Auditory Accessibility and Hearing Assistive Technologies

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Disclaimer Statement

I have no relevant financial or nonfinancial relationships of products or services described, reviewed, evaluated or compared in this presentation.

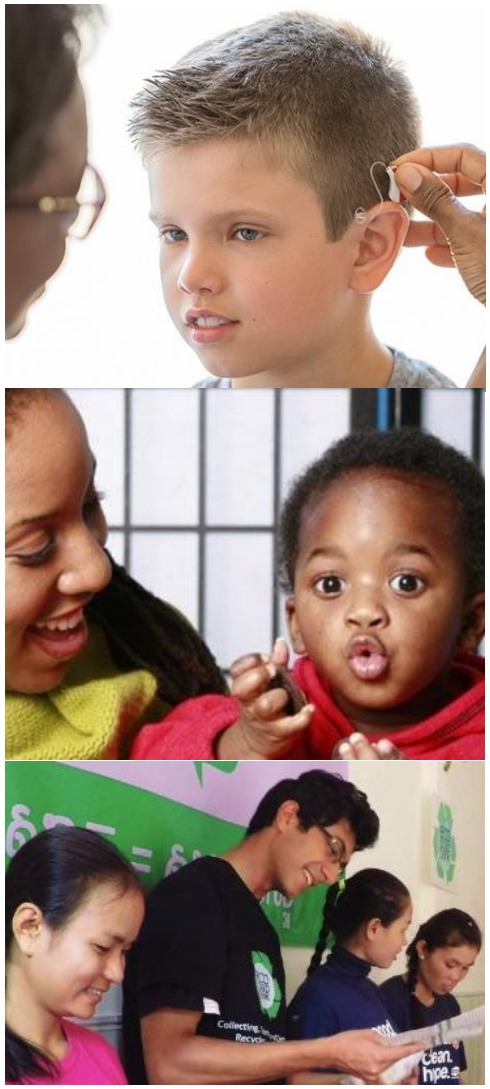
Objectives

- …explain how hearing assistive technology benefits children that are deaf/hard of hearing.
- …describe situations where hearing assistive technologies benefit children that are deaf/hard of hearing.
- …identify new and emerging digital hearing assistive technologies that provide hearing access for children that are deaf/hard of hearing.

What hearing assistance technologies do you provide/support beyond hearing aids and implant devices?

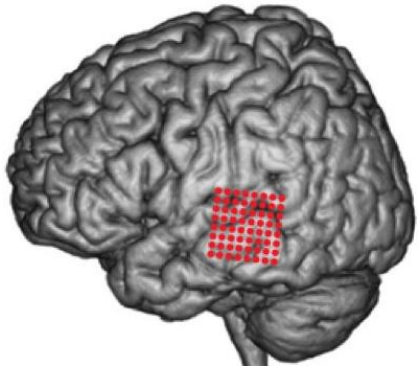
What does IDEA state about assistive technology?

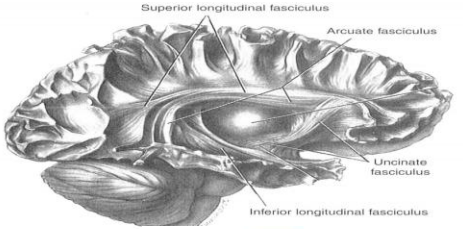
What does ADA Title II state regarding effective communication for children with hearing loss?



Neuroplasticity

- Auditory Access!
- Childhood hearing loss is a “neurodevelopmental emergency”!
  - Without early access to consistent intelligible speech, the auditory centers of the brain will not develop and normal intrahemispheric connections
- Children hear 46 million words by age 4 years
  - Hear 46 million words by 4 years of age (Risley and Hart)
  - Listening 20,000 hours to learn to read…listening at least 12 hour days for 1,667 days (Dehaene, 2009)
  - 10,000 hours to learn things (Dehaene, 2009)
  - Children with hearing loss require up to 3 times **more** (not less) auditory exposure to learn new words and concepts



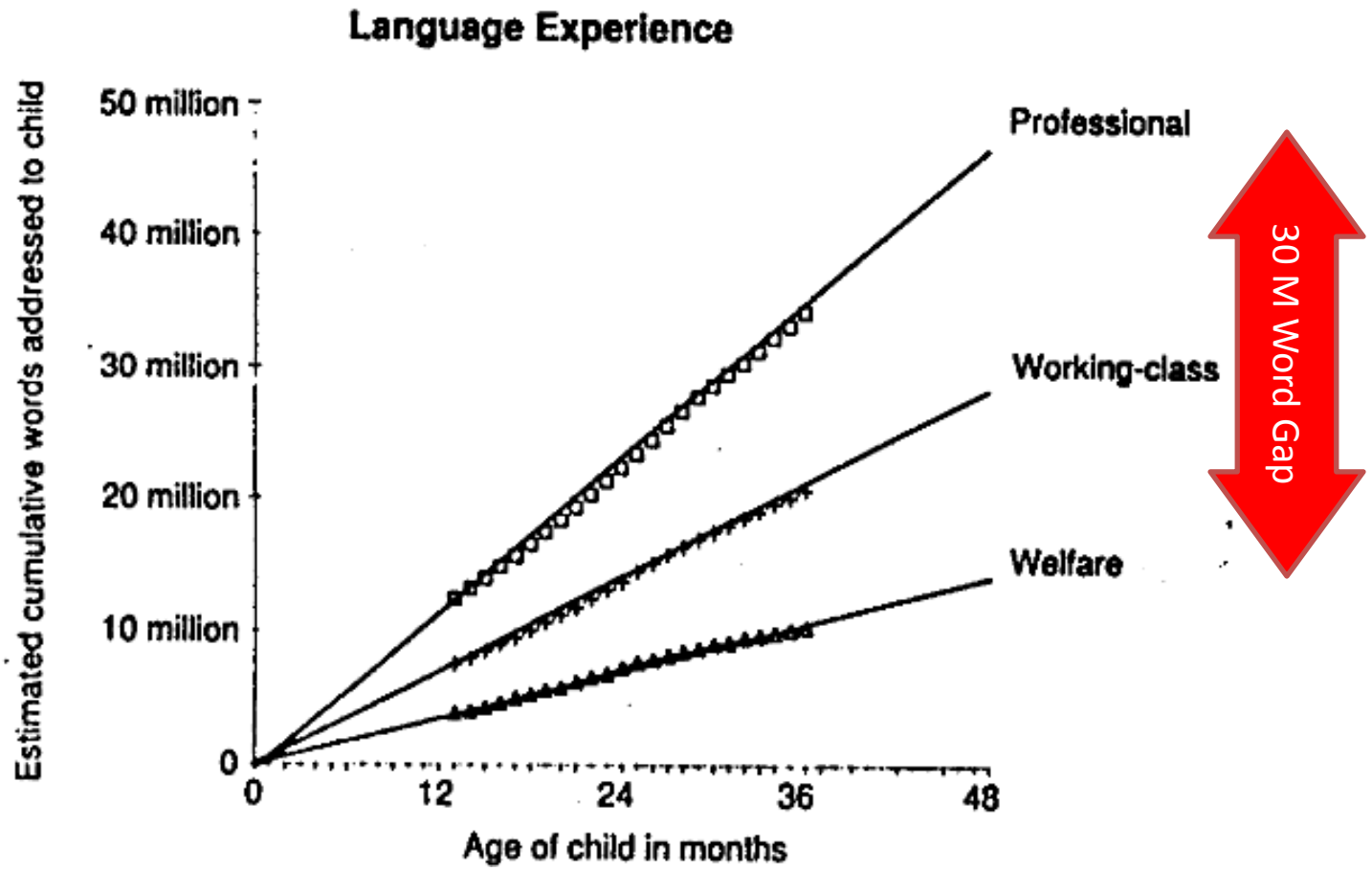


Neuroplasticity

- Child wearing hearing aids/implant devices and HAT
  - 4 hours a day
  - Takes 6 years for that child to hear what a child with normal hearing hears in one year!
- Area of brain for listening (temporal lobe) serves as foundation for:
  - Language and speech development
  - Phonemic awareness which is infrastructure of reading
  - Social skill development that allows participation with peers

30 Million Word Gap Initiative

30 Million Word Gap Initiative



(Hart and Risley, 1995)

Communication Access

Adults use residual hearing to continue to communicate.

Children use residual hearing to learn to communicate.

Why Hearing Assistive Technologies?

- Distance
  - Hearing aids and implant devices function best 3-8 feet
  - Classroom teacher-student distance can vary
- Noise
  - Recommended quiet room conditions are 35 dBA
- Reverberation
  - Need reduced reverberation times for speech recognition
  - Reverberation AND noise have far greater impact on hearing aid users compared to normal hearing individuals
- Signal to Noise Ratio (SNR)
  - Younger children (6 years) with normal hearing require significantly higher signal-to-noise values (>+15dB) for speech recognition

(Bradley & Sato, 2008; Neuman et al, 2010, Nishi et al, 2010; Valente et al, 2012; Yang and Bradley, 2008)

Noisy World Challenge

- Talker-dependent factors
  - Effort, spectrum, rate, articulation, accent, and orientation relative to speaker
- Language-dependent factors
  - Vocabulary, grammatical complexity, idea complexity, language context, and physical context
- Listener-dependant factors
  - Chronological/developmental age, hearing ability, cognitive status, attention, auditory processing and first language

Classrooms are Noisy

- Classrooms: 68 dBA (Choi & McPherson, 2005)
  - Occupied classroom noise levels range 64 – 72 dBA (Massie & Dillon, 2006)
  - School Auditorium – 79 dBA
  - School Lunchroom – 82 dBA
- Average SNRs from 41 classrooms (Sanders, 1965)
  - 17 Kindergarten: -1 dB
  - 12 Elementary: +5 dB
  - 12 High School: +5 dB

Infants and Toddlers, too?

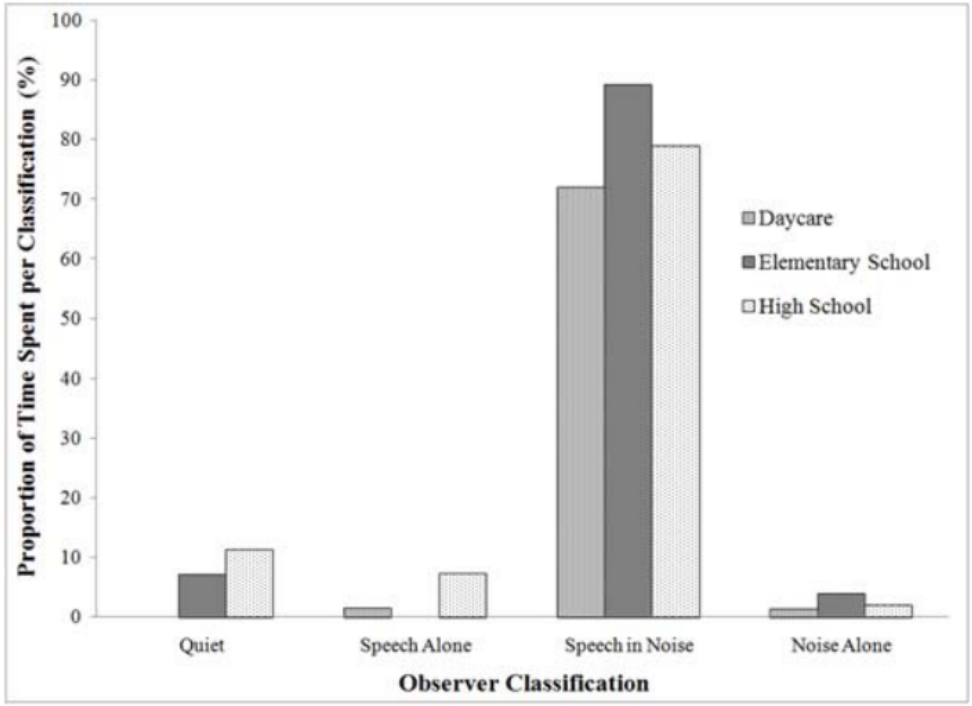
- LENA data logging of Infants and Toddlers
  - Car seat (70 mph) -10 dB SNR
  - Car seat (30 mph) - 5 dB SNR
  - Bus -10 dB SNR
  - Stroller - 8 dB SNR
  - Shopping cart - 6 dB SNR
  - Wind noise - 3 dB SNR

(Imram Mulla, 2013)

Decibel Hell – Impact of Noise on Learning

- 45-60% of classroom time, children engaged in listening (Rosenberg et al, 1999)
- Children particularly vulnerable to classroom noise
- Test scores significantly related to classroom noise (Shield and Dockrell, 2008)
- Reading scores associated with noise levels (Green et al, 1982)

Figure 5. Proportion of time spent in each sound environment, as classified by the observer for each site.



