

AUDITORY BRAIN DEVELOPMENT: A PARADIGM SHIFT FOR CHILDREN WHO ARE DEAF OR HARD OF HEARING

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THEMES

- ☞ *Because of technology and brain neuroplasticity, the audiologist's role has expanded in pediatric sectors.*
- ☞ *Because of technology and brain neuroplasticity, the landscape of deafness has changed.*
- ☞ *Because of technology and brain neuroplasticity, today's infants represent a new and different generation of children who are deaf.*
- ☞ *We are in a position to provide to the world, a new and expanded vision of hope and possibility regarding intervention outcomes.*

MAIN IDEAS

- ☞ Hearing is a first-order event for the development of spoken communication and literacy skills.
- ☞ Anytime the word “hearing” is used, think “auditory brain development”!!
- ☞ Acoustic accessibility of *intelligible* speech is essential for brain growth.
- ☞ Signal-to-Noise Ratio is the key to hearing intelligible speech.
- ☞ *Our early intervention protocols must take into consideration the listening capabilities and limitations of ALL children.*

IT'S ALL ABOUT THE BRAIN

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

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

NEW BRAIN RESEARCH

Basic neural research now provides data that substantiates the necessity of accessing and stimulating auditory brain centers.

There is a science behind our Auditory-Verbal practice.

NEUROLOGICAL ISSUES

- ☞ We hear with the brain -- the ears are just a way in! What's the big deal?
- ☞ Human beings are rich in auditory brain tissue – *But children can't listen like adults!*
- ☞ **Why?** 1) the higher auditory brain centers are not fully developed until a child is about 15 years old, 2) and children cannot perform sophisticated “automatic auditory cognitive closure”.
- ☞ Therefore, **all** infants and children need a quieter environment and a louder signal than adults.

Auditory Neural Activity

- ❧ Important changes have been shown in the higher auditory centers due to hearing loss of any type and degree.
- ❧ The auditory cortex is directly involved in speech perception and language processing in humans (Kretzmer et al, 2004).
- ❧ Normal maturation of central auditory pathways is a precondition for the normal development of speech and language skills in children (Sharma et. Al, 2006).

P1 Cortical Auditory Evoked Potential

- ☞ It's a bio-marker of central auditory development.
- ☞ The P1 cortical response latency is 100-200 msec in children.
- ☞ The P1 latency decreases with age to mark the maturation of central auditory pathways.
- ☞ A shorter P1 latency is correlated with better speech perception capabilities in children.

Why Early ID and Implantation, before age 2, is Critical (Robbins, et. al, 2004)

- ☛ Skills mastered as close as possible to the time that a child is biologically intended to do so, results in developmental synchrony.
- ☛ Mastery of any developmental skill depends on cumulative practice: the more delayed the age of acquisition of a skill, the farther behind children are in the amount of cumulative practice they have had to perfect that skill. The same concept holds true for cumulative auditory practice.
- ☛ Delayed auditory development leads to delayed language skills.
- ☛ A cochlear implant can make oral proficiency in more than one language possible for prelingually deaf children....provided we do what it takes.

Summary of Neuroplasticity

- ☞ Greatest in the first 3 ½ years of life
- ☞ The younger the infant, the greater the neuroplasticity
- ☞ Rapid infant brain growth requires prompt intervention, typically including amplification and a program to promote auditory skill development.
- ☞ In the absence sound, the brain re-organizes itself to receive input from other senses, primarily vision – “cross-modal re-organization”; this reduces auditory neural capacity.
- ☞ *As Prof. Graeham Clark reported, the competition from visual brain centers will dominate the auditory brain centers unless we focus on auditory brain access followed by extensive listening experience.*

Summary of Neuroplasticity

- ☞ Early implantation stimulates a brain that has **not** been reorganized and will therefore be more receptive to auditory input = greater auditory capacity.
- ☞ Early implantation synchronizes activity in the cortical layers.

Therefore, Identification of newborn hearing loss should be considered a neurodevelopmental emergency!!

