



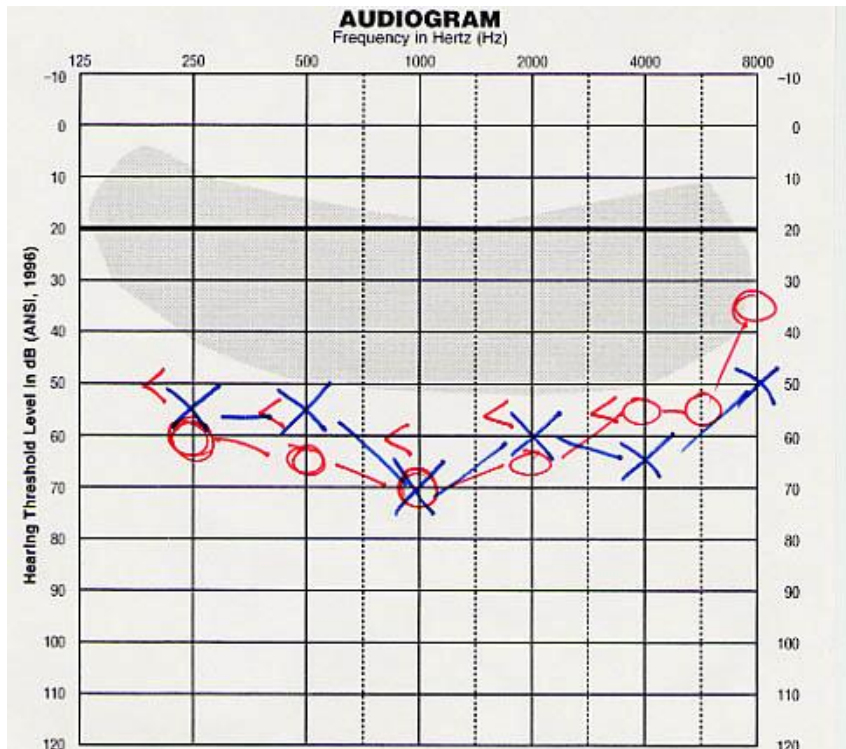
EDHI: Partnering for Progress

**Developmental Approach to
Hearing Assistance Technologies
October 27, 2011**

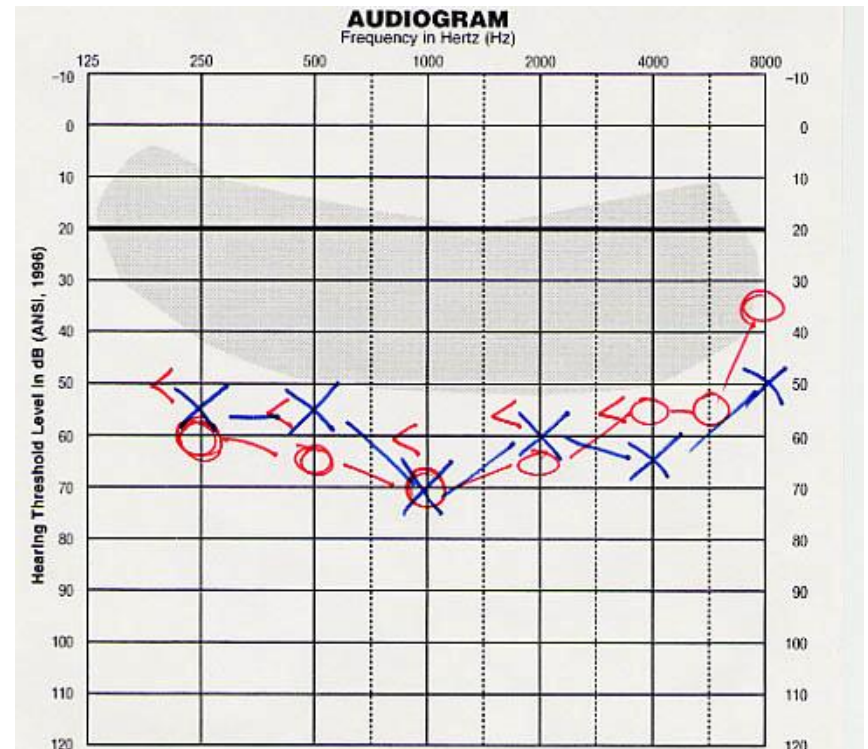
Ryan McCreery, Ph.D.
Boys Town National Research Hospital
Martha Mundy, Au.D.
University of North Carolina at Chapel Hill