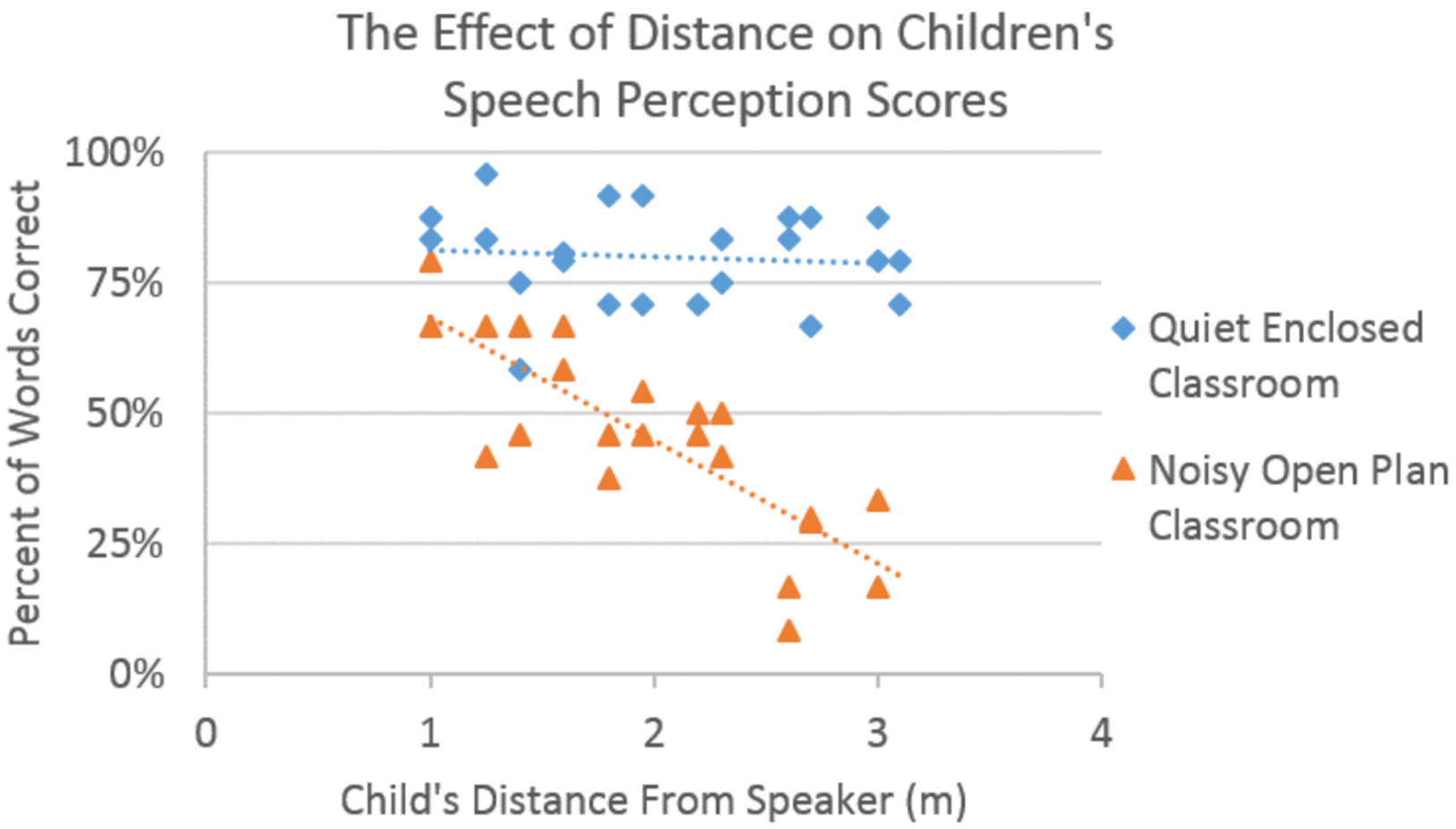
J Educ Audiol 2011;17:23-35

http://www.edaud.org/journal/2011/2-article-11.pdf

Reverberation -What the Research Shows

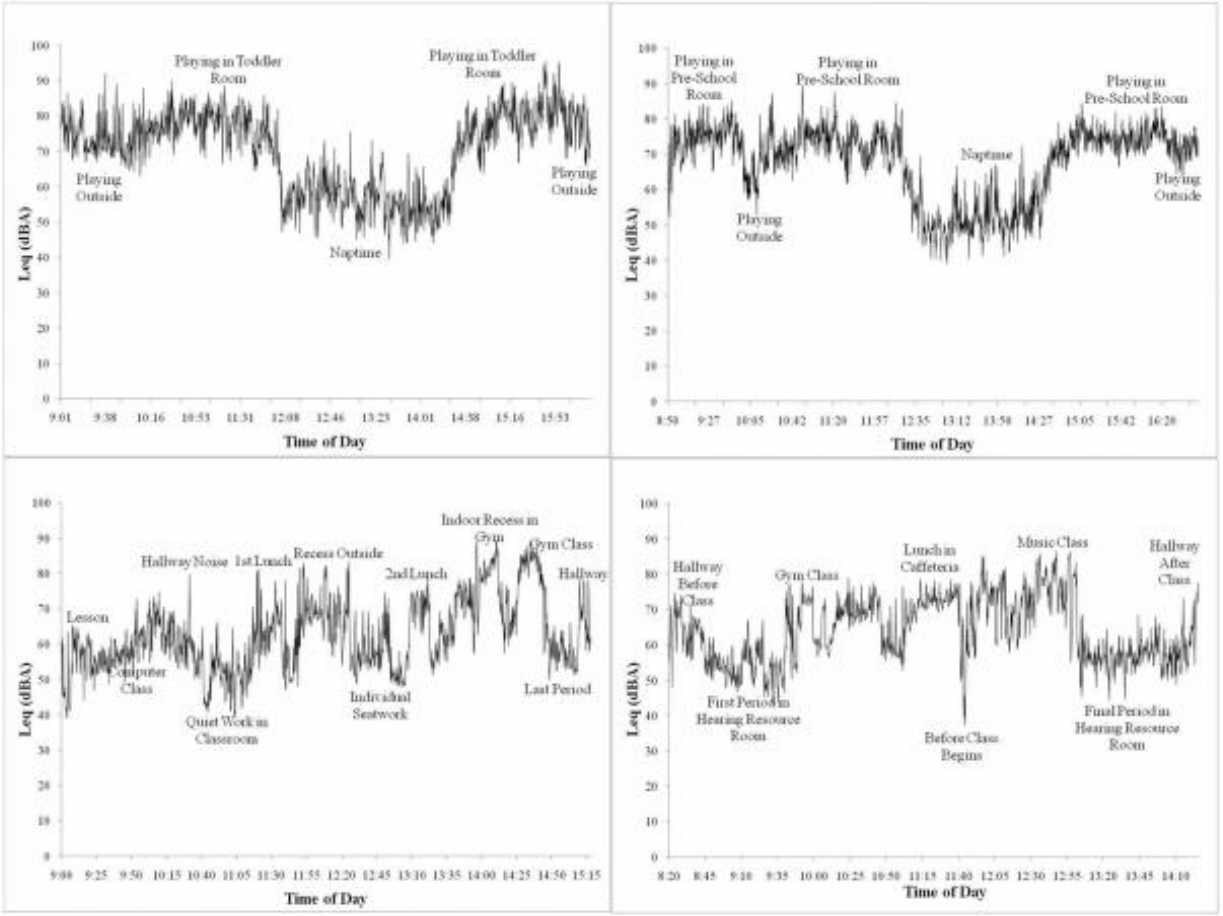
- Younger children (6 years) with normal hearing require significantly higher SNR values (**>+15dB**) and reduced reverberation times for speech recognition compared to older children and adults
  - Noise: Bradley & Sato, 2008; Eisenberg et al. 2000; Neuman et al, 2010; Nishi et al, 2010; Nozza et al., 1990; Valente et al, 2012; Yang and Bradley, 2008
  - Reverberation: Neuman & Hochberg, 1983; Neuman et al, 2010; Valente et al, 2012; Yang and Bradley, 2008
- Reverberation AND noise have far greater impact on hearing aid users compared to normal hearing individuals
  - Finitzo-Hieber & Tillman, 1978; Hawkins & Yacullo, 1984; Peters, Moore & Baer, 1997

Children with Normal Hearing – Noise



Children Need HAT at Daycare and School

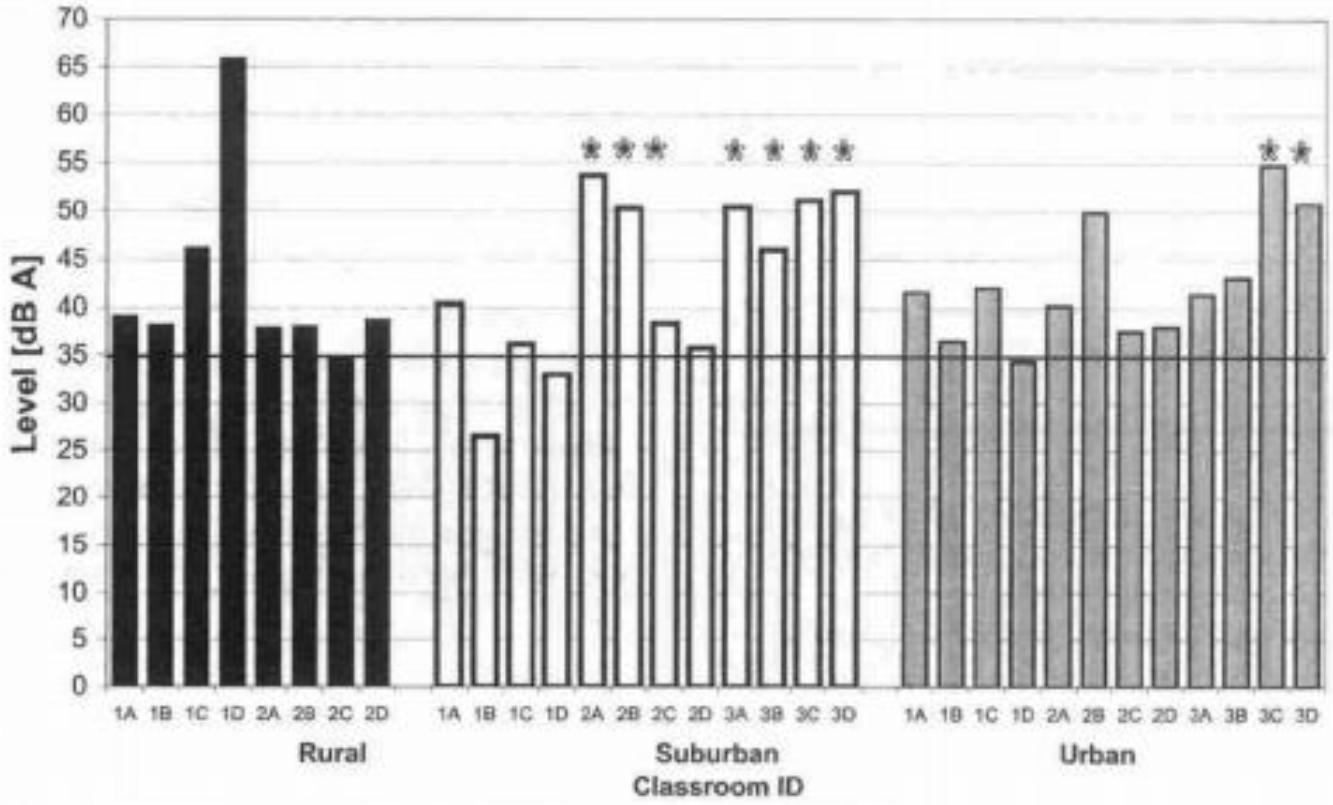
Noise levels at daycare & school:



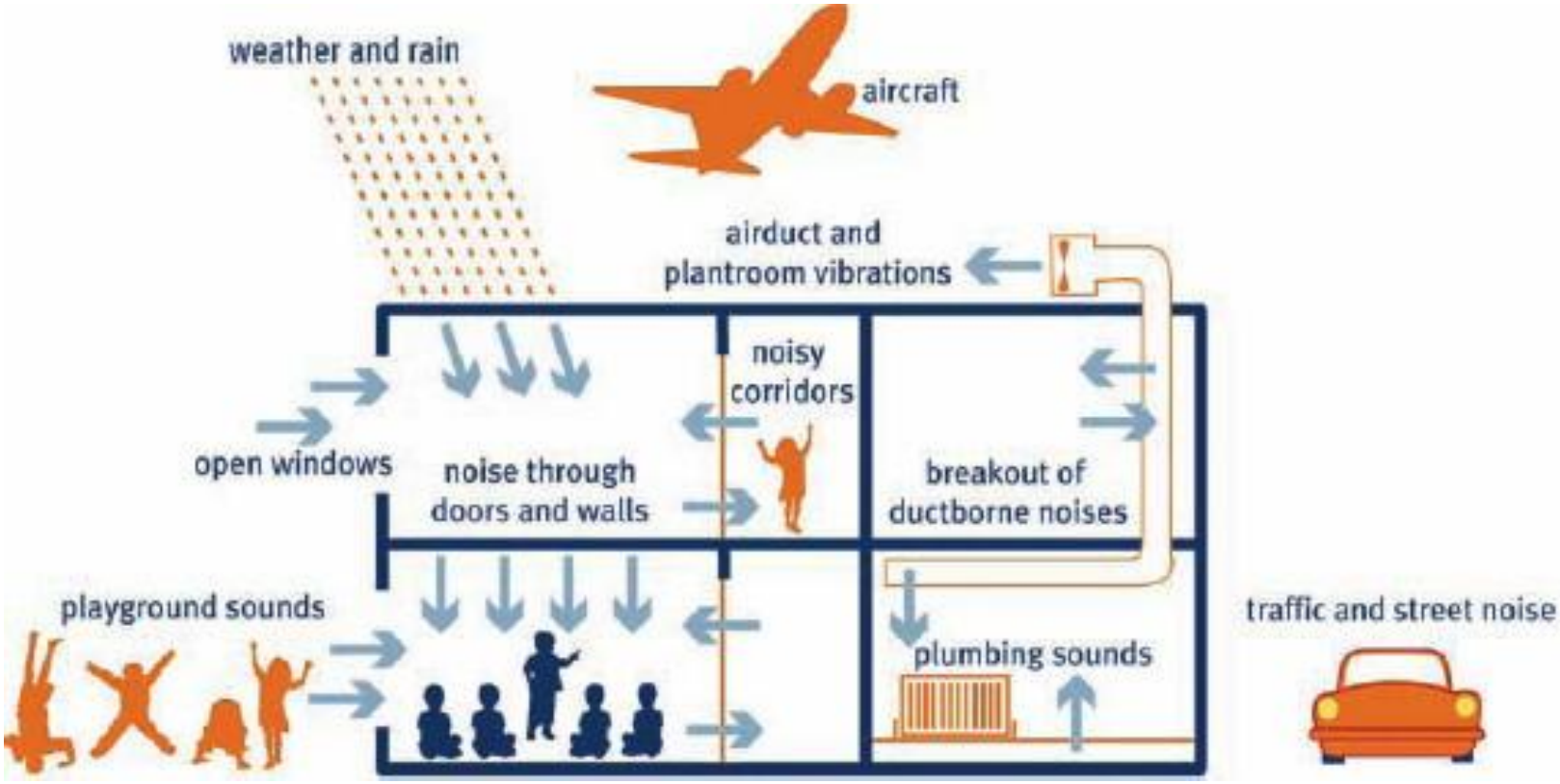
Crukley, Scollie, & Parsa 2011

Noise Levels in Schools

FIGURE 2. Background noise levels in dB(A) for the 32 classrooms. Those classrooms with HVAC systems on at the time of testing are noted with an asterisk (*).

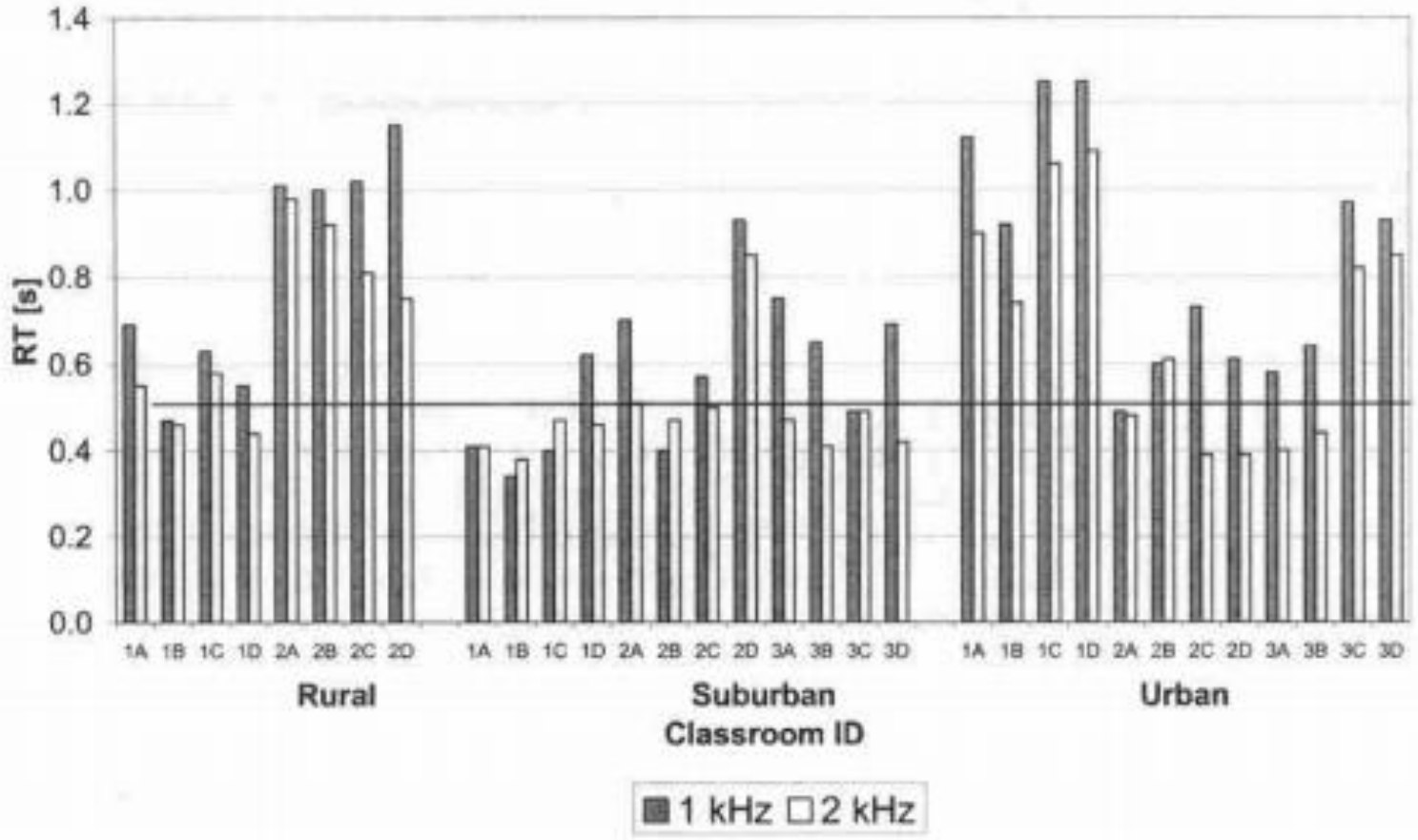


Children with HL Require >+15 dB SNR



Reverberation Times (RT) Need <.6 ms

FIGURE 3. Reverberation times (RT 60) at 0.5, 1, and 2 kHz for the 32 classrooms.



