



The Ears are Doorways to the Brain

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

www.carolflexer.com

The Context: Auditory Brain Development

Topics Covered

- Auditory neurophysiology beginning in infancy
- How does a child's auditory brain develop?
- What is hearing?
- Early language enrichment for cognitive growth

Begin at the Beginning

So, where to start?


Begin at the beginning!

- Making the connection between hearing loss, auditory neural deprivation, and use of hearing technologies – and, how to explain this connections to families.
- Brain Clip

Three Core Concepts in Early Development

1 Experiences Build Brain Architecture

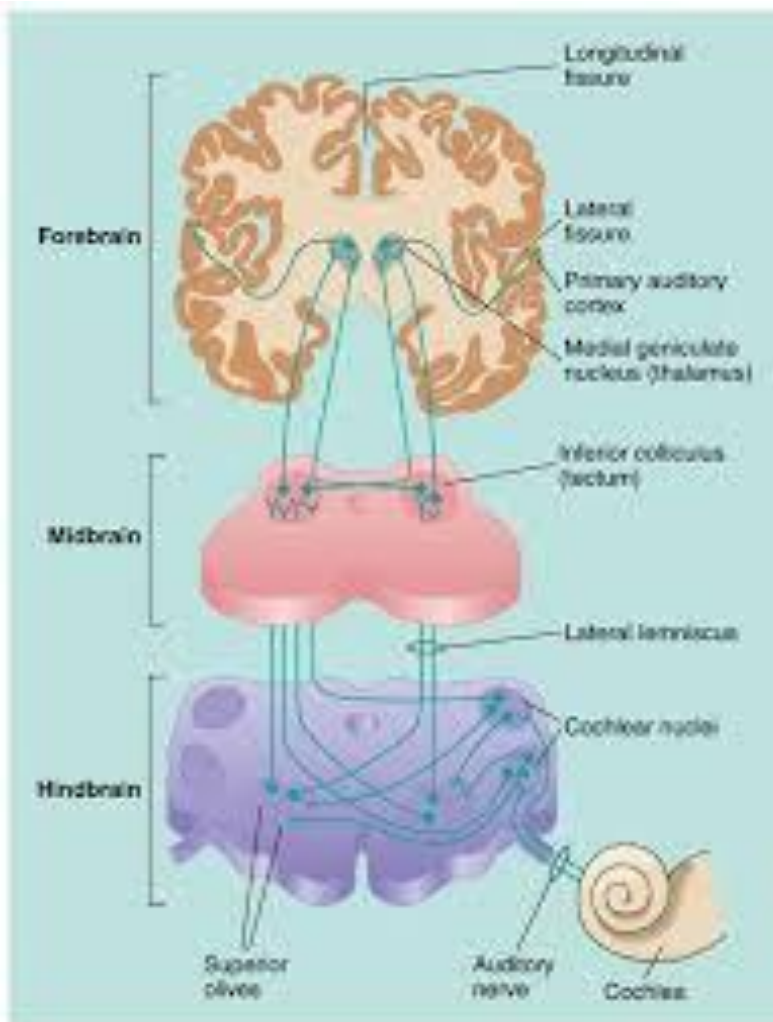
NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

Center on the Developing Child  HARVARD UNIVERSITY

The Critical Question: What is the Family's Desired Outcome?

- The family's desired outcome guides us – ethically and legally.
- What is your long term goal for your child?
- **How do you want to communicate with your child? What language(s) do you know?**
- Where do you want your child to be at age 3, 5, 14, 20? What does it take to get there?
- *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 families who are interested in a listening and spoken language outcome for their child.

The Challenge for Professionals: How do we take our knowledge of Neuroplasticity and Auditory Deprivation, and Use that Information to Create a Brain Context for Understanding and Managing Hearing Loss?



Explain terms in a comprehensible fashion

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

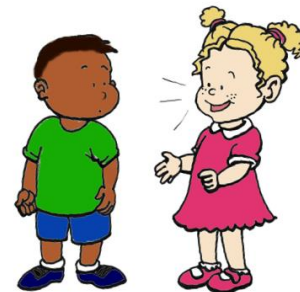


To Begin With: What is Sound? (Boothroyd, 2017)

- Sound is an “event” – not a label.
- For example, you don’t “hear” Mommy. You hear Mommy walking, talking, singing, tapping, dancing.
- An event creates vibrations.
- Vibrations 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.**
- It consists of sounds, words and grammar used to express inner thoughts and emotions.
- Language includes facial expressions, gestures, and body movements.



talking

How Does Information Get into the Child's Brain?

