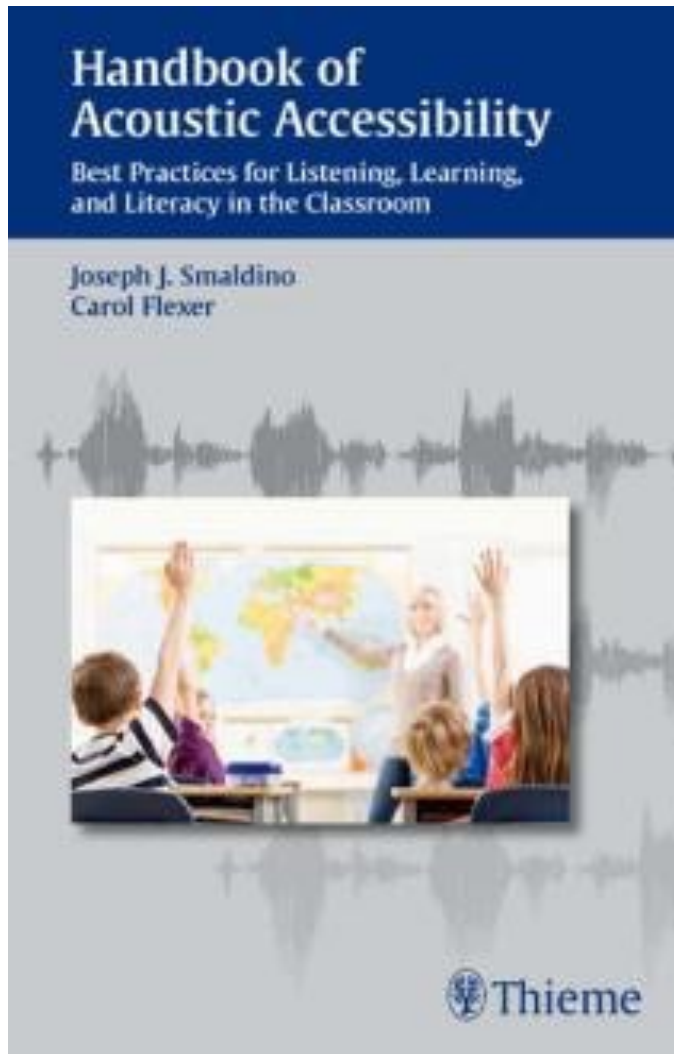


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