Hearing vs Listening

- ☞ **Hearing** is acoustic access to the brain; it includes improving the signal-to-noise ratio by managing the environment and utilizing hearing technology.
- ☞ **Listening** is attending to acoustic events with intentionality.
- ☞ *“Hearing” must be made available before “listening” can be taught.*

Early Literacy Development – Janet Werker at UBC, Dev. Psy. 2006

- ☞ Infants acquire native languages by listening, and start life being prepared to speak.
- ☞ At birth, infants prefer their mother's speech and songs and stories heard **before** birth.
- ☞ In the first 6 months, babies can discriminate many speech sounds, but by the end of the 1st year, there is a functional reorganization to language specific phonemes.
- ☞ This reorganization improves and tunes the phonetic categories required for their language, and attenuates those distinctions not required.

Early Literacy Development – Janet Werker at UBC, Dev. Psy. 2006

- ☛ Infants use their phonetic categories to bootstrap learning new words.
- ☛ Phonetic distinctions guide new word learning at 17 months.
- ☛ Listening experience in infancy is critical for adequate language development.
- ☛ Phonetic categories > phonological processes > lexical-semantic use > reading and higher order language use.

Focused Auditory Skill Development

- ☞ Peripheral hearing loss causes central changes.
- ☞ Hearing loss *reorganizes* the central auditory system.
- ☞ Auditory stimulation shows a change in auditory availability in the brain plus a recruitment of more neural fibers. Listening embellishments always make a difference!
- ☞ Auditory enrichment embedded in language = informal stimulation.
- ☞ In addition, focused and intentional Auditory Skill Development is needed.
- ☞ Linking prosodic and linguistic features promotes *interhemispheric transfer*. And, add “bouncing”.

Early Intervention Outcomes

- ☞ Emerging data are showing that **over 90%** of children born with a profound hearing loss who obtain a cochlear implant before they are 2, attain intelligible speech.
- ☞ This outcome also is based on having the cochlear implant mapped appropriately and worn consistently.
- ☞ Direct, repetitive auditory skill instruction as part of an effective early intervention program, also is critical. That is, “extra” auditory stimulation is necessary.

Outcomes

- Data show that only **about 20%** of children born with a profound hearing loss who wear hearing aids (and not a cochlear implant), attain intelligible speech.
- Data also show that **about 80%** of children born with a profound hearing loss who have a cochlear implant inserted between 2 years and 4 years of age, attain intelligible speech (with appropriate intervention).