A Tale of Two Audiograms

JOSEPH JONES – 50 YEARS



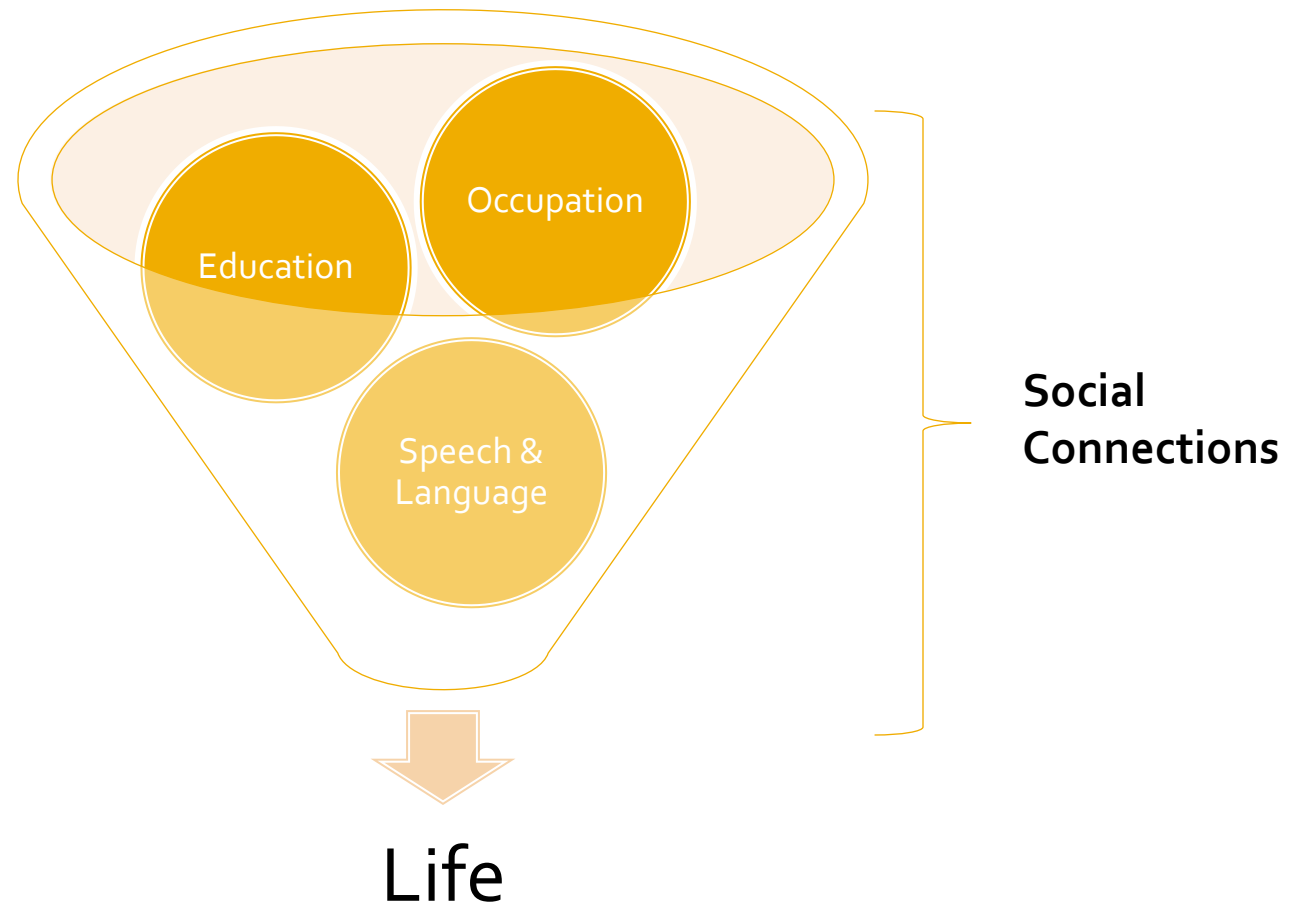
JOEY – 15 MONTHS



Considerations

- Language Development
- Speech Development
- Education Achievement
- Social Connections
- Occupation / Employment

Adults	Children
NA	Important
NA	Important
NA	Important
Important	Important
Important	Important



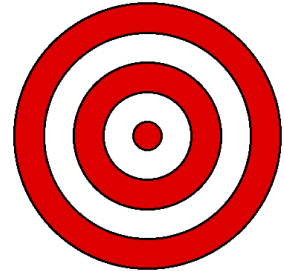
Hearing Aid Fitting Process

ADULT

- Tell me about your listening challenges.
- Let me tell you about different HAs and technologies that may help
- During fitting “how does that sound?”
- Adults actively participate in their treatment

CHILD

- Prescriptive fitting