Hearing Loss in Children: Fatigue and Stress

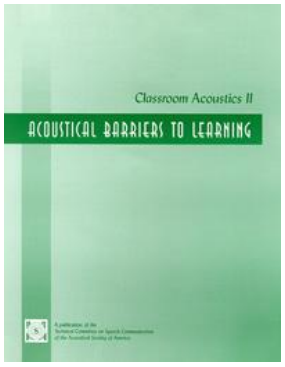
- Pediatric Quality of Life Inventory Multidimensional Fatigue Scale (PedsQL MFS)
- Children with HL report greater fatigue of all types compared to children with normal hearing
- Reduce amount of listening effort in difficult listening situations, to decreasing stress and fatigue
  - HAs and CIs
    - Digital noise reduction (DNR)
    - Directional microphones
  - HAT
    - FM/2.4 GHz
    - Classroom soundfield amplification

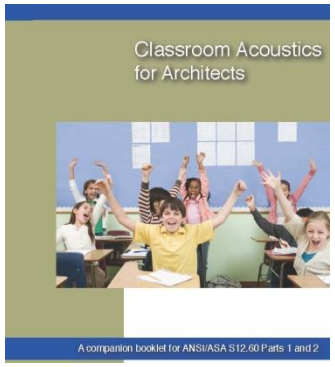
(Hornsby et al, 2014)

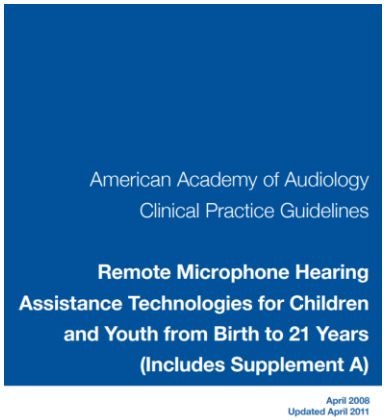
ANSI & AAA Can Save the Day for Children

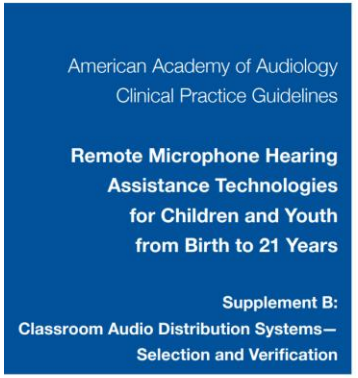
acousticalsociety.org/about_acoustics/acoustics_of_classrooms

www.audiology.org/publications-resources/document-library/hearing-assistance-technologies









All You Need is ~~Love~~ a HA or Implant! Right?

- Hmmm…
- Unfortunately, too many have this opinion
- HAT use with HAs and implants widely accepted and most effective

Consumers Unaware of HAT?

- At best only 30% of hearing aid users informed of HAT

  (Fino et al, 1992; Ross, 2000; Stika et al, 2002; Kenneth Southall, Jean-Pierre Gagné & Tony Leroux, 2006) (Kochkin, 2002; Tomita et al, 2002; Statistics Canada, 1992; Que´bec, L'Institut de la Statistique du Que´bec, 1998; Greville, 2005)

- Most non-owners unaware of hearing aid enhanced features and available accessories (Abrams and Kihm, 2015)

  http://www.hearingreview.com/2015/05/introduction-marketrak-ix-new-baseline-hearing-aid-market/

- 78% of audiologists reported HAT services provided (Predergast and Kelley, 2002)

Hopefully Attitudes of HAT Are Changing

2016 Audiologist Survey of 360 audiologists by Hearing Tracker and UBS Evidence Lab

- "What is the most exciting recent hearing aid innovation in recent years?"
- More than half mentioned:
- "Made for iPhone hearing aids", "Bluetooth connectivity," "direct connection to smartphones," "wireless technology," and numerous other connectivity features

Pervasive Assistance/Assistive Technology

Key advantages of smartphones and wearables:

- Less stigmatized
- Familiar to users
- Known and available worldwide
- Personalization…customized to fit individual needs
- More ‘future proof’

Thorpe, J. R., Rønn-Andersen, K. V. H., Bień, P., Özkil, A. G., Forchhammer, B. H., & Maier, A. M. (2016). Pervasive assistive technology for people with dementia: a UCD case. *Healthcare Technology Letters*, *3*(4), 297–302. http://doi.org/10.1049/htl.2016.0057

- What percentage of children with hearing loss use HAT in your practice?
- 0
- 10
- 25
- 50
- 75
- 90
- 100

HAT in Home

Two year longitudinal study in home setting for preschoolers with mild to severe SNHL (Moeller et al, 1996)

- One group used HAT system at home, frequently
- Other group used only personal hearing aids

- HAT used in home – preschoolers made unusually large gains in language development
- Parents communicated more frequently with child

Unilateral Hearing Loss/Single Sided Deafness

- Two ears need to localize sound
- Need better SNR to process speech particularly in noise
- 1/5 to 1/3 repeat a grade
- 40% need additional educational assistance
- More likely to have behavioral issues
- More likely to exhibit poorer oral language skills
- The greater the severity of SSD, more likely language and other delays present

- Benefit from personal hearing aids/implants
- MFi may benefit students

Assistive technology service (IDEA)

…means any service that directly assists a child with a disability in the selection, acquisition, or use of an assistive technology device. The term includes--

(a) The evaluation of the needs of a child with a disability, including a functional evaluation of the child in the child's customary environment;

(b) Purchasing, leasing, or otherwise providing for the acquisition of assistive technology devices by children with disabilities;

(c) Selecting, designing, fitting, customizing, adapting, applying, maintaining, repairing, or replacing assistive technology devices;

(d) Coordinating and using other therapies, interventions, or services with assistive technology devices, such as those associated with existing education and rehabilitation plans and programs;

(e) Training or technical assistance for a child with a disability or, if appropriate, that child's family; and

(f) Training or technical assistance for professionals (including individuals providing education or rehabilitation services), employers, or other individuals who provide services to, employ, or are otherwise substantially involved in the major life functions of that child.

Office for Civil Rights - 504

- School district explained to OCR, that since student had continued to maintain “A” and “B” grades while FM device was unavailable, they felt he was not affected by district’s failure to follow 504 Plan
- Office for Civil Rights agreed with student’s mother that maintenance of good grades was due to student’s own diligence
- OCR determined district’s failure to implement 504 Plan and failure to implement mitigating measures denied student FAPE and violated 504
- School districts should not rely solely on adequacy of student grades in determining eligibility for services or impact on student when required services NOT provided

U.S. Department of Justice
Civil Rights Division

U.S. Department of Education
Office for Civil Rights
Office of Special Education and Rehabilitative Services

November 12, 2014

Dear Colleague:

Students with disabilities, like all students, must be provided the opportunity to fully participate in our public schools. A critical aspect of participation is communication with others. We have enclosed a document, entitled "Frequently Asked Questions on Effective Communication for Students with Hearing, Vision, or Speech Disabilities in Public Elementary and Secondary Schools" (FAQs), which explains the responsibility of public schools to ensure that communication with students with hearing, vision, or speech disabilities is as effective as communication with all other students.

Three Federal laws – the Individuals with Disabilities Education Act (IDEA), Title II of the Americans with Disabilities Act of 1990 (Title II), and Section 504 of the Rehabilitation Act of 1973 (Section 504) – address the obligations of all public schools to meet the communication needs of students with disabilities, but do so in different ways. In particular, the IDEA requires that schools make available a free appropriate public education (FAPE), consisting of special education and related services, to all eligible children with disabilities (including those with disabilities that result in communication needs). Title II requires schools to ensure that students with disabilities receive communication that is as effective as communication with others through the provision of appropriate auxiliary aids and services.[1]

Public schools must apply both the IDEA analysis and the Title II effective communication analysis in determining how to meet the communication needs of an IDEA-eligible student with a hearing, vision, or speech disability. In many circumstances, an individualized education program under the IDEA will also meet the requirements of Title II. However, as a recent Federal court decision highlighted, the Title II effective communication requirement differs

[1] Because compliance with the IDEA can satisfy Section 504's requirement to provide FAPE to a student with a disability for the vast majority of students covered by the FAQs, and because, in general, a violation of Section 504 is a violation of Title II, the focus of the FAQs is on the IDEA and the specific Title II regulatory requirements for effective communication.

from the requirements in the IDEA.[2] In some instances, in order to comply with Title II, a school may have to provide the student with auxiliary aids or services that are not required under the IDEA. In other instances, the communication services provided under the IDEA will meet the requirements of both laws for an individual student.

The FAQs address the interplay of these IDEA and Title II requirements. Our hope is that the FAQs are helpful to schools, parents, and others in explaining students' rights and schools' obligations to address the communication needs of students with hearing, vision, or speech disabilities.

Thank you for your continued efforts to ensure that all students, including students with disabilities, have access to equal opportunities at school.

Sincerely,

/s/	/s/	/s/
Vanita Gupta	Michael K. Yudin	Catherine E. Lhamon
Acting Assistant Attorney General	Acting Assistant Secretary	Assistant Secretary
Civil Rights Division	Office of Special Education and	Office for Civil Rights
U.S. Department of Justice	Rehabilitative Services	U.S. Department
	U.S. Department of Education	of Education

Attachment as stated

[2] The United States Court of Appeals for the Ninth Circuit addressed the IDEA and Title II effective communication obligations in *K.M. v. Tustin Unified School District*, 725 F.3d 1088 (9th Cir. 2013), *cert. denied,* 134 S. Ct. 1493 (2014), available at http://cdn.ca9.uscourts.gov/datastore/opinions/2013/08/07/11-56259%20web%20revised.pdf. The United States government filed an amicus (friend of the court) brief in this case when it was before the Ninth Circuit; that brief can be found at http://www.justice.gov/crt/about/app/briefs/kmtustinbr.pdf.

U. S. DOJ & U. S. DOE 2014 Statement

- "Public schools must apply both the IDEA analysis and ADA Title II effective communication analysis in determining how to meet the communication needs of an IDEA-eligible student with a hearing, vision, or speech disability.
- In some instances, in order to comply with Title II, a district may have to provide the student with services that are not required under the IDEA.
- In other instances, the communication services provided under the IDEA may meet the requirements of both laws for an individual student.
- Schools need to be knowledgeable about requirements of both Federal laws in order to meet the communication needs of students with disabilities."

ADA Title II (2014)

- Applies to all elementary and secondary school programs, activities, and services of public school districts, including all public schools within school districts
- A disability is defined as
  - (1) a physical or mental impairment that substantially limits a major life activity;
  - (2) a record of such an impairment; or
  - (3) being regarded as having such an impairment.
- Students with disabilities are covered regardless of their eligibility for special education and related services under IDEA or 504

https://www2.ed.gov/about/offices/list/ocr/letters/colleague-effective-communication-201411.pdf

Effective Communication (ADA)

- (C.F.R.) at 28 C.F.R. pt. 35. These regulations require, among other things, that public schools provide students with disabilities an equal opportunity to participate in all school activities and that public schools ensure, through the provision of auxiliary aids and services, that communication with students with disabilities is as effective as communication with students without disabilities

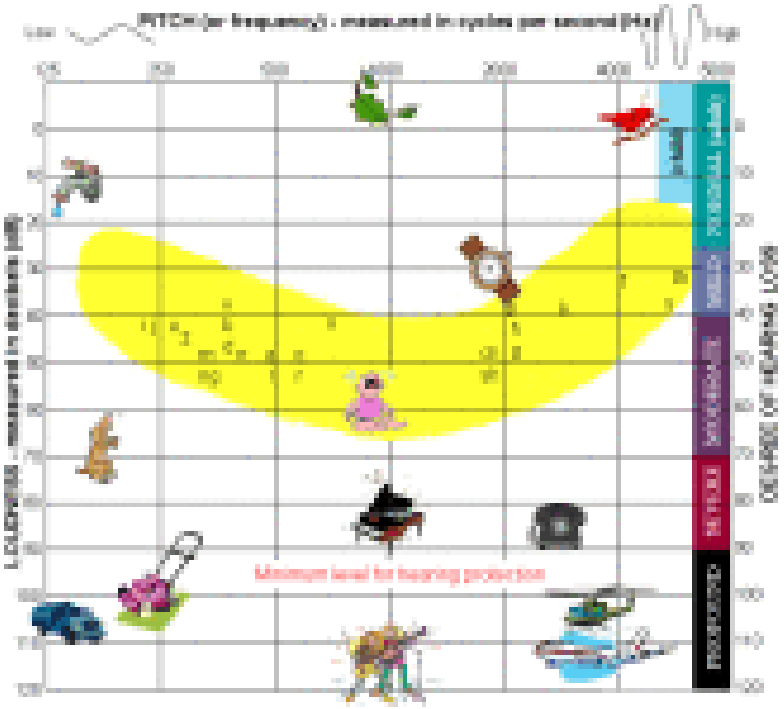
http://successforkidswithhearingloss.com/access-ada
http://www.ada.gov/doe_doj_eff_comm/doe_doj_eff_comm_faqs.htm

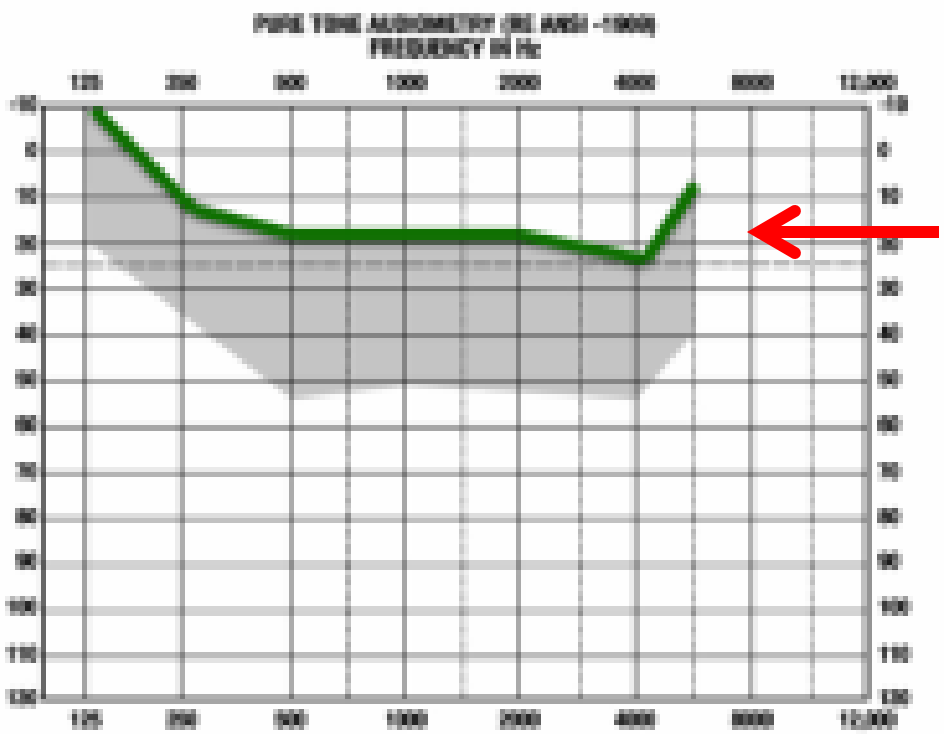
Title II of ADA

- Public entities must 'furnish appropriate auxiliary aids and services where necessary to afford an individual with a disability an equal opportunity to participate in, and enjoy the benefits of, a service, program, or activity conducted by a public entity.'
- In determining what type of auxiliary aid and service is necessary, a public entity shall give primary consideration to the requests of the individual with disabilities.'"

SD IDEA Definition of Hearing Loss!!!

24:05:24.01:10. Hearing loss defined. A student may be identified as having a hearing loss if an unaided hearing loss of 35 to 69 decibels is present that makes the acquisition of receptive and expressive language skills difficult with or without the help of amplification.





