



## The Big Picture: Using Remote Microphone Technology to Breach the Ear/Doorway for Brain Development

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## Topics Covered

This talk focuses on developing a context for counseling about hearing, hearing loss and use of technology.

- Describe the amazing auditory brain
- Propose a counseling narrative for use of RM technology
- Emphasize early language enrichment through technology for cognitive growth

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## Begin Counseling with The Critical Question: What is the Family's Desired Outcome?

- The family's desired outcome guides us – ethically and legally.
- What is the family's long term goal for their child?
- **How does the family want to communicate with the child? What language(s) do they know?**
- Where does the family want the child to be at age 3, 5, 14, 20? What does it take to get there?
- *About 95% of children with hearing loss are born to hearing and speaking families.*
- *Many families use a main language at home other than the school language, so they likely are interested in their child speaking several languages.*
- The following information is focused on counseling families who are interested in a listening and spoken language outcome for their child.

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## Our Challenge: How to take knowledge of complex auditory brain development, and transform that information into a meaningful counseling narrative about technology and listening

Let's begin with some critical points about the "Auditory Brain."

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## Sample of References for Brain Research

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## 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.

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## So, where do we start the counseling narrative?

### Begin at the beginning

Connect the dots between hearing, brain plasticity, technology, listening, talking and literacy development



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## The Following slides describe a *Counseling Narrative*.

**Right from the start, explain complex concepts in a comprehensible fashion.**

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

??????

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## To Begin With: What is Sound? (Boothroyd, 2017)

- Sound is an *event* – not a label.
- For example, you don't "hear" Mommy. You hear Mommy in action -- talking, walking, typing, laughing, dancing.
- An event creates vibrations.
- These raw vibrations are picked up by the "ear doorway" and are sent to the brain as energy for neural coding, and for perception as information.

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## What is Language?

- **Language is an organized system of communication used to share information.**
- Language consists of sounds, words and grammar used to express inner thoughts and emotions.
- Language includes facial expressions, gestures, and body movements.

**But -- How does information get into the child's brain?**

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**Five senses capture different types of raw environmental information and transform that information into neural impulses read by the brain:**

- Hearing
- Sight
- Smell
- Taste
- Touch

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**The nose is the "doorway" to the brain for the sense of smell.**

- But, we smell with the brain, not the nose.
- "Smelling" occurs in the brain.

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**The eyes are the doorway to the brain for visual information.**

But, we see with the brain – not the eyes.

“Seeing” occurs in the brain.

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**So, what is Hearing Loss? We can counsel families to think about hearing loss as a “doorway” problem**

- The ear is the “doorway to the brain” for sound.
- Hearing loss of any type and degree obstructs that doorway a little (hard of hearing), a lot (more hard of hearing) or completely (deaf), preventing sound/auditory information from reaching the brain.
- Hearing aids, cochlear implants and remote microphone systems break through the doorway to allow access, stimulation and growth of auditory neural pathways, with auditory information, for development of the child’s cognition.

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## **Well then, What is Hearing?**

- Hearing can be defined as brain perception of auditory information.
- Anytime the word “hearing” is used, think “auditory brain development” using 1 billion neurons with a quadrillion connections!
- 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 receiving intelligible auditory information – speech must be 10 times louder than background sounds.
- ***Our homes, early intervention programs and classrooms must take into consideration the child’s brain access of acoustic information for language and for social growth.***

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**The ear is the “doorway” to the brain for sound -- spoken language/information – talking – reading.**

- “Hearing” occurs in the brain!
- The knowing of the meaning of sound occurs in the brain.
- The five sense organs are portals to the brain for unique types of raw environmental information.