 - X degree of loss suggests ## amount of amplification
- Monitoring of ear canal growth & stability of loss
- Children passive recipients of management



Childhood Hearing Loss

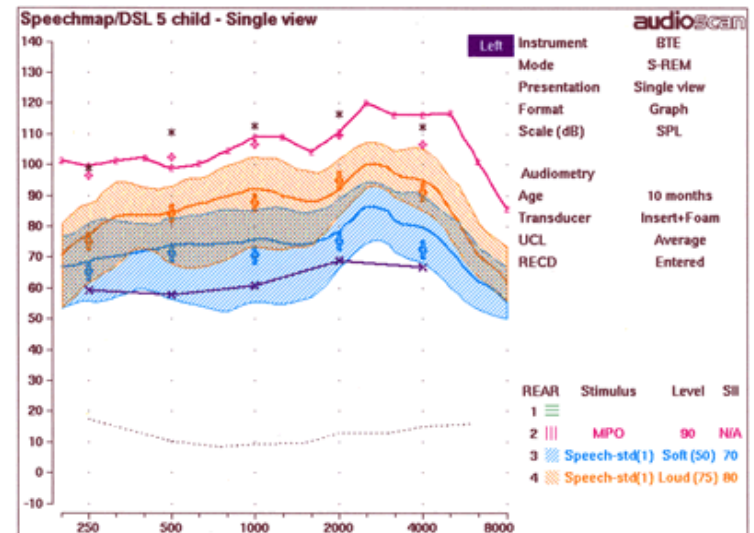
- Requires more amplification than adults
- Requires more intensive monitoring
- Eventually, requires development of self-advocacy skills
- Children fit with adult formulas, **underfit**
- Children fit without attention to physical canal size differences, **overfit**

HATs Piggy Back on HAs

- Output and frequency shaping are done by the HA, not the HAT
- “Maximum” benefit of HATs depends upon appropriate HA output