HAT Parts

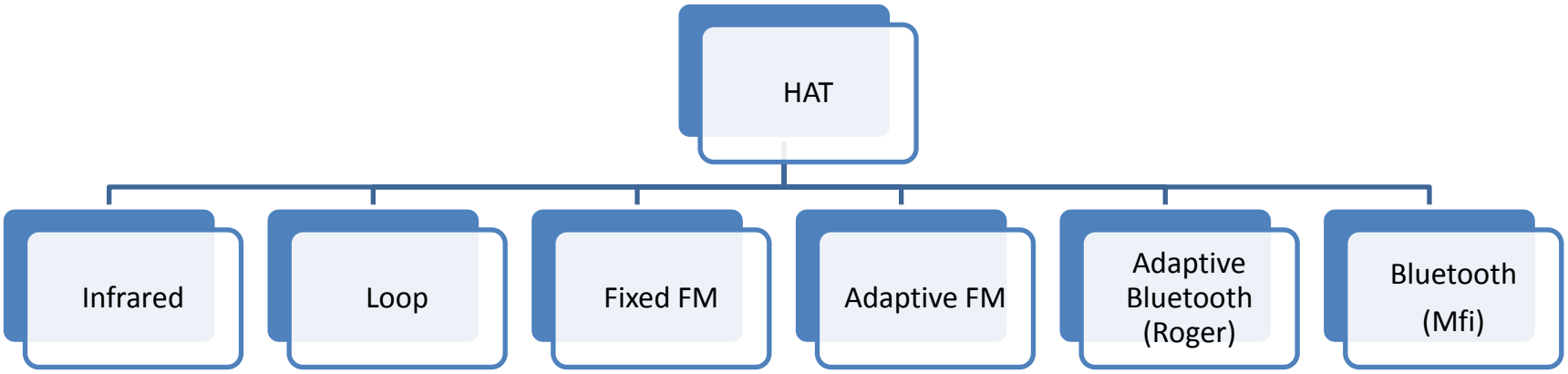
Mic/Transmitter/Pass-along

Receiver

- On/in ear
- Soundfield
- Personal soundfield
- Streamer/neckloop

Hearing aid/Implant device

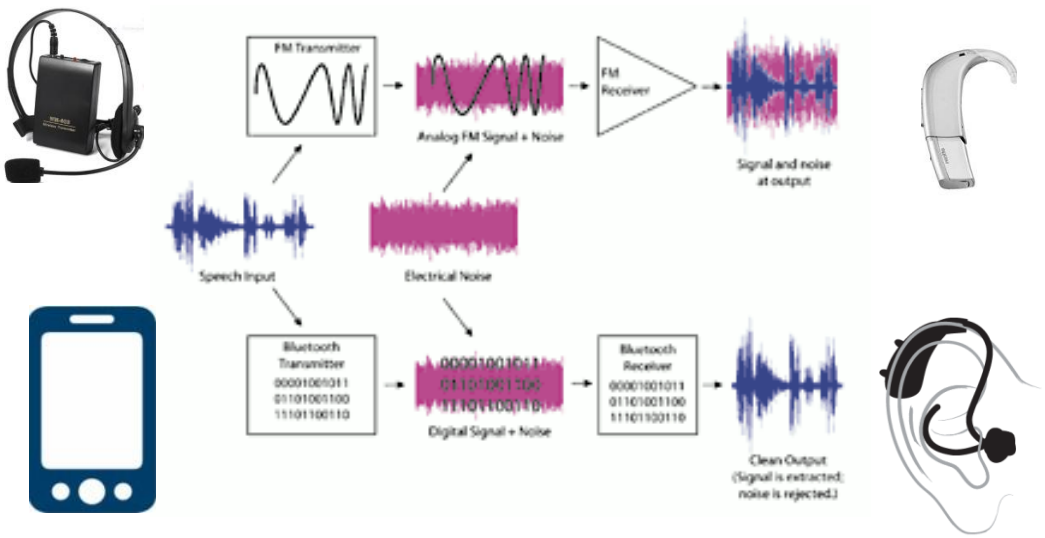
HAT Types



Bluetooth or 2.4GHz – disruptive technology
More options for parents and schools

Bluetooth vs. FM

- **FM** – 72-75 MHz and 216 MHz frequency bands for use under American with Disabilities Act (ADA)
- **Bluetooth** - ultra high frequency radio waves 2.4 to 2.485 GHz license-free Industry Science Medical (ISM) band
  - Low cost
  - Low energy

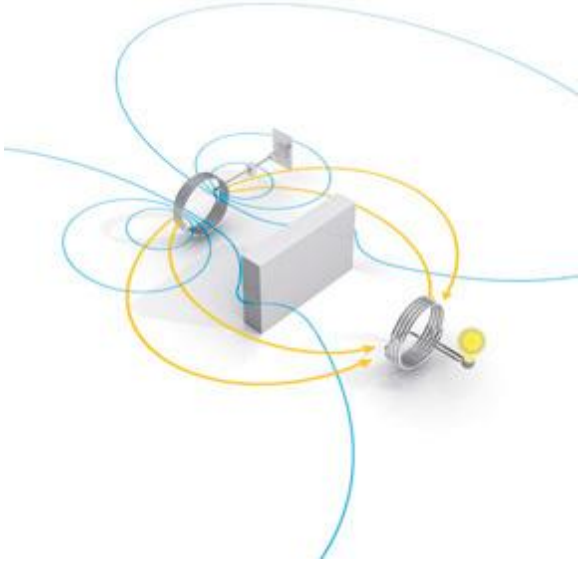


www.hearingreview.com/2005/05/a-wearable-bluetooth-device-for-hard-of-hearing-people/

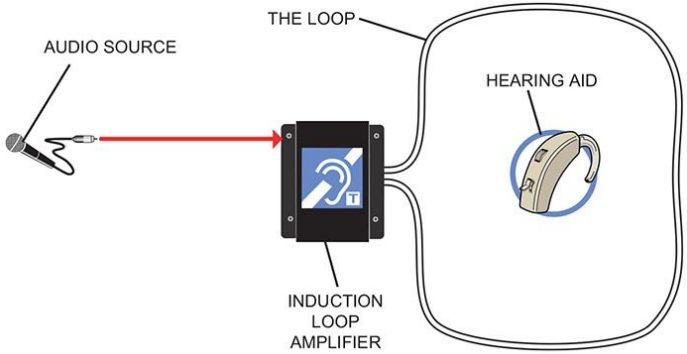
NFMI vs. Loop Induction

Near Field Magnetic Induction creates a secure wireless ‘bubble’ around each user with telecoil receiver

- Gateway/Intermediate devices
- Communication between HA



Loop Induction system transmits an audio signal directly into a hearing aid via a magnetic field with a telecoil receiver



WiFi vs. Cell Phone 4G

WiFi - standard wireless local area network (WLAN) technology connecting computers and myriad of electronic devices to each other and to the Internet

- The 802.11 workgroup currently documents use in five distinct frequency bands: 2.4 GHz, 3.6 GHz, 4.9 GHz, 5 GHz, and 5.9 GHz bands

Cellular phone - a telephone with access to a cellular radio system used over wide area without physical connection to network

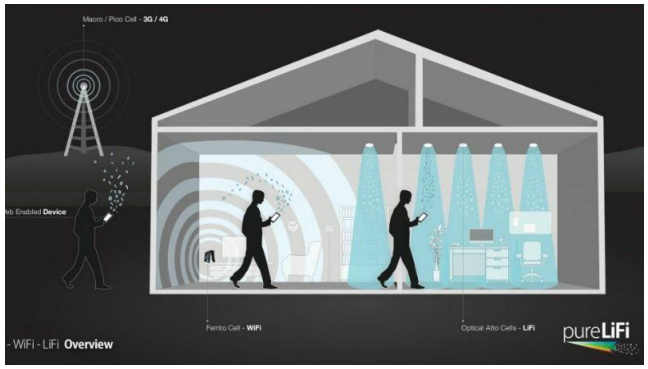
Infrared vs. LiFi

Infrared uses infrared light to transmit sound

- Transmitter converts sound into a light signal and beams signal to a receiver worn by a listener

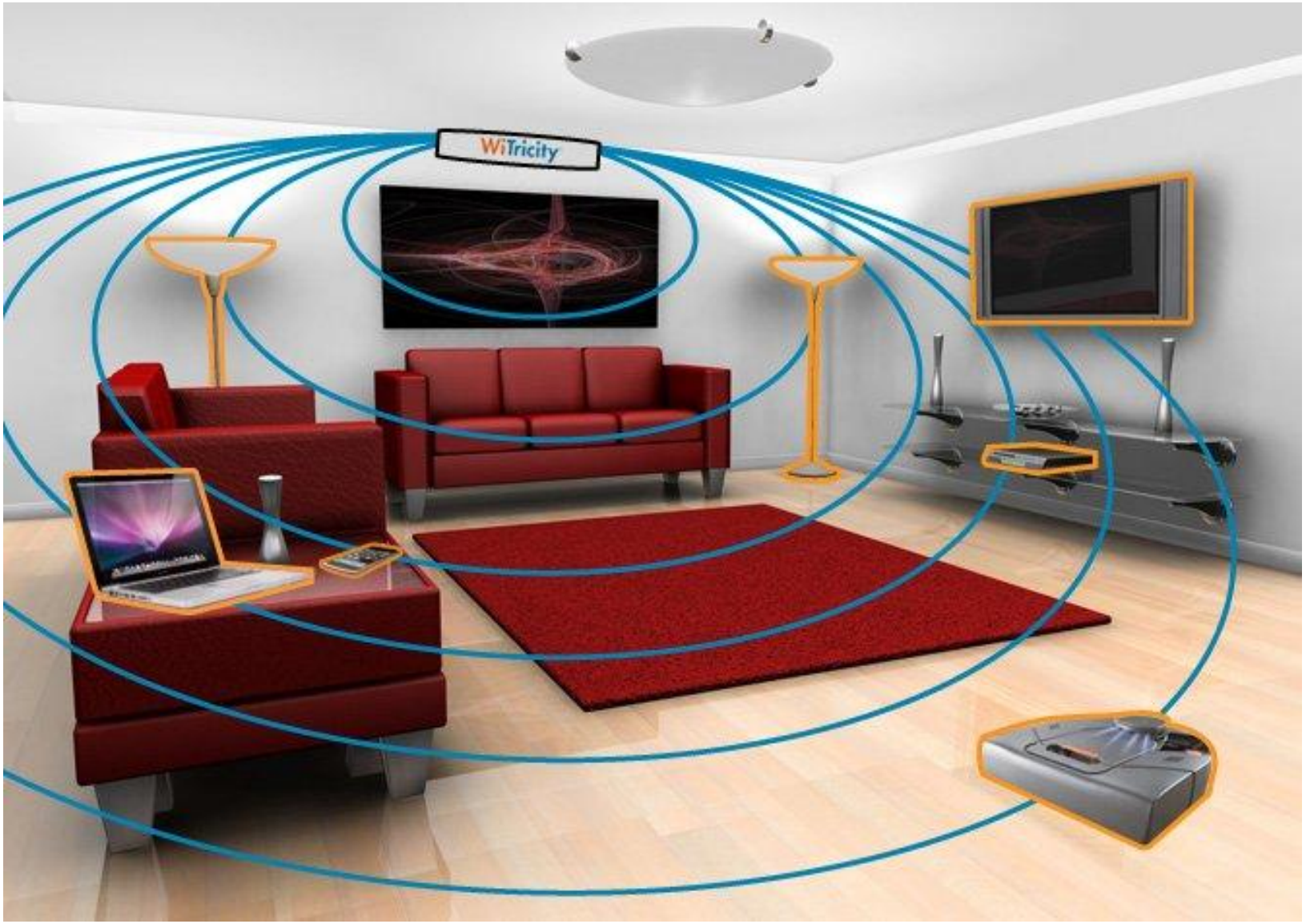
Li-Fi

- Relies on solar energy to power Internet connections so that an LED light source paired with a solar panel becomes a fully functional transmitter and receiver system for high speed, secure data transfer.

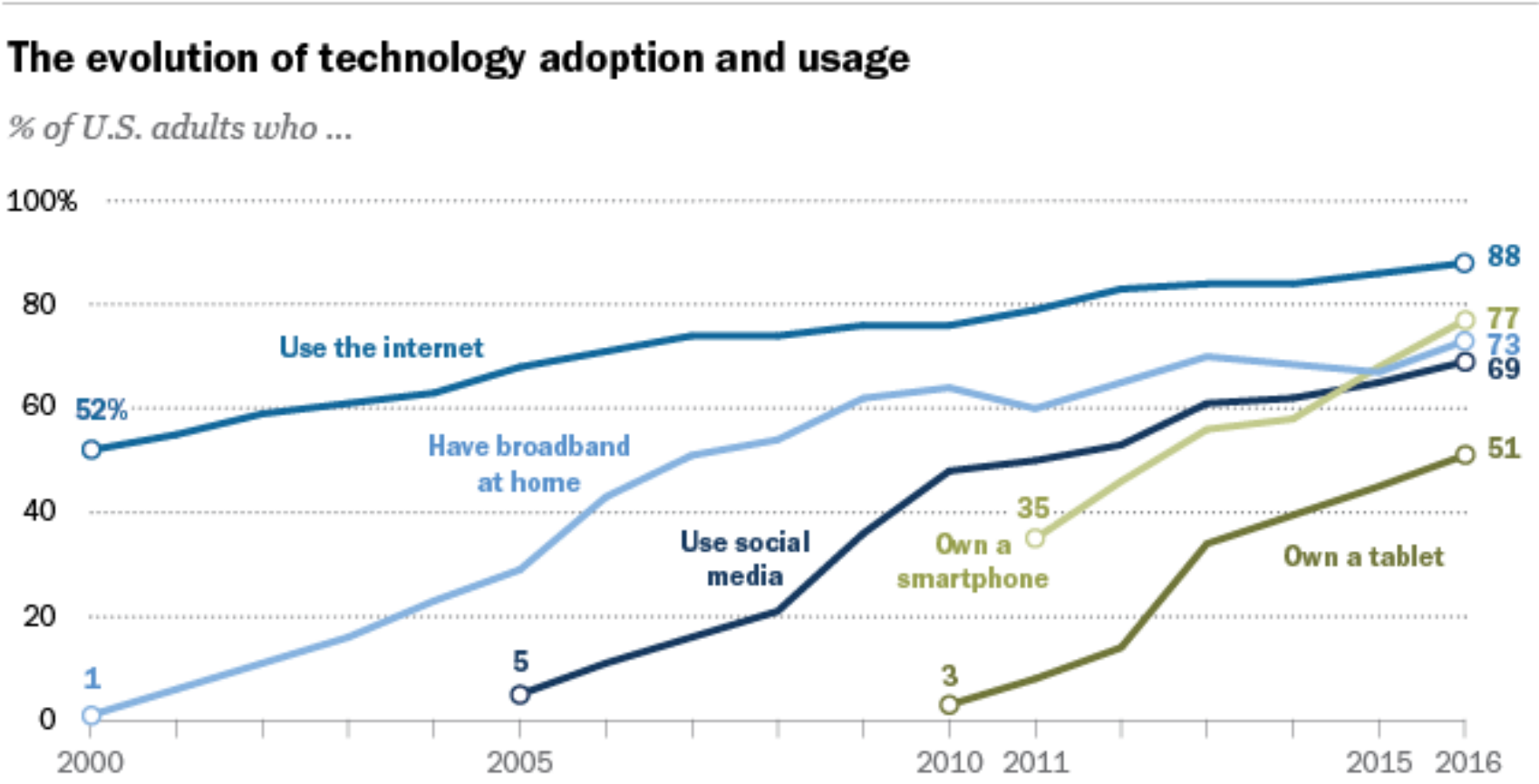


www.digitaltrends.com/cool-tech/li-fi-wireless-internet-led-light-solar-cell/#ixzz4d9gY9RC7