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

- *Hearing*
- *Sight*
- *Smell*
- *Taste*
- *Touch*

The Nose is the “Doorway” to the Brain for the Sense of Smell – but, we smell with the brain, not with the nose.

The Eyes are the Doorway to the Brain for Visual Information

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

The Ear is the “Doorway” to the Brain for Sound -- Spoken Language/Information – Talking – Reading. We hear with the brain – not with the ears!

So, what is Hearing Loss? 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 and cochlear implants break through the doorway to allow access, stimulation and development of auditory neural pathways.

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

Well then, What is Hearing?

- Hearing is 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 hearing intelligible auditory information – speech must be 10 times louder than background sounds. Download **SLM APP on iPhones or Tablets.**
- ***Our early intervention programs and classrooms must take into consideration the child’s brain access of acoustic information for language and for social growth.***

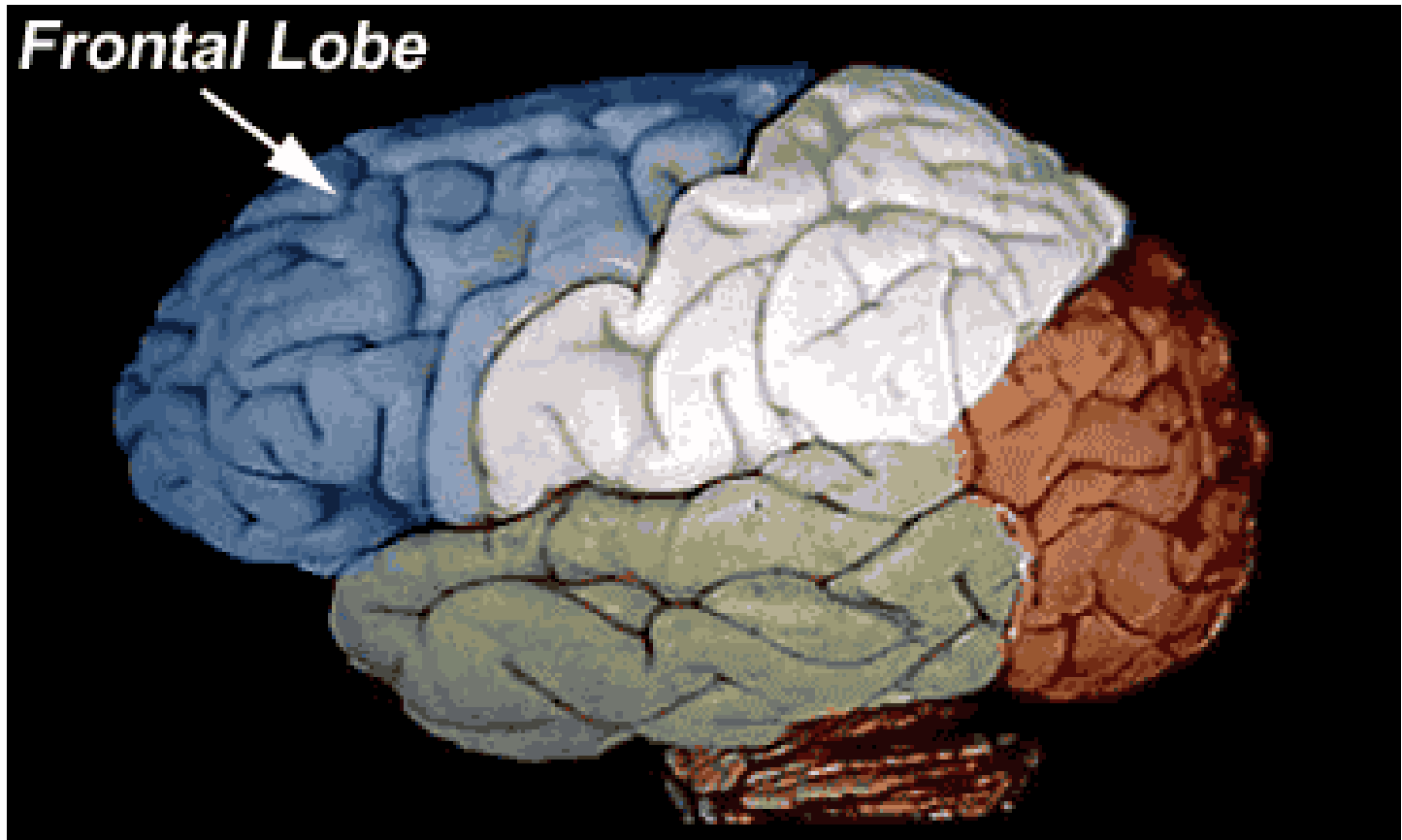
It's All About The Brain

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!