Verification



HATs also require verification

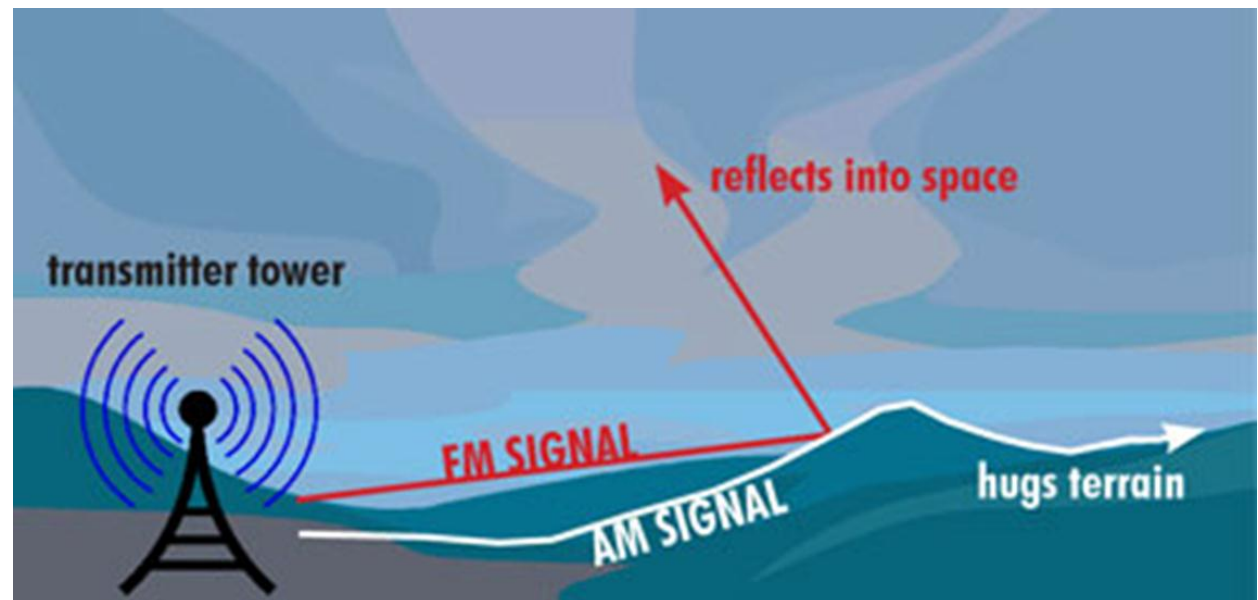
- Just because they can be put together like pop-beads, doesn't mean they should . . .
- Many individuals involved in HAT implementation with children, but audiologic verification should precede the use of these devices



FM & the Remote Microphone



- Early devices amplification in addition to FM receiver capability
- Remote Teacher microphone



Electromagnetic Waves

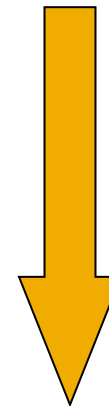
Vibrations / second

- X-Rays
- Ultra-violet
- Visible Light 1,000,000 MHz
- Infra Red
- Microwaves 1,000 MHz
- Radio waves 75 MHz