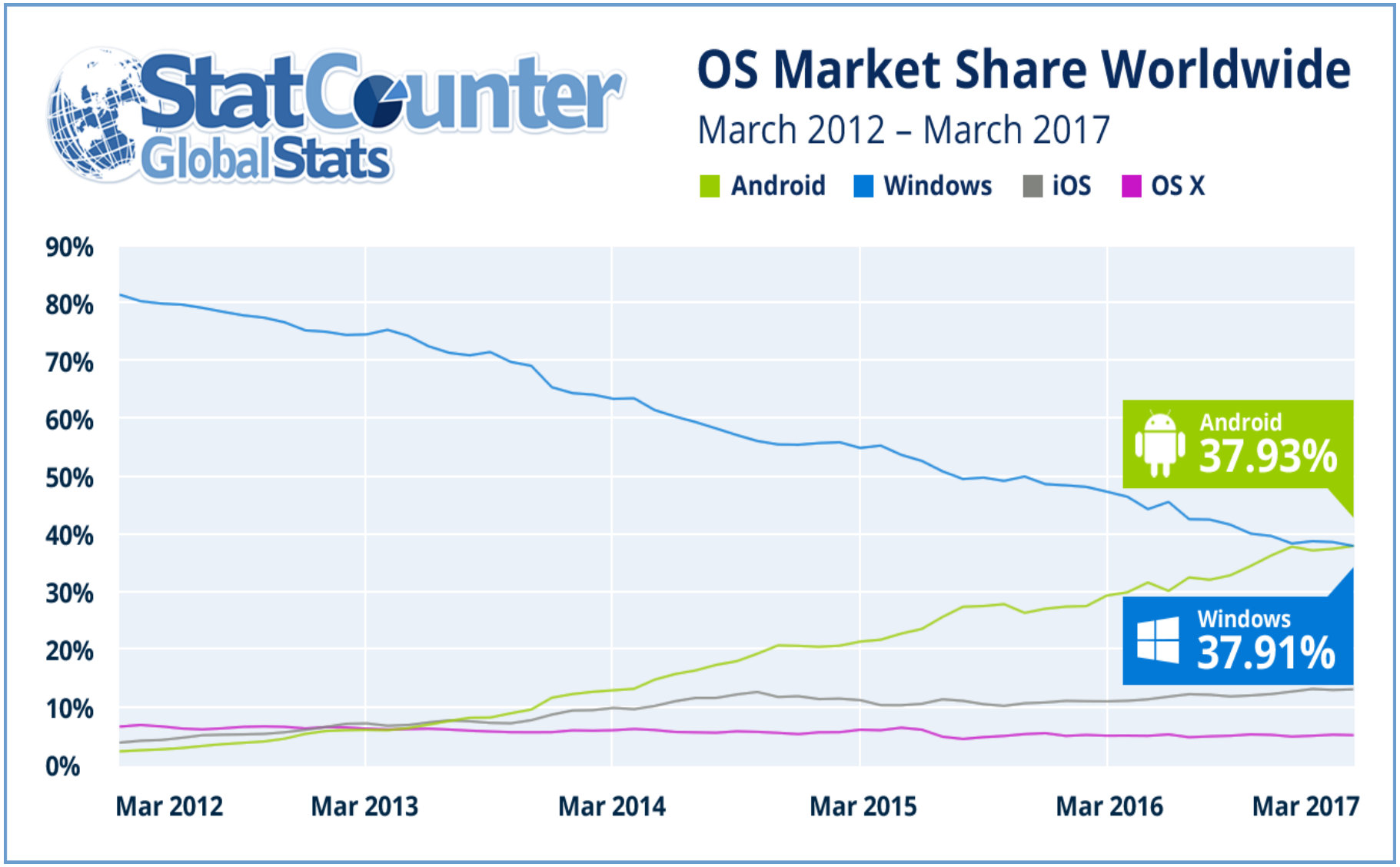
WiTricity – No Wires or Batteries Needed



Pew Research, 2017



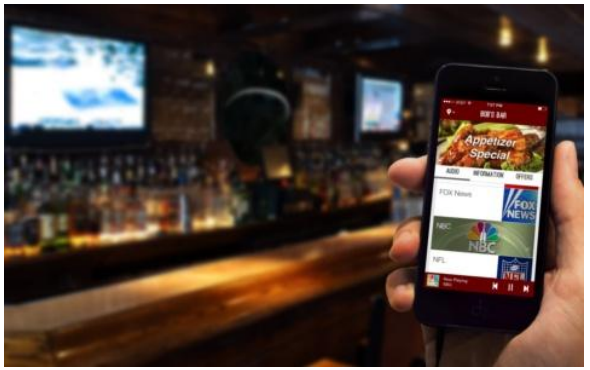
Android OS Surpasses Windows OS – Mobile



AudioEverywhere – Audio Streamed via WiFi

- Listen with iPhone – stream to HAs
- Churches, Sports Bars, Education, Museums, Entertainment Venues, Theaters, Tour Groups, Waiting Rooms, TVs, other video sources
- Users may choose to listen with single earbud and simultaneously socialize and hear show or game
- Can run App in background to listen while surfing Internet

Audio Everywhere



Jacoti Lola (iOS) (free) via WiFI – Classroom System

HAT Options

Table 1. Hearing assistance technology used by the study participants (N = 81).

	Type of assistance	*Number of participants*
Telephone	Special/amplified telephone	63
	Speaker telephone	12
	CapTel	12
	Relay/TTY	4
	Telecoil	4
TV/Radio	Headphones	19
	Closed captions	12
	Bluetooth	4
Public	Loop system	9
	FM system	6
Alerting	Device	4
	Sound dog	1

Note: Some participants reported using more than one type of hearing assistance technology.

Kelly-Campbell, RJ and Lessoway, K. (2015). Hearing aid and hearing assistance technology use in Aotearoa/New Zealand. International Journal Of Audiology, 54:5, pp. 308-315.

Daunting Task

DAILY EVENT	HEARING ASSISTIVE DEVICE(S)
Wake-up	Alarm clock with vibrator and/or flashing light
Land lines: home and work	HAC phone, texting, amplification, ringer with visual or vibrator signal, speech recognition
1:1 conversations	Personal communication device (FM or infrared)
Small group meetings	Portable FM, infrared, loop, real-time captioning, 1:1 personal communicator
Noisy restaurant	Personal communication device with directional mike
Large group meetings	Large-area infrared, FM or loop system
Cell phone	HAC phone, vibrate option, texting, high volume output
Vehicle	1:1 device with directional mike, emergency siren recognizer
Family meals	Portable infrared or FM device in middle of table
TV	Captioning, Infrared, FM or loop connected to TV
Door bell	Vibrator worn on body and flashing lights
Child care	Baby monitoring device with vibrating annunciator
Fire/Carbon Monoxide alarm	Flashing lights and/or vibrating annunciator
Weather alert	Weather radio with vibrator and/or flashing light
Theater	Infrared, loop or FM

Laszio, (2012) *Canadian Hearing Report, Vol.7 No.6.*

The HAT Challenge

- No single HAT suites every listening/alerting situation
- Each HAT interfaces differently with hearing aids or implants
- Each HAT generally operates differently

Laszio, (2012) Canadian Hearing Report; 7(6)

Assistive/Assistance

"All technology is assistive technology"

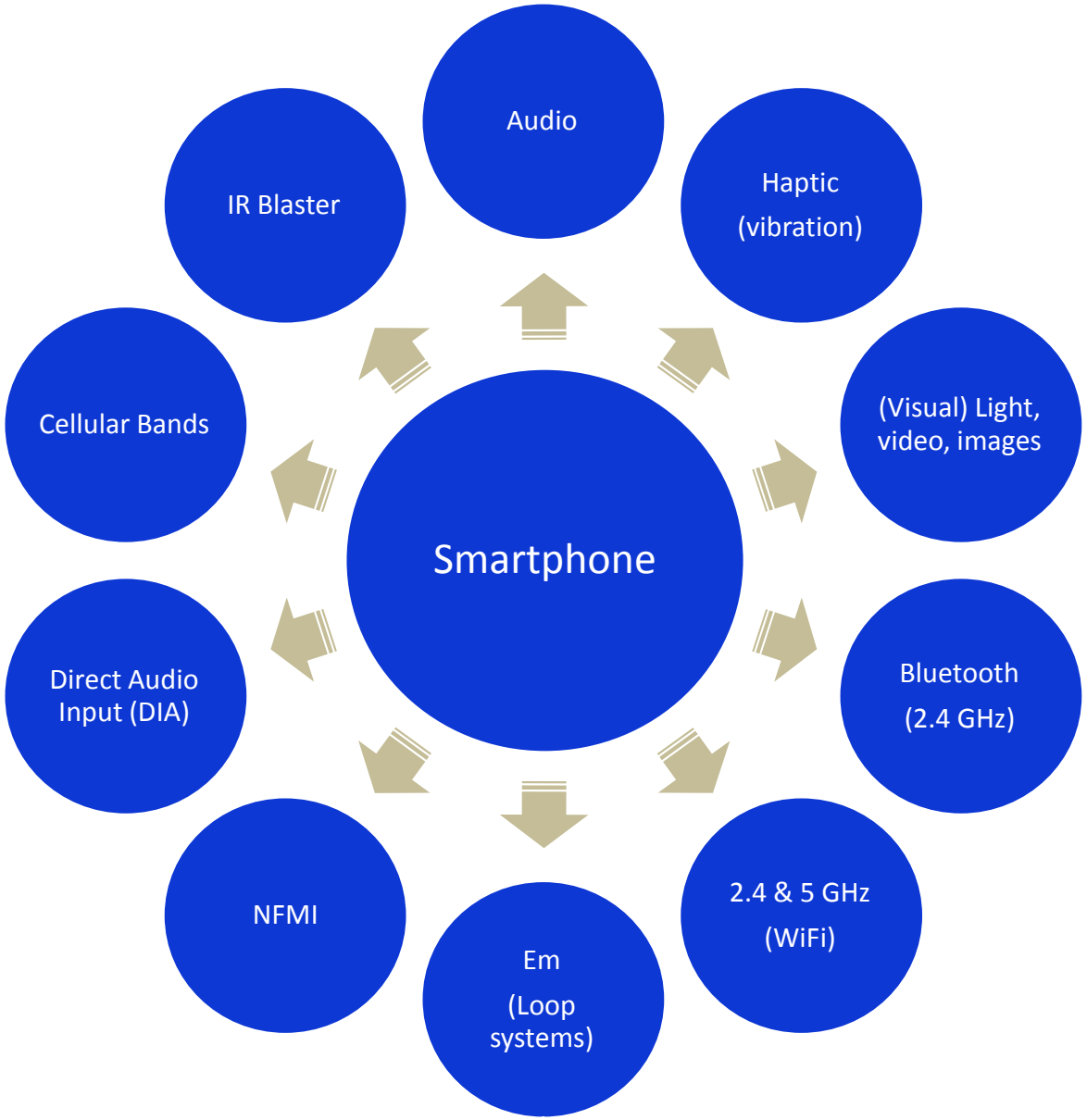
"Honestly — what technology are you using that's not assistive? Your smartphone? Your eyeglasses? Headphones?"

Sara Hendren

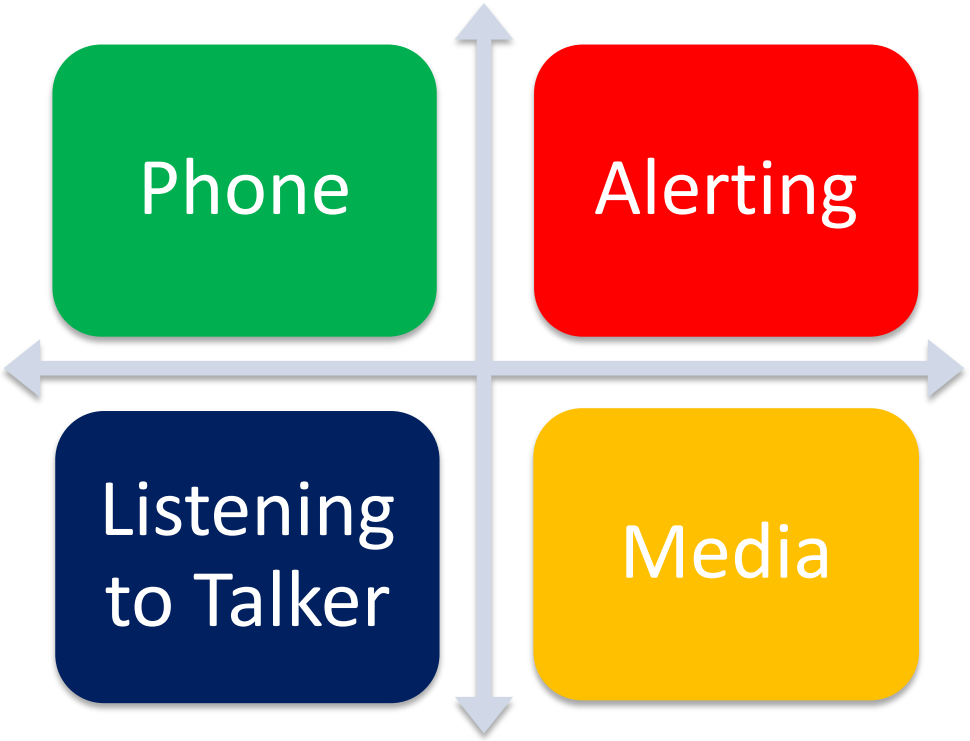
https://backchannel.com/all-technology-is-assistive-ac9f7183c8cd#.nckylnz1v