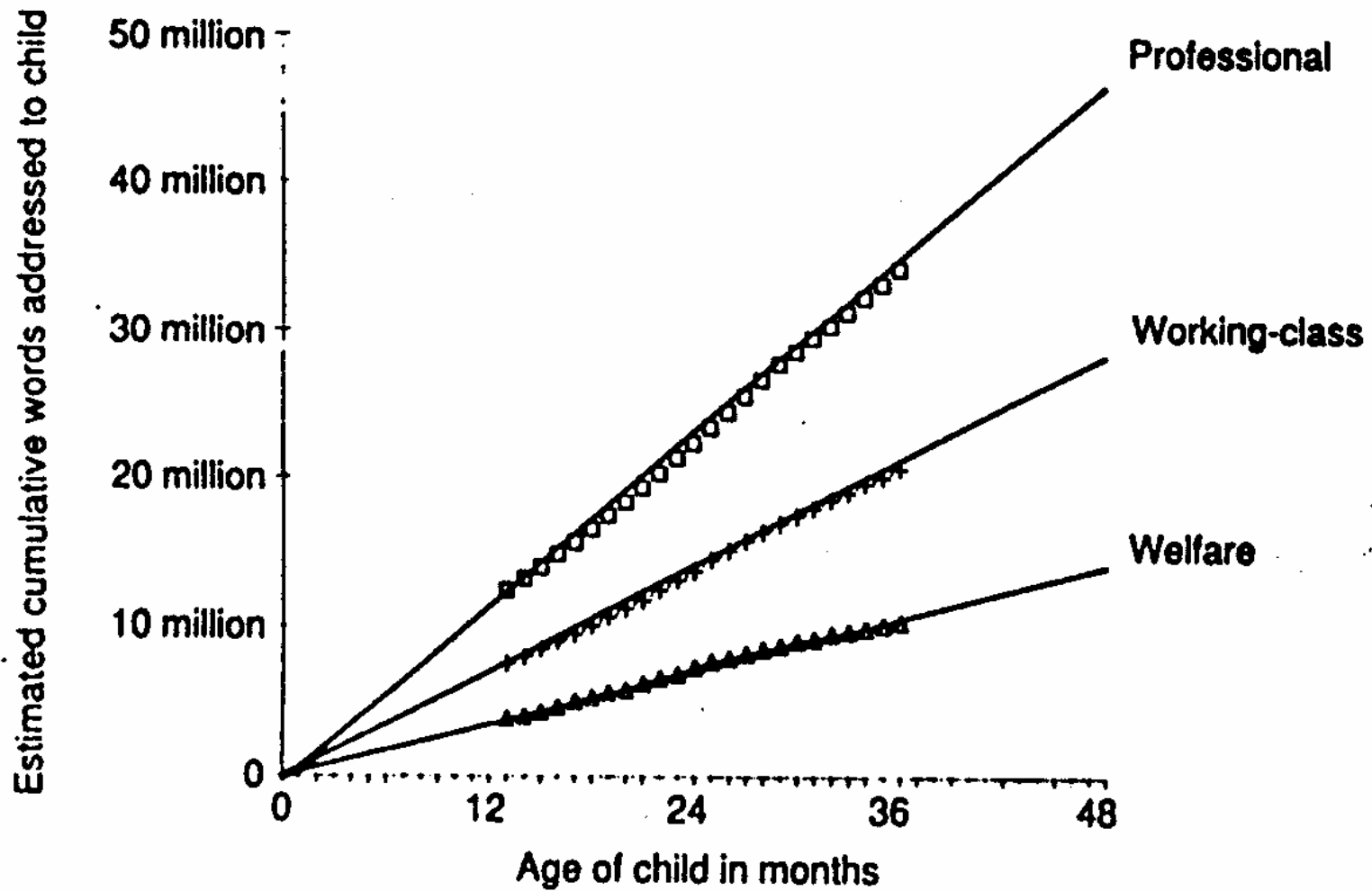
THE BIG PICTURE: THE WORLD HAS CHANGED!

- ☛ *Who Moved my Cheese?* by Spencer Johnson, M.D. – a book about change
- ☛ We are Information/Knowledge-based economies that demand high levels of spoken communication and literacy.
- ☛ We are educating children to take charge in the world of 2030, 2040, and 2050....not in the world of 1970 or 1990 or even 2009.

KEY STUDY BY HART AND RISLEY
SHOWING JUST HOW MUCH
AUDITORY STIMULATION IS NEEDED

**Meaningful Differences in the Everyday
Experience of Young American Children**

Language Experience



Therefore, early intervention is not about the child, it is about the family.

Think of early intervention as “adult education”.

THE WORLD HAS CHANGED FOR HEARING LOSS, TOO.

SPOKEN COMMUNICATION: PAST AND PRESENT

(1) CD of possible auditory-oral outcomes before early identification, early intervention, and cochlear implant technology – and (2) Present-day outcomes have been displayed in videos by Warren and others during the conference.

Same Words -- Different Concepts: Do our Words Hold us Back?

- ☞ Deaf – Counter-intuitive to think that over 90% of today's children who are born “deaf” can listen and talk, if we do what it takes.
- ☞ Hard of Hearing -- Functionally and/or Audiometrically – still requires management.
- ☞ Today's children are audiometrically deaf and functionally hard of hearing.