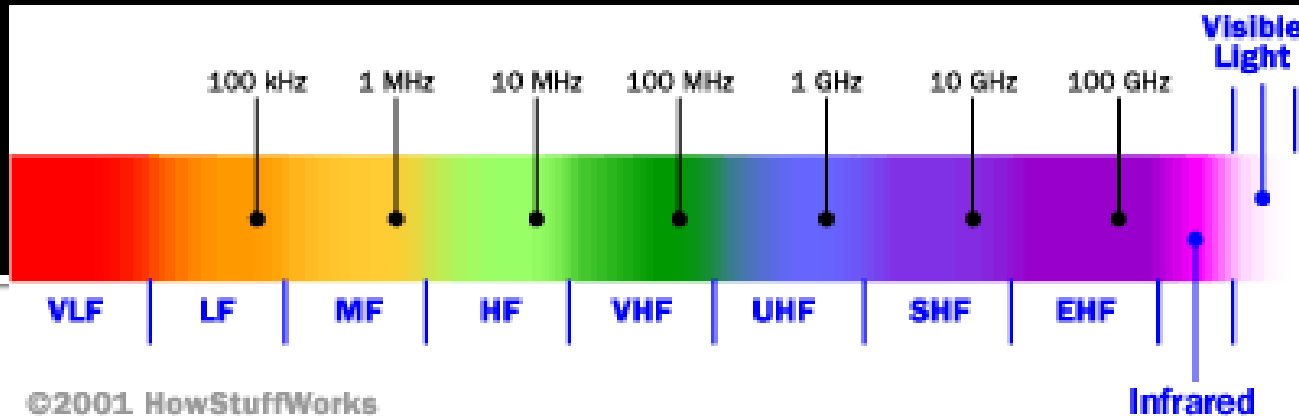
AM & FM carriers

75,000,000 Hz

High Freq



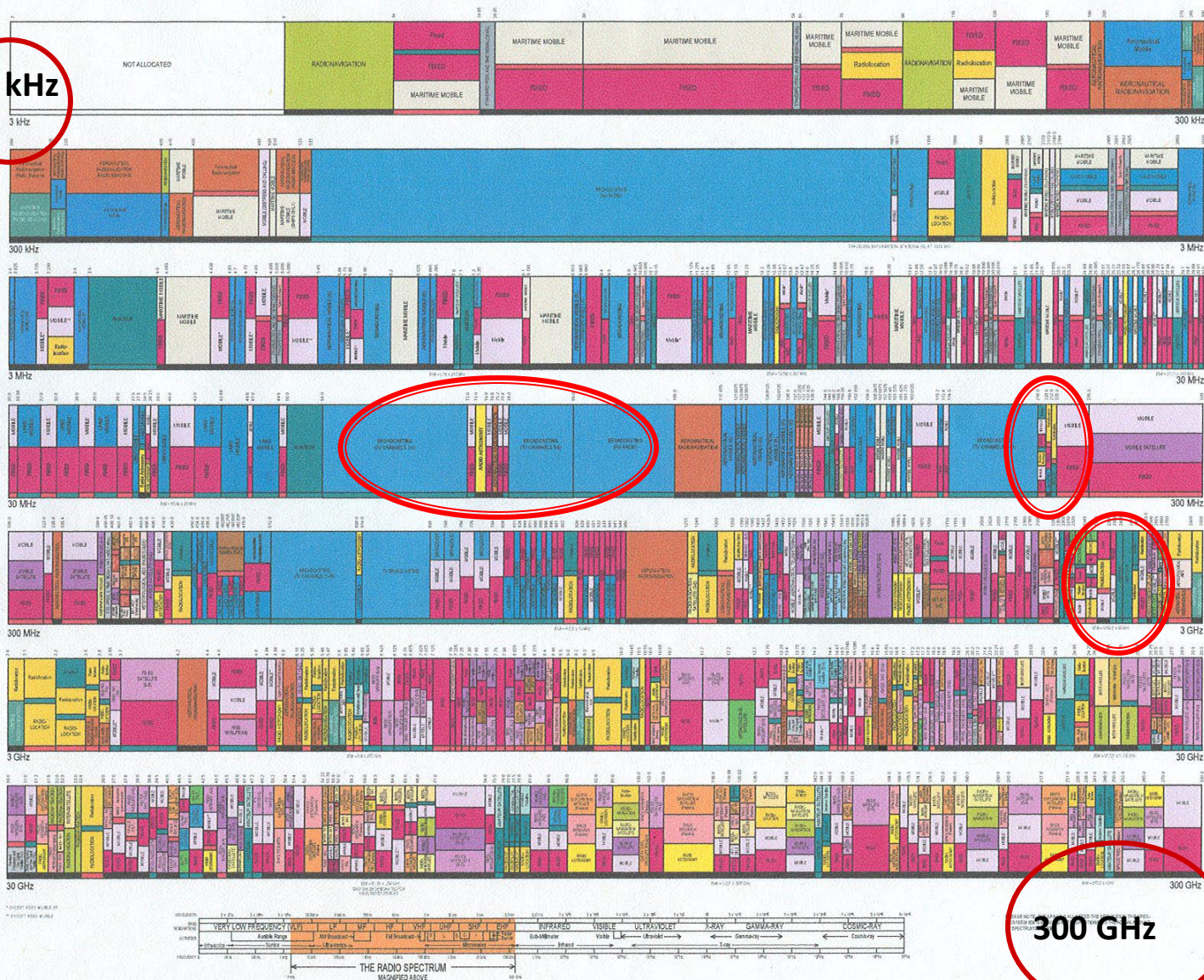
Low Freq



- Television 2 to 6 54-88 MHz
- Television 7-13 174-220 MHz
- Cordless Phones 40-50 MHz
- Baby Monitors 49 MHz
- Cell Phones 824-849 MHz
- FM HATs 72-76 MHz
- VHF 165-216 MHz
- Bluetooth 2.45 GHz 2450 MHz

<http://electronics.howstuffworks.com/radio-spectrum.htm>

3 kHz



300 GHz

What is Bluetooth?



- Bluetooth is an international wireless protocol
 - BT physical standard – radio frequency
 - BT protocol standard – speed/amount transmission
- Current generation “wireless” HAs and CI Processors can be programmed to accept BT transmission
 - “Paired”
- Low power (1 milliwatt vs cell phone 3000 mw)
- Transmission in ISM radio band (around 2.45 GHz)
 - Frequencies randomly change 1600X per second
 - Frequency hopping transceiver

Similarities / Differences

FM TRANSMISSION

- VHF Carrier Frequencies
- Single carrier
- Good at distance
- HA engineering must accept an FM signal
- Requires Transmitter
- Requires 1-2 Receivers
- Can couple with wires Tx to
 - Television
 - Phone
 - Etc., but one device at a time

BLUETOOTH

- ISM Carrier Frequencies
- Randomly changing carrier
- Distance within 10 meters
- HA engineering must have BT or T-coil
- Requires Transceivers
- With HA BT device, can couple wirelessly to