Smartphone Signal Reception

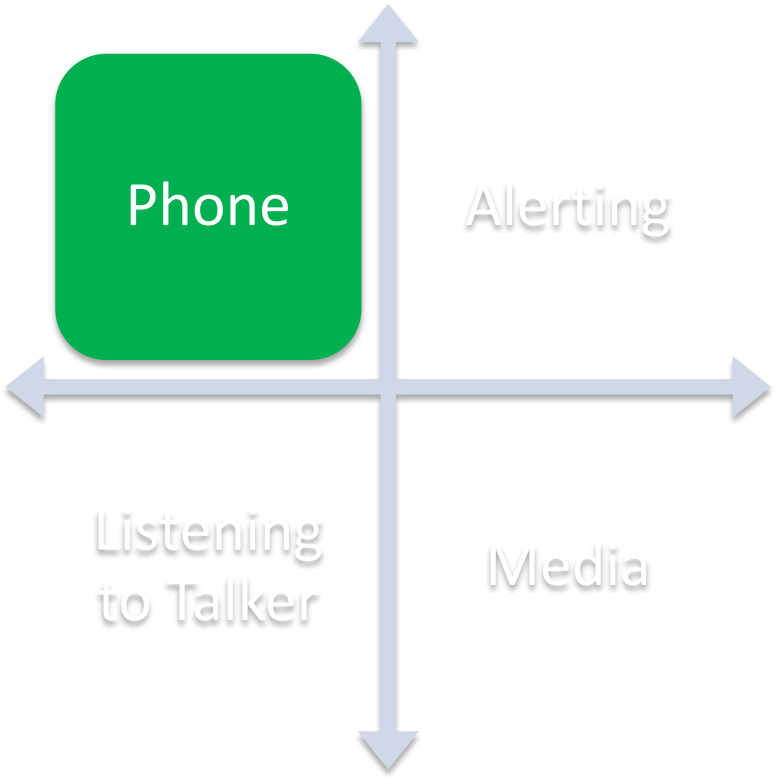
Smartphone Signal Transmissions



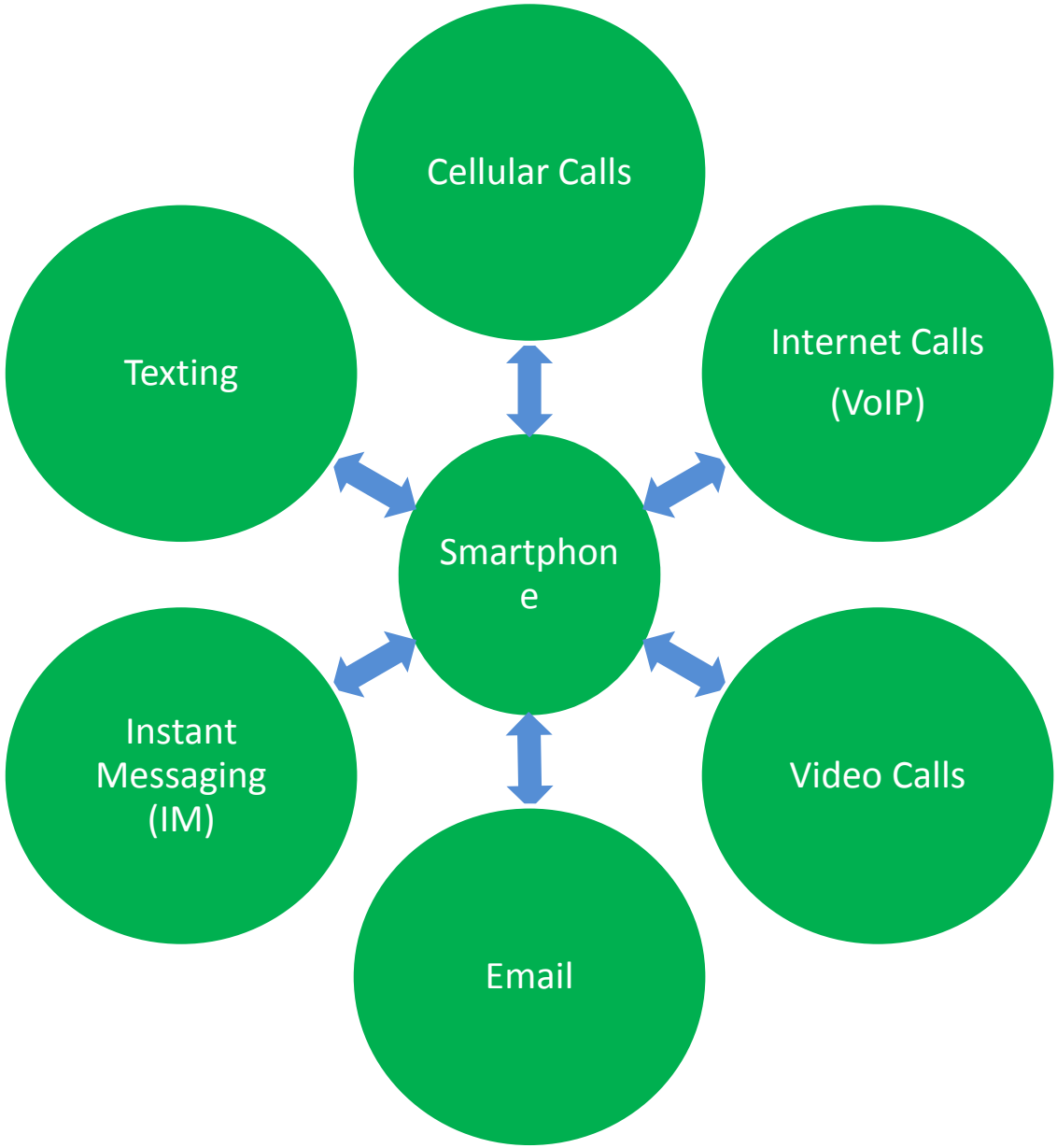
HAT Categories (PALM) – Assessment



HAT Phone Options

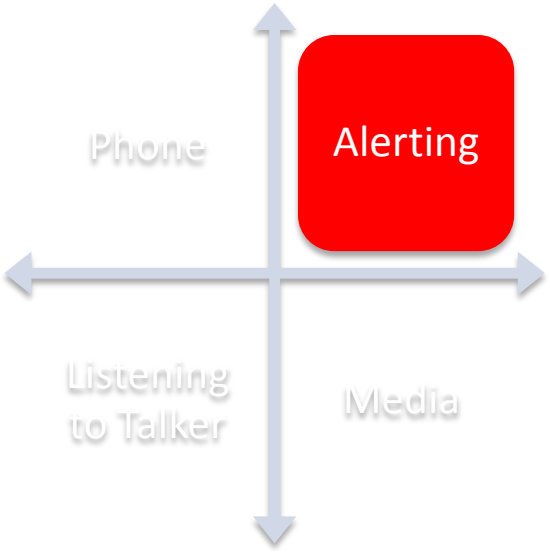


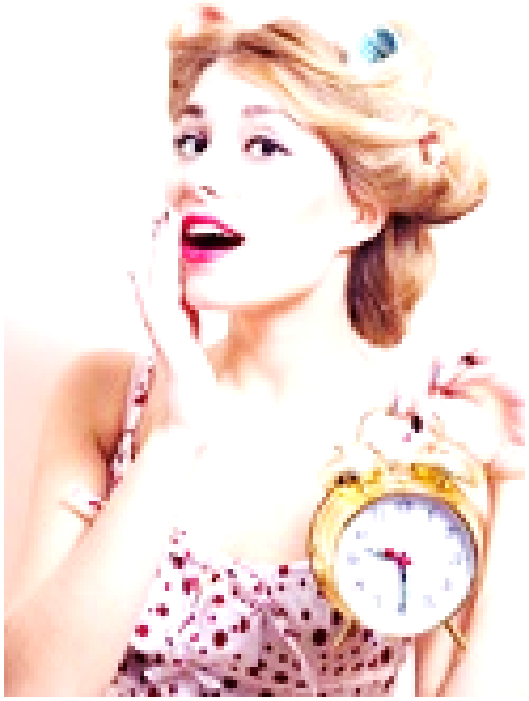
HAT Phone Options



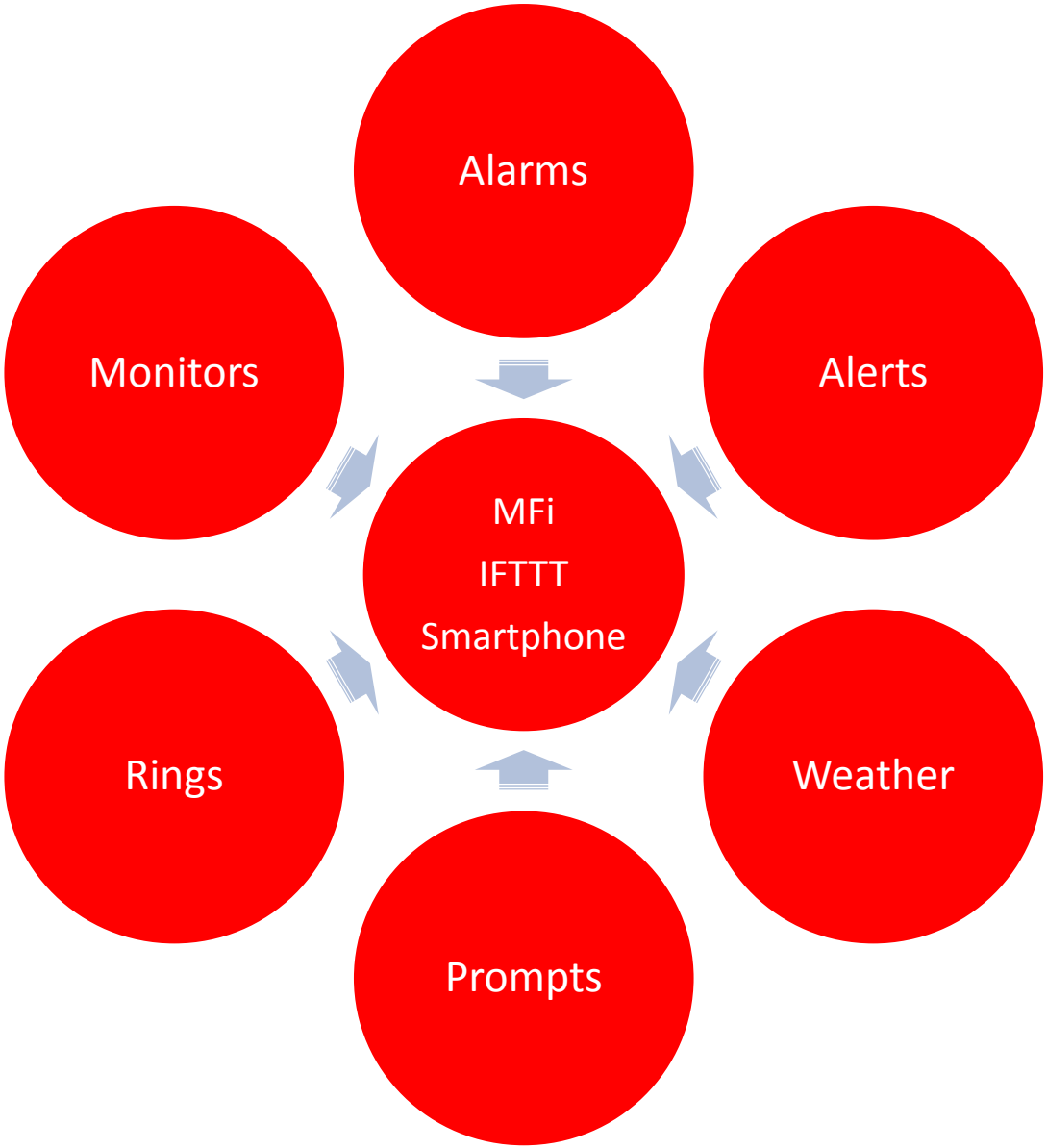
HAT Alerting/Awareness Options

Alarm clock, doorbell, telephone ring, ire/smoke alarm, burglar alarm, child monitor, timers (appliances, test), computer prompts, weather alerts





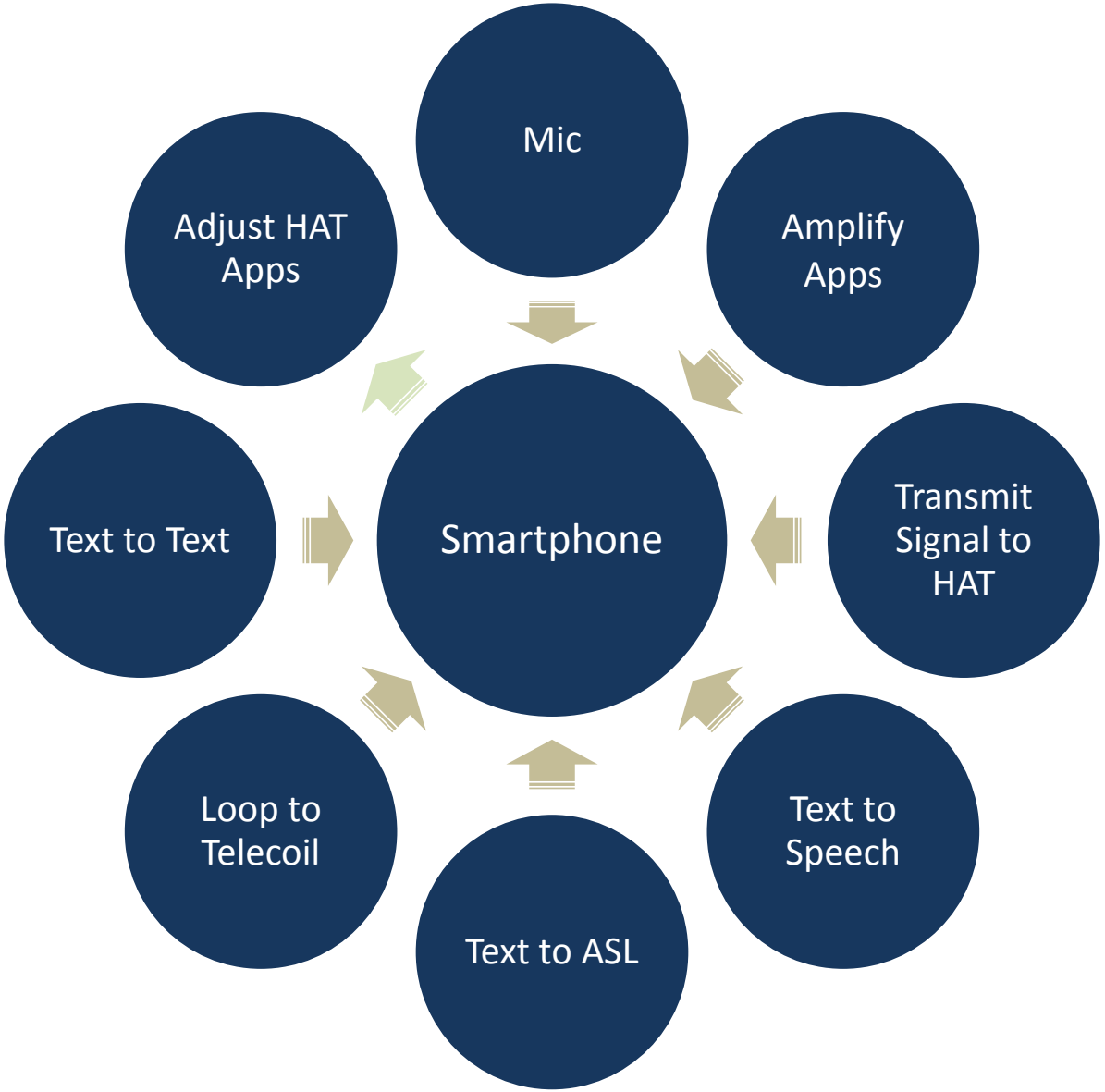
HAT Alerting/Awareness – IoT and IFTTT



HAT Listening to Talkers Options

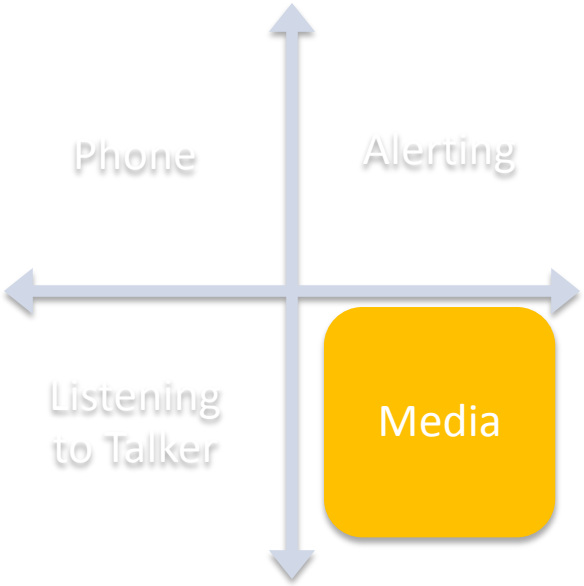
One on one, group, place of worship, meeting, classroom, lectures, conferences, presentations, theater, etc.

HAT Listening to Talker/Speaker Options

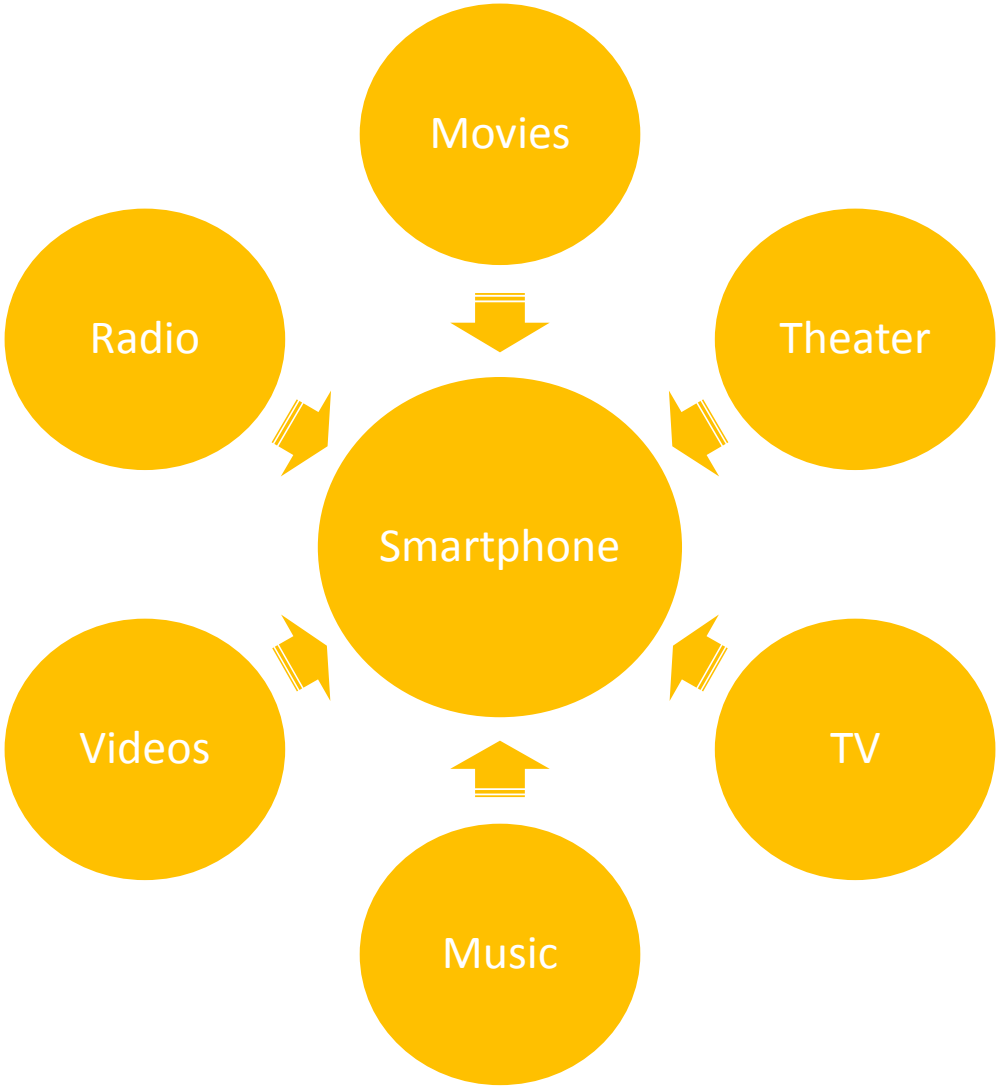


HAT Media Options

Radio, TV, mp3,
YouTube, etc.