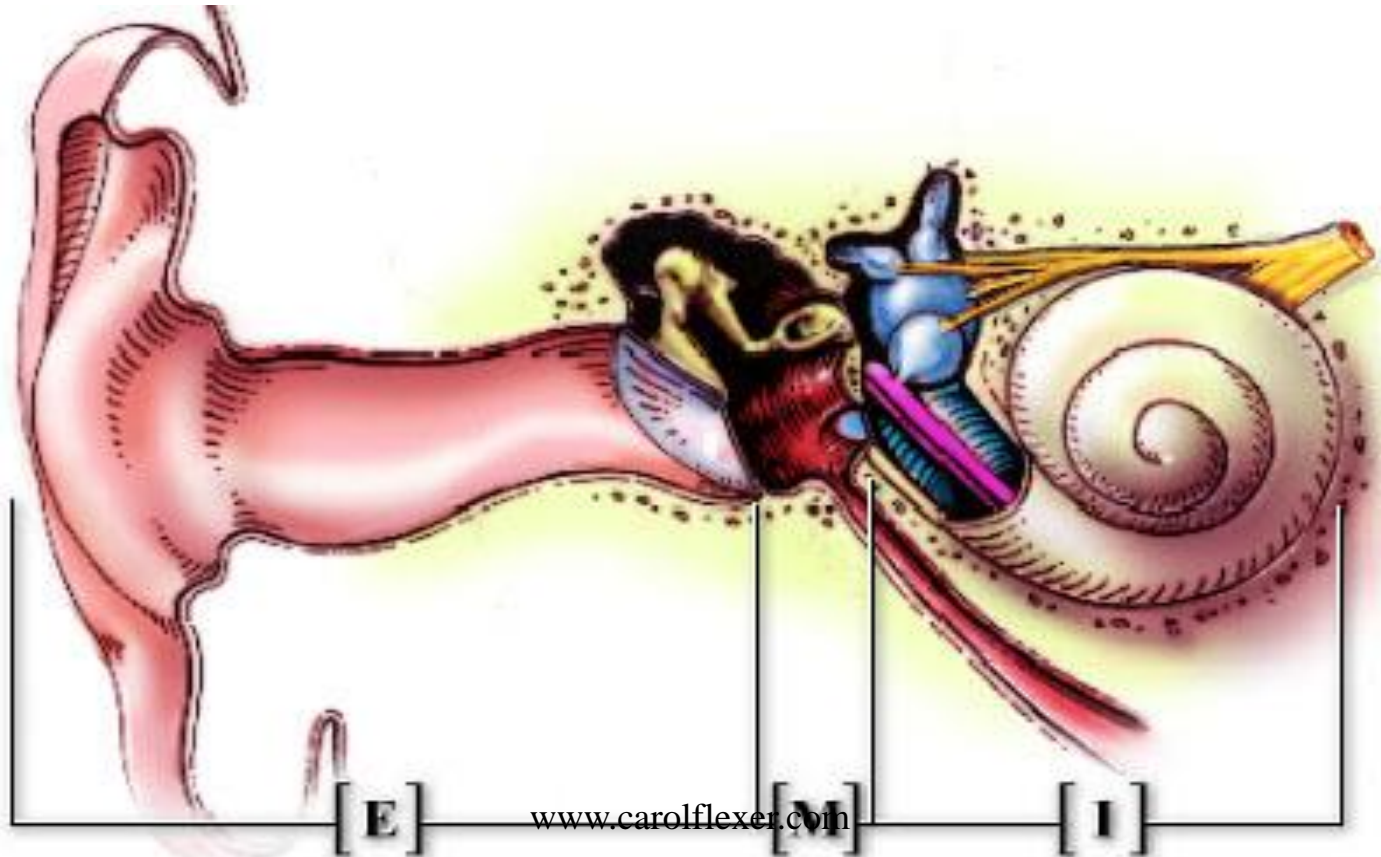
They are “brain access tools”.