 - Phone
 - Music
 - Up to 8 devices that are BT capable

With all the advanced technology available, are hearing aids and cochlear implants (CI) enough?

- Sometimes yes.
- Sometimes no.
- In order to participate fully in his/her environment, children with HL need to use additional hearing assistance technology (HAT):
 - full- or part-time along with hearing aids/CI
 - instead of hearing aids/CI



Goals When Choosing Assistive Technology

- Awareness of environmental sounds
- Communication access in a variety of environments
- Access to electronic media
- Fostering independence
- Ensuring safety



Individual & Family Characteristics

- Age
- Degree of Hearing Loss
- Hearing Aid Use
- Physical Limitations
- Lifestyle
- Budget
- Monitor Changing Needs



Access is important!

- Social interaction
- Recreational participation
- Communication opportunities



Developmental Approach to HAT

- Based on child's current needs
 - Anticipate changes will development
- Developmental Index of Audition and Listening¹
 - Auditory needs / activities by age



¹ DIAL, Mormer & Palmer, 1997

Infants (Birth – 12 months)

- Rapid change and development
- Favorable positions
 - Cradle
 - Hip
- Mobility is limited until late



Infant Auditory Activities



- Localization to sounds and voices
- Enjoys music
- Vocal games
 - "So BIG"
- Story time