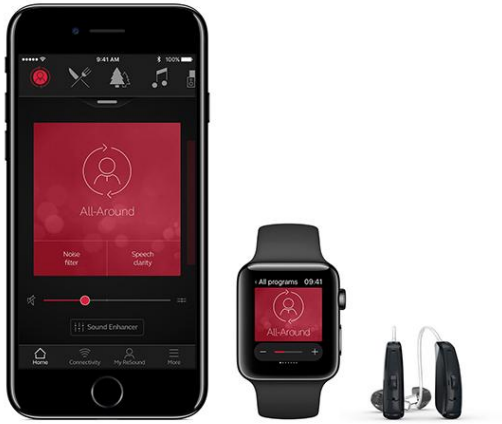
HAT Media Options



HAT Moving from FM to 2.4 GHz

Two dominate HAT forces

1. Phonak Roger
2. Made For iPhone (Mfi)
   - Improved hearing in background noise
   - Less signal transmission interference
   - Smaller Receivers
   - Communicate with the Internet of Things (IoT)



MFi (Bluetooth) Hearing Aids

Audibel
- A3i
- A4i

Audigy
- AGXsp
- AGXsp 2

Audika
- First
- Legend

Auris
- Øre

Beltone
- Beltone Boost
- Beltone First
- Beltone Legend
- Beltone Boost Plus
- Beltone Silk

Cochlear
- Baha 5
- Baha 5 Power
- Baha 5 SuperPower

Concept
- Complete

Danavox
- Danavox Aio
- Danavox Gala
- Danavox Logar

EarLens
- EarLens Processor

eMeritus
- eMeritus

Intela-Hear
- Atom

Interton
- Centro

Kirkland Signature
- KS 6.0

MicroTech
- Kinnect
- Kinnect 2

NuEar
- iSDS
- iNOW

Optima
- Deuce

Oticon
- Opn

ReSound
- ReSound Cala
- ReSound ENZO
- ReSound ENZO^2
- ReSound Lancio
- ReSound LiNX
- ReSound LiNX TS
- ReSound LiNX^2
- ReSound Sola
- ReSound SOUSA Fine
- ReSound Up Smart

Starkey
- Halo
- Halo 2

Signia
- Pure 13 BT

TruHearing
- Flyte

Udisens
- Udisens

Udio Finissimo
- Udito Finissimo

Widex
- Beyond

MFi hearing aids – iOS 7 or later and Devices

- iPhone 4s and later
- iPad Pro
- iPad Air and later
- iPad (4th generation)
- iPad mini and later
- iPod touch (5th generation) and later

support.apple.com/en-us/HT201466

ReSound Up Smart 2.4 GHz HAT (Pediatric)

- Pediatric – Up Smart
- MFi with Smart app
- Stream from iPhone/iPad/iPod
- Geofencing/Geotagging
- Micro Mic
- Multi Mic
  - Lapel and table microphone, connects with loop and FM and Dynamic Mic systems, and has a mini-jack input so you can stream sound directly to ReSound Up Smart hearing aids from any device with headphone output
- Remote Control 2
- ReSound Phone Clip+
- ReSound TV Streamer 2






MFi Hearing Aids – 2.4 GHz

	Oticon Opn	Resound LiNX 3D	Starkey Halo	Widex Beyond	Signia Pure 13 BT
iPhone/iPad/iPod	Yes	Yes	Yes	Yes	Yes
App	ON	Smart	TruLink	Beyond	myControl
Apple Watch	Yes	Yes	Yes	Yes	Not yet
Geotag		Yes	Yes	Yes	
Find my HA	Yes	Yes	Yes	Yes	
Life remote adjustment by Audiologist		transmits for download updates for HA			Yes
Remote Mic	Yes	Yes	Yes	Yes	Yes
IFTTT	Yes				
Tele Data/Monitor					
Remote controls	Yes	Yes			Yes
Beacons			Yes		

MFi and Use for Student, Parent and Others

- Check battery status (most)
- Check and modify HA settings/programs (all)
- Help locate lost Has (most)
- Send HA data and/or status to audiologist (ReSound and Signia)
- Receive HA updates and adjustments to HAs (some)
- Geotag HA settings for various locations (most)
- Beacons can vary settings in various rooms in home/school/location (Starkey)
- Create “recipes” or “apps” to interact with hearing aids (Oticon)
- Remotely communicate with audiologist directly and connect to hearing aid for remote adjustments (Signia)
- Mic – turn on iPhone mic and record sound, messages and playback (Starkey)

Cochlear™ Baha® 5 Sound Processor (Mfi)

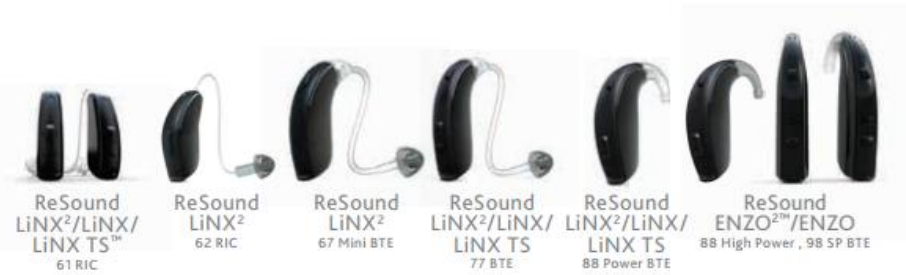
- MFi
- ReSound HAT
  - Micro Mic
  - Multi Mic
  - Remote Control 2
  - ReSound Phone Clip+
  - ReSound TV Streamer 2

ReSound – Cochlear Baha Compatibility

Wireless Compatibility – Cochlear™ Baha® Sound Processors and ReSound

Cochlear®

ReSound GN



Compatibility Table

Accessory	ReSound Unite Remote Control 2	ReSound Unite TV Streamer 2	Cochlear TV Streamer	ReSound Unite Phone Clip+	Cochlear Phone Clip	ReSound Multi Mic	Cochlear Mini Microphone 2+	ReSound Micro Mic	Cochlear Mini Microphone 2	Airlink 2	Apple Mobile Devices
LiNX²/LiNX TS/LiNX	✓	✓ B	✓ B	✓	✓	✓ B	✓ B	✓ B	✓ B	✓	✓
ENZO²/ENZO	✓	✓ B	✓ B	✓	✓	✓ B	✓ B	✓ B	✓ B	✓	✓
Baha 4	✓	✓ B†	✓ B	✓	✓	✓ B	✓ B	✓ B	✓ B	✓	
Baha 5	✓	✓ B†	✓ B	✓	✓	✓ B	✓ B	✓ B	✓ B	✓	✓
Baha 5 Power	✓	✓ B†	✓ B	✓	✓	✓ B	✓ B	✓ B	✓ B	✓	✓
Baha 5 SuperPower	✓	✓ B†	✓ B	✓	✓	✓ B	✓ B	✓ B	✓ B	✓	✓

B – Bimodal functionality
† – Bimodally compatible with some previous generations of ReSound hearing aids

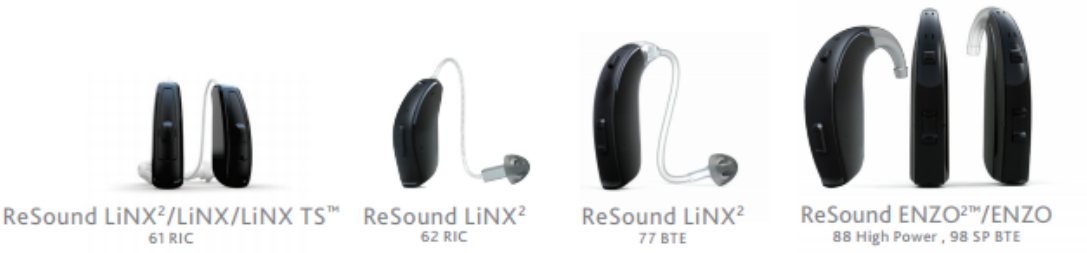
ReSound – Cochlear Nucleus 6

Wireless Compatibility – Cochlear™ Nucleus® 6 and ReSound

Cochlear®

Cochlear™ Nucleus® 6 | Cochlear™ Hybrid®

ReSound



ReSound LiNX²/LiNX/LiNX TS™ 61 RIC | ReSound LiNX² 62 RIC | ReSound LiNX² 77 BTE | ReSound ENZO²™/ENZO 88 High Power , 98 SP BTE

Compatibility Table

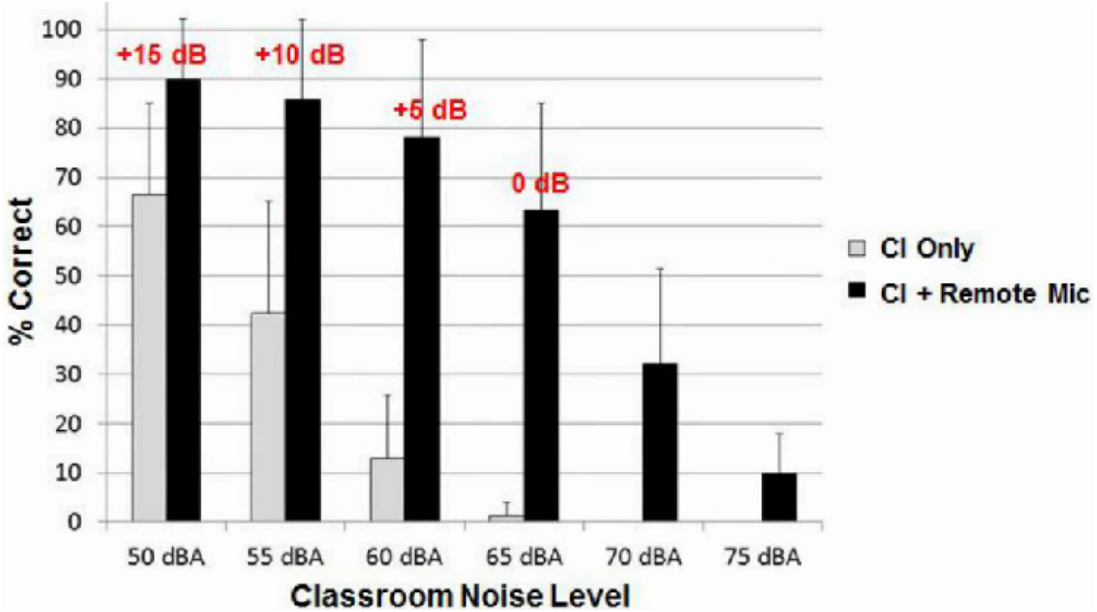
Accessory	ReSound Unite Remote Control 2	Cochlear CR230 Remote Assistant	ReSound Unite TV Streamer 2	Cochlear TV Streamer 2	ReSound Unite Phone Clip+	Cochlear Phone Clip+	ReSound Multi Mic	Cochlear Mini Microphone 2+	ReSound Micro Mic	Cochlear Mini Microphone 2	Airlink 2
LiNX²/LiNX TS/LiNX	✓		✓ B	✓ B	✓	✓ B	✓ B	✓ B	✓ B	✓ B	✓
ENZO²/ENZO	✓		✓ B	✓ B	✓	✓ B	✓ B	✓ B	✓ B	✓ B	✓
Nucleus 6		✓	✓ B†	✓ B		✓ B	✓ B	✓ B	✓ B	✓ B	

B – Works bimodal

† – Bimodally compatible with some previous generations of ReSound hearing aids

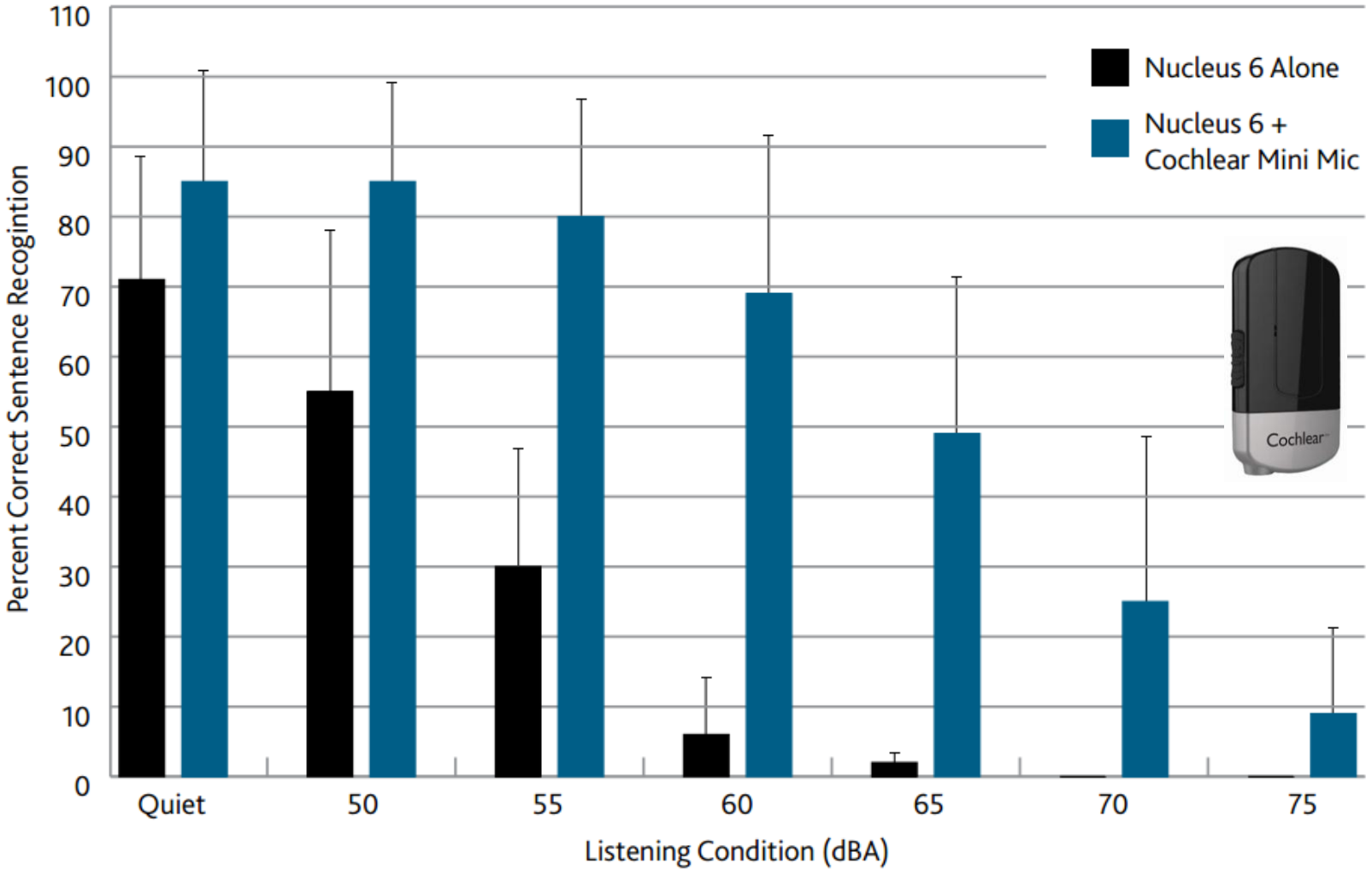
Speech in Noise with CI (with remote mic)