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**The purpose of technologies (e.g. hearing aids, cochlear implants, remote microphone systems such as Roger) is to get sound -- auditory language information -- through the doorway to the brain for the growth of cognition.**

**There is NO other purpose!**

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## **It’s All About The Brain**

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

**Hearing aids, remote microphone systems and cochlear implants are not about ears; they are about getting auditory information to the brain!**

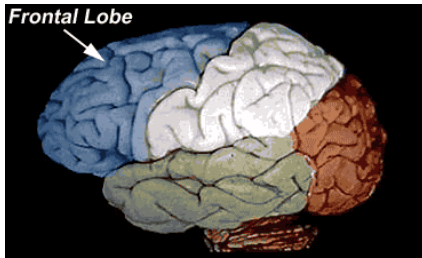
**They are “brain access tools”.**

**Consider: What is the status of the child’s auditory brain?**

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## The Real Ear

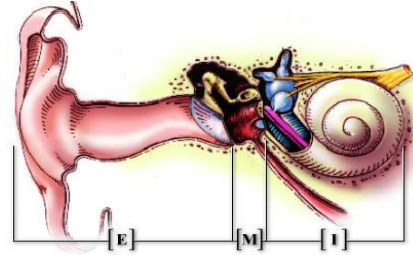


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First display a picture of the “Brain Ear”, and then the more traditional picture of the “doorway” ear, showing:

Outer (external), Middle and Inner Ear



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### What is the Difference Between Hearing and 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.
- **“Hearing” must be made available before “listening” can be taught.**
- **We must know about the “hearing thing” before we can do the “listening thing”.**
- **The concept of Extrinsic vs. Intrinsic redundancy.**

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### Extrinsic vs Intrinsic Redundancy: A Key Concept (James Jerger)

- Extrinsic redundancy refers to the integrity of information from outside the person.....**“bottom-up”** sensory input.
- Intrinsic redundancy refers to the cognitive capacity -- the internal knowledge and attentional resources of the person.....**“top-down”** processing.
- There is an inverse relationship between these two concepts that must be considered for children.
- Specifically, children do not have the top-down capabilities available to adults.

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### Improve Intelligibility of our Spoken Communication to Enhance “Bottom-Up” Sensory Input – Use a Remote Microphone and Speak Slower!

- Most adults speak faster than most children (and many aging persons) can process (often faster than 200 words per minute – way too fast!).
- Use “clear speech” ....slow down (aim for 124 words per minute, like Mr. Rogers)....**pause**....use appropriate suprasegmentals to enhance meaning.
- The talker’s use of clear speech can improve the listener’s speech discrimination by up to 40%.
- **Remote microphone technology, such as Roger, can enhance extrinsic redundancy by improving the SNR in all of a child’s environments.**

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## Family Engagement

### The Necessity of Early Language Enrichment for Cognitive Growth

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#### Calculating the Time Children Spend at Home vs. at School, From Birth to Age 18

- Assume that a child sleeps 8 hours/day
- 24 hours/day - 8 hours sleeping = 16 waking hours/day
- 365 days/year x 18 years = 6,570 days
- 6,570 days x 16 waking hours/day = 105,120 waking hours by age 18
- Average 6 hours per day at school.
- Average 180 school days/year
- 180 school days/year x 6 hours/school day = 1,080 hours per school year.
- 1,080 hours/school year x 13 school years (1 year kindergarten + 12 years through H.S.) = 14,040 school hours
- 14,040 school hours / 105,120 waking hours = .13356 or ...

**Just 13.36% of waking hours by age 18 are spent in school!**  
**PARENT ENGAGEMENT MATTERS!!!!**

Adapted from "Nine Truths about Parent Engagement" (Wherry, 2014)

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#### Infant Auditory Language Development

How much parents converse with their child is the best predictor of the child's language competence, whether or not the child has a hearing loss.

Parents need to speak the language(s) they know.

Wear hearing technologies 10-12 hours per day.

90% of what a very young child knows, is learned incidentally (through conversations, etc.), and not through direct instruction.

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#### Six Principles of Language 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

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#### Read, Read, Read to your Child!

Creating Neural Pathways for Reading: An Exercise in Plasticity, because Reading is not Natural!

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#### 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.
- *Think about reading aloud as a conversation, not as a task to be completed.*
- You can never read too much!