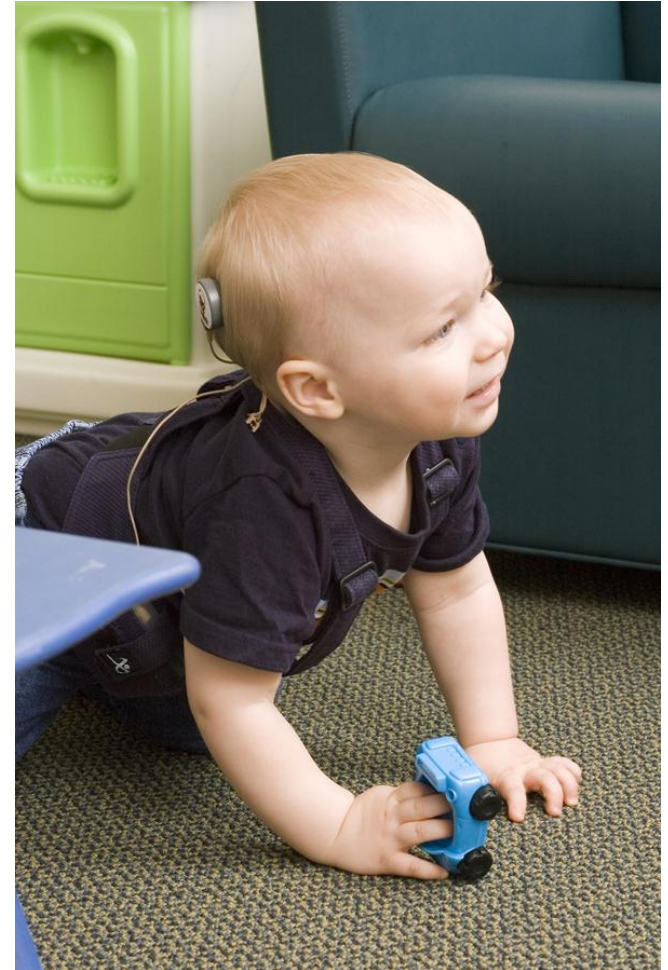
Infant HAT solution examples

- FM for use in the car
 - Rear-facing car seats
 - Use in conjunction with mirror



Infant HAT solution examples

- FM use to extend auditory access / range of overhearing
- FM use during story or reading



Toddler (12 – 36 months)

- Mobility
- Emergence of cognitive and language skills
- Logistical considerations
 - Parents Instructing Teachers



Toddler Auditory Activities

- Dances to music
- Sees parent answer phone and doorbell
- Attends to books
 - Group storytime
- Listens on telephone
- Awaken to smoke detector
- Overhearing



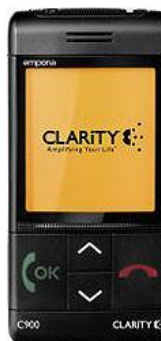
Toddler HAT examples

- Telephone needs
 - Landline
 - Mobile/cellular
 - Relay
- Skype / Facetime
- Relay



Auditory (Voice Phone) Systems

- Portable Amplifiers
- FM Transmitter with Phone
- Amplified Phones
- Bluetooth connections



Cell Phone Accessories



Visual Phone Devices

- TTYs
- Relay Services
 - Traditional
 - Internet
 - Video



Preschool (3-5 years)

- Classroom learning
- Increasing telephone and computer use
- Attend a movie or play in a theatre
- Television
- Dance / swimming lessons
- Playing at a distance



Preschool Solutions

- Classroom FM?
 - Dependent on situation
 - Multiple teachers?



Preschool Solutions

- Television
- Theatre
- Zoo
- Museum
- Houses of worship



Elementary School Age (6-10 Years)

- First cell phone?
- Access to electronic media / video games
- Independent telephone use
- Enjoys iPod / Music
- Sports / hearing at a distance



Elementary School Age Solution

- Sports
 - Difficulty hearing at a distance
 - FM?
 - Helmet



Elementary School Age Solution

- Music / iPod / iPad



Middle School (10-14 years)

- Social networking
 - Compatibility may provide motivation for use of device
- Attends movies and plays independently
- Alarm clocks



Wake Up Alarms



Computers

- Along with cell phones, computers have replaced the family telephone as the communication option of choice by many children/teens/young adults
 - Instant messaging
 - chat rooms
 - blogs
 - Facebook™
 - MySpace™



Self-advocacy

- Access to HAT in public venues
- ADA kits for travel
- Home alone
- Prepare for future independence



Older Adolescent (> 15 years)

- Increasing independence
- Driving
- Dances
- Employment/Vocation
- Travel
- Large lecture classes



Older Adolescent Solutions

- Travel
 - ADA kits



Employment / College

- Self advocacy
- Awareness of ADA
- Seeking accommodations
- Independent living
 - Fire / CO alarms