The Real Ear

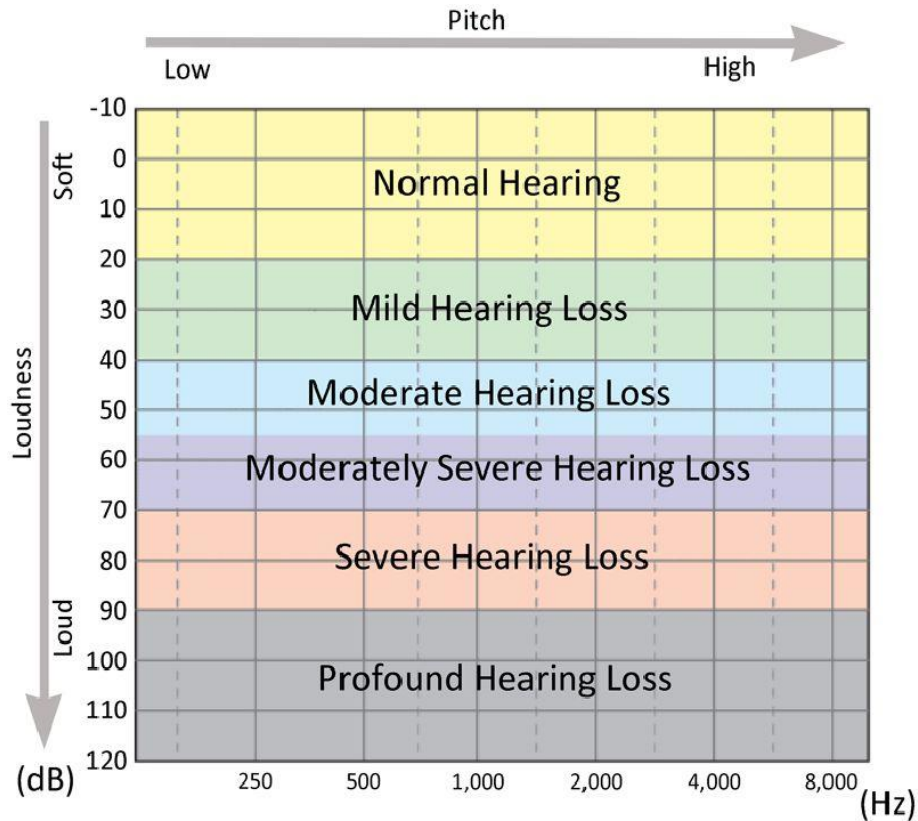


First display a picture of the “Brain Ear”,
and then the more traditional picture of the
“doorway” ear, showing:

Outer (external), Middle and Inner Ear



An Audiogram is the way audiologists measure the quantity and quality of the “Doorway” Problem



What Does “Deaf” Look Like in 2018?

- Does 2018 “Deaf” look like 1990 “Deaf”?
- We have used the same words for decades, but the context and possibilities have changed, dramatically!

Therefore, we now know we must always consider:

What auditory information has reached and developed the brain, through the ear/doorway?

What is the status of the child's auditory brain?

Where has the brain been?

What does the brain "know"?

What is the Child's "Hearing Age"?

Family Engagement: The Necessity of Early Language Enrichment for Cognitive Growth

Infant (Auditory-Verbal) 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 learns, is learned incidentally (through conversations, etc), and not through direct instruction.

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

Read, Read, Read to your Child!

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

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!

What about Music?

Brain Talks about Music – the Brain LOVES Music!

- By music, we mean adult-directed singing 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” -- emotion.
- Discuss rhythm and literacy research.

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!

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 should be included in every audiologic report as a holistic brain development activity that stimulates language development, literacy development and social development.

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.*
- Their “brain access devices” must be worn at least 10 hours per day, and families are encouraged to speak their home language, beginning in infancy.
- 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

- Cole, E., & Flexer, C. (2016). *Children with Hearing Loss: Developing Listening and Talking, Birth to Six, 3rd ed.* San Diego: Plural Publishing.
- Madell, J., & Flexer, C. (2014). *Pediatric Audiology: Diagnosis, Technology, and Management, 2nd ed.* New York: Thieme Medical Publishers.
- Madell, J., & Flexer, C. (2011). *Pediatric Audiology Casebook* New York: Thieme Medical Publishers.
- Merzenich, M.M. (2010, April). *Brain plasticity-based therapeutics in an audiology practice.* Learning Lab presented at the American Academy of Audiology National Conference, San Diego.
- Robertson, L. (2014). *Literacy and Deafness: Listening and Spoken Language, 2nd ed.* San Diego: Plural Publishing.

Pediatric Audiology

Diagnosis, Technology, and Management

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

Third Edition
plus videos



Pediatric Audiology Casebook

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

Second Edition



Thieme Medical Publishers, Inc.

Order toll-free: 1-800-782-3488

Fax: 1-212-947-0108

www.thieme.com