NEW PARADIGMS AS A RESULT OF EHDI PROGRAMS

- ☞ **1. We can now implement a developmental rather than a remedial model**
- ☞ **2. The focus is family-child with interventionist as coach, rather than teacher-child dyad; adult education**
- ☞ **3. Degree of hearing loss is no longer a factor in outcome; there is NO degree of hearing loss that precludes auditory access. Deaf is not really “deaf”.**
- ☞ **4. The audiologist is a key player – the professional who makes auditory brain access possible.**
- ☞ **5. An accessible auditory rather than a visual world is now possible for children with all degrees of hearing loss – if we do what it takes.**
- ☞ **6. 90% of children with hearing loss will be in general education classrooms, if we do our job right during the birth-3 period.**

The Bottom-Line Question To Ask Families Is: What is Your Vision for your Child?

95% of children with hearing loss are born into hearing and speaking families; they are interested in having their child communicate through speaking.

Once we know that listening and speaking are desired outcomes, the next conversation is – what will it take?

What Does it Take to Have a Listening and Spoken Communication Outcome?

- ☞ **Early identification and intervention to take advantage of neuroplasticity and developmental synchrony.**
- ☞ **Vigilant, ongoing and kind audiologic management.**
- ☞ **Immediate auditory brain access via technology – hearing aid loaner banks – to preserve auditory neural capacity.**
- ☞ **Engage a professional who is highly qualified in the development of listening and speaking, through techniques of parent coaching.**
- ☞ **Employ strategies that “Grow the Baby’s Brain”...both an art and a science!**

HOW TO “GROW” YOUR BABY’S BRAIN

**Information to share with families of children
with hearing problems of any type and degree,
including auditory processing difficulties.**

FOR PARENTS: HOW TO GROW AUDITORY BRAIN CENTERS

- ☺ 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 hour. The auditory brain centers need consistent access to clear, complete sound in order to develop.
- ☺ Check your child's technology regularly. Equipment malfunctions, often.

FOR PARENTS: HOW TO GROW AUDITORY BRAIN CENTERS

- ☞ **Minimize background noise.** Turn off the T.V.
- ☞ **Sing** to your child! Fill their days with all kinds of music and songs.
- ☞ **Speak in full sentences. Pronounce words clearly,** 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*.

FOR PARENTS: HOW TO GROW AUDITORY BRAIN CENTERS

- ☞ **Read aloud** every day. Try for 10 books per day.
- ☞ 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.

FOR PARENTS: HOW TO GROW AUDITORY BRAIN CENTERS

- ☞ Talk about where objects are **located**. You will use many prepositions such as in, on, under, behind, beside, next to, between. Prepositions are the bridge between concrete and abstract thinking.
- ☞ **Describe sequences**. Talk about the steps involved in activities as you are doing the activity. Sequencing is necessary for organization.

RESOURCES

- ❧ Cole, E., & Flexer, C. (In Press). *Children with Hearing Loss: Developing Listening and Talking, Birth to Six*. San Diego: Plural Publishing.
- ❧ Archives of Otolaryngology – Head and Neck Surgery. May 2004.
- ❧ Flexer, C. (1999). *Facilitating Hearing and Listening in Young Children, 2nd ed.* San Diego: Singular Publishing Group.
- ❧ Roberston. L. (2000). *Literacy Learning for Children Who are Deaf or Hard of Hearing*. Washington DC: Alexander Graham Bell Association for the Deaf and Hard of Hearing.

WEB SITES

- ☞ www.audiology.org
- ☞ www.agbell.org
- ☞ www.agbellacademy.org
- ☞ www.oraldeafed.org
- ☞ www.nciohio.com
- ☞ www.auditoryoptions.org
(A state-wide auditory initiative in Ohio)
- ☞ www.carolflexer.com

BRAIN, BRAIN, BRAIN!!!

The purpose of hearing aids, cochlear implants, personal-worn FM, classroom FM and IR systems, and auditory-verbal intervention is to access, grow and develop auditory brain centers.