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#### Tip: Enhance the Child's Reading Fluency -- A Key to Developing Literacy – Use an RM!

- To read aloud, we need to develop the child's "Auditory Feedback Loop"
- Enhance extrinsic signal redundancy by improving the SNR of the child's own speech
- Therefore, place the child's RM microphone close to the child's mouth as he/she reads aloud
- Recent findings link the child's ability to effectively read aloud with growth in comprehension

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## What about Music?

By music, we mean adult-directed singing with the child throughout the day – an active, not a passive type of conversation.

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## The Brain LOVES Music!

- 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.

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## Work in Harmony with Our Organic Design

- Human beings are “*naturally*” designed to listen and talk....if we do what it takes to develop their auditory brain centers with spoken language information!

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## Audiologic Recommendations

- A literacy recommendation should be included in every pediatric audiology report, e.g. read 10 “baby” books each day to your baby.
- A singing and dancing recommendation also should be included in every audiologic report as a holistic brain development activity that stimulates language development, literacy development and social engagement.

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## For Parents: How To Grow Auditory Brain Centers – Always explain the “Brain Why”

- Above all, **love, play, and have fun** with your child!
- Once your child receives a hearing aid or cochlear implant, make sure he/she **wears it every waking moment (at least 10-12 hours/day – eyes open, technology on)**. The auditory brain centers need consistent access to clear, complete sound in order to develop. **Use a wireless microphone System for an improved SNR.**
- **Check** your child’s technology regularly. Equipment can malfunction. Without auditory brain access, talk to the floor.

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## For Parents: How To Grow Auditory Brain Centers – Always Explain the “Brain Why”

- **Minimize background noise.** Turn off the T.V.
- **Sing** to your child! Fill their days with all kinds of music and songs; promotes **interhemispheric transfer**. And, “bounce”.
- **Speak slowly, clearly** and in full sentences with correct grammar and with lots of melody. Stay close!
- Focus your child on **listening**. Call attention to sounds around the room. Point to your ear. Use listening words such as “you heard that”, and “you were listening”.
- **Emphasize sound** before vision for *auditory enrichment*.

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## For Parents: How To Grow Auditory Brain Centers – Always Explain the “Brain Why”

- **Read, Read, Read aloud** every day. Try for 10 baby books per day. *We should be reading chapter books to our children by age 4.*
- Name **objects** in the environment as you encounter them in daily routines.
- Talk about and **describe** how things sound, look, and feel.
- **Compare** how objects or actions are similar and different in size, shape, smell, color, or texture.

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## For Parents: How To Grow Auditory Brain Centers – Always Explain the “Brain Why”

- Talk about where objects are **located**. Use many and varied prepositions such as in, on, under, behind, beside, next to, between. Prepositions are the bridge between concrete and abstract thinking, and *should be known by age 4.*
- **Describe sequences.** Talk about the steps involved in activities as you are doing the activity. Sequencing is necessary for organization.

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## To Summarize.....

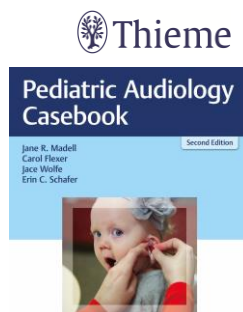
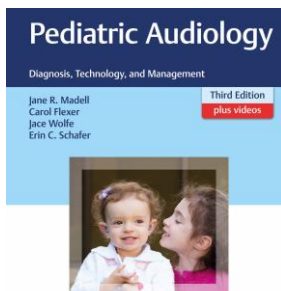
- Hearing loss is a neuro-biological emergency, and we must act urgently to avoid auditory sensory deprivation!
- For families choosing a listening and spoken language (LSL) outcome for their children who are deaf or hard of hearing (status of the doorway), the appropriate hearing technologies for breaching 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.*
- 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, such as Roger, 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 grow their brain with knowledge for spoken language and literacy development. The neurological concept is, “*experience dependent plasticity*”.

## General References

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