- Note 60% improvement in understanding speech with remote mic
- CI users often continue to experience difficulty understanding in noisy and reverberant environments w/o remote mic



(Wolfe 2014 Seminars in Hearing)

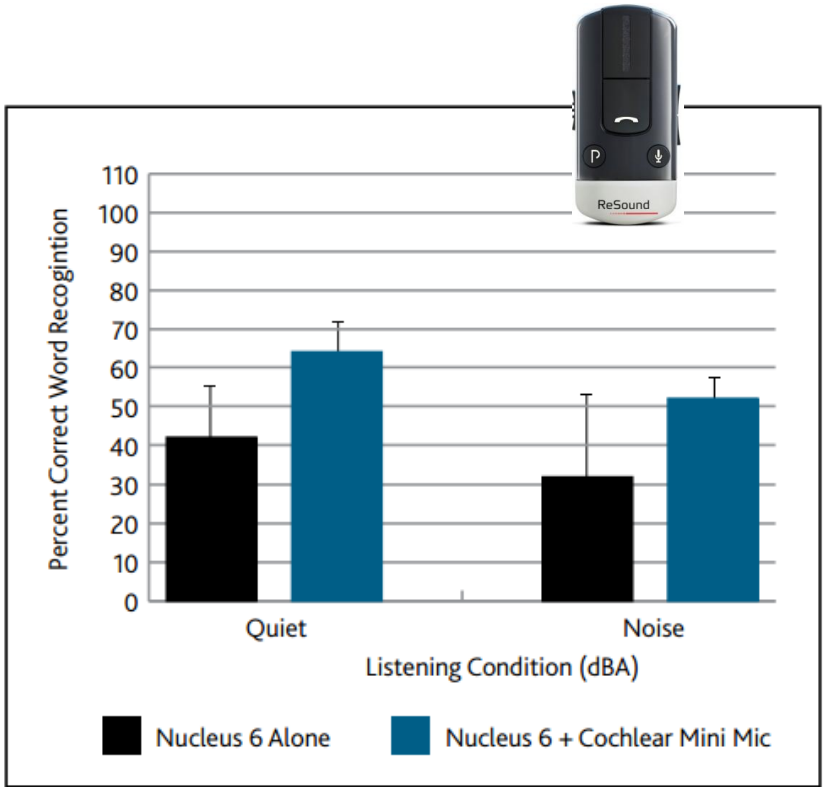
Cochlear Implants – Who Needs HAT?!@?



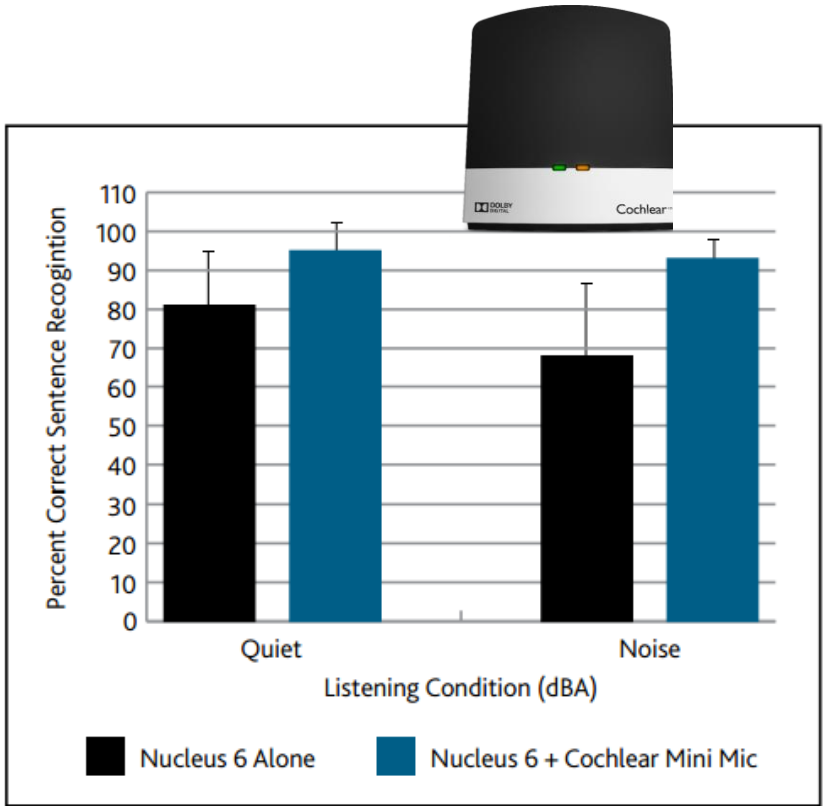
Cochlear Mini-Mic

Wolfe et al, 2015

Cochlear Implants – Who Needs HAT?!@?



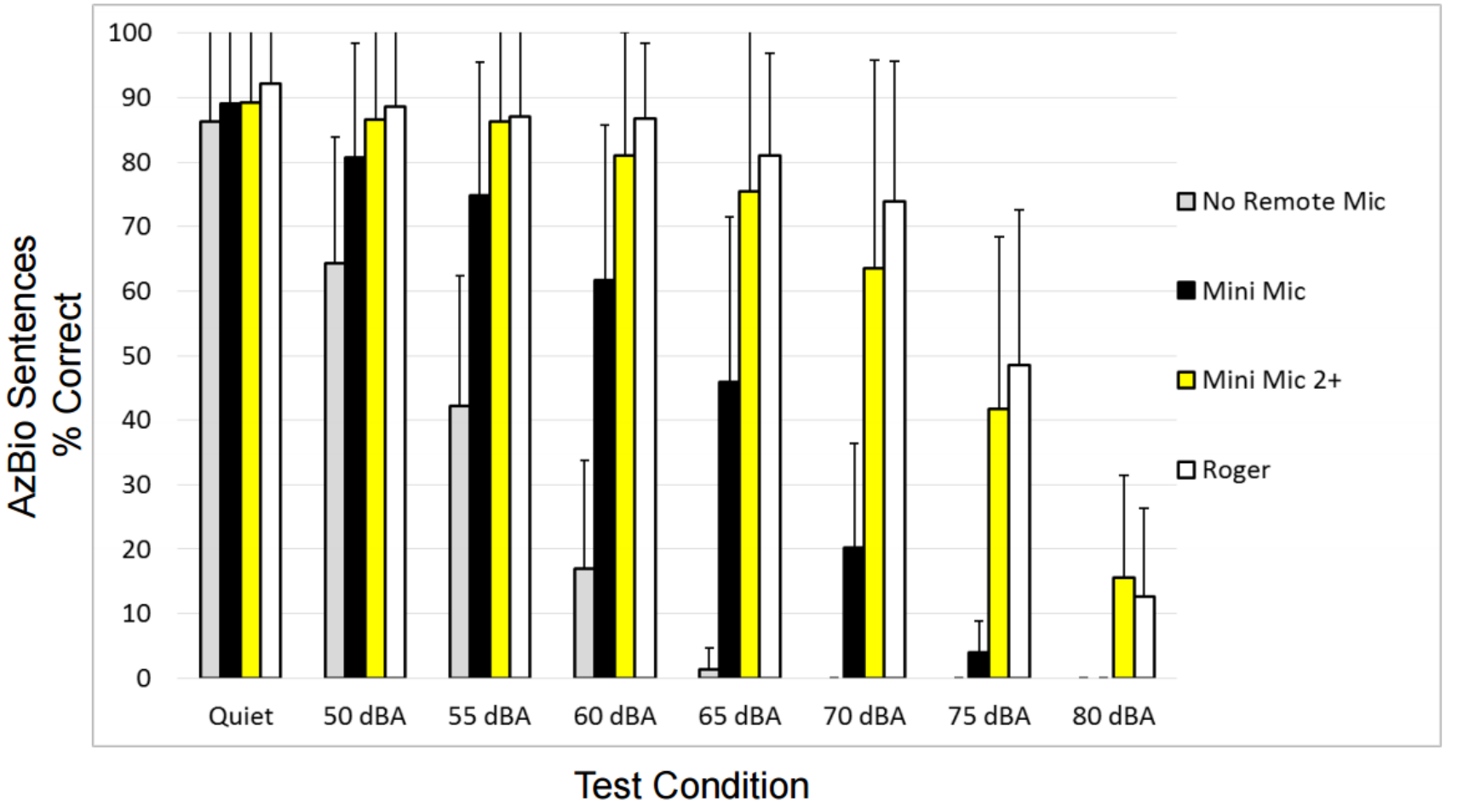
Cochlear Phone Clip+



Cochlear TV Streamer

Wolfe et al, 2015

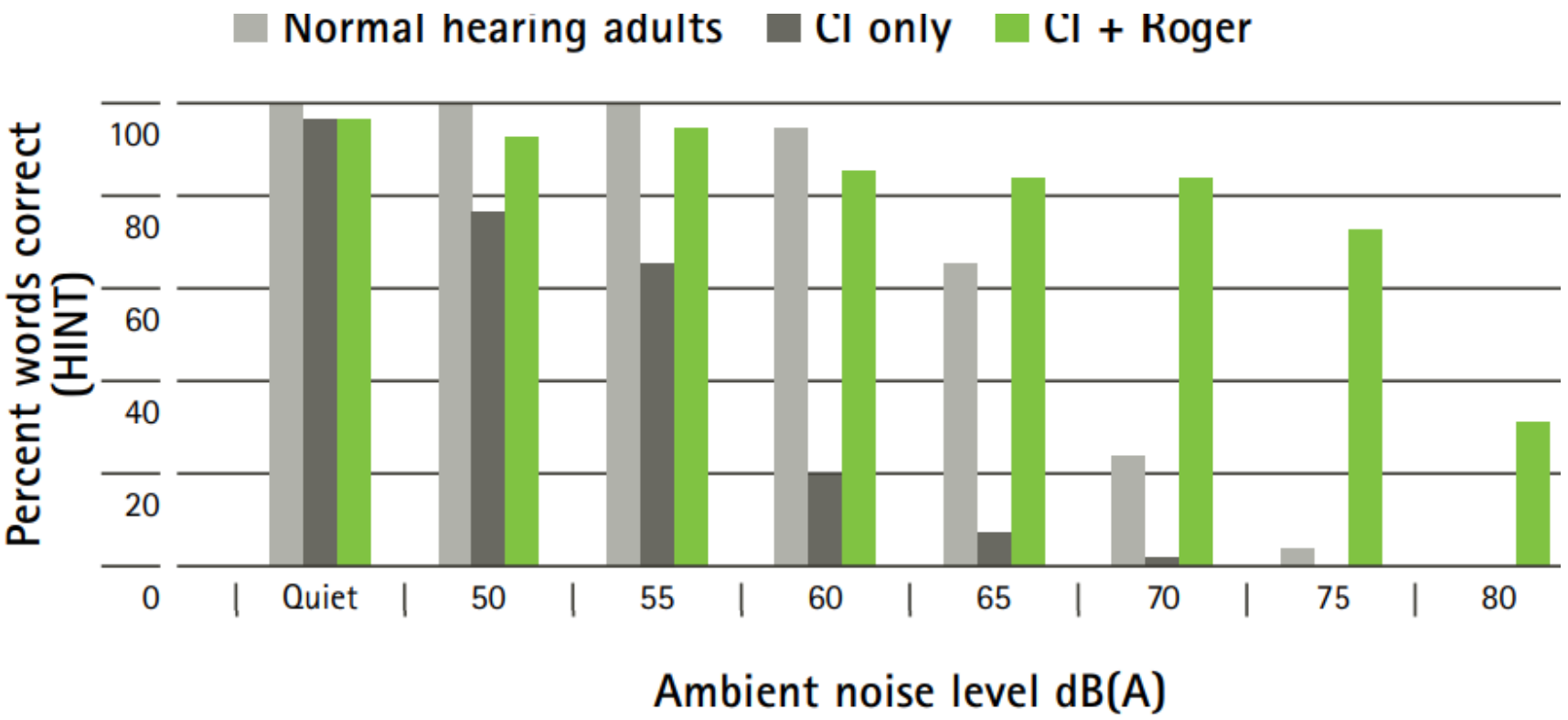
ReSound Mini Mic 2+ and Phonak Roger Mic



n = 15

Wolfe, 2016

Cochlear Implant with Phonak Roger Pen



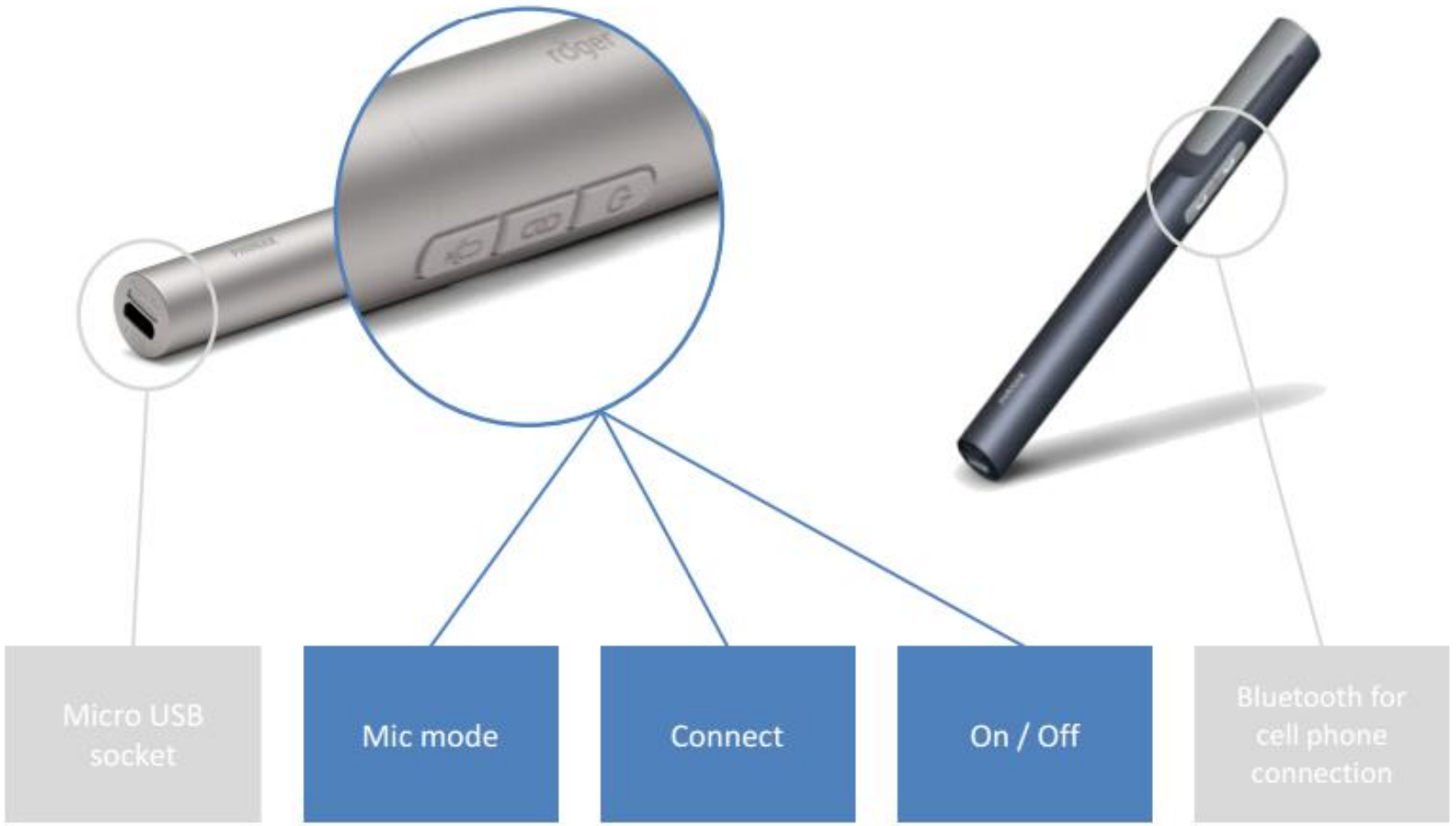
(Wolfe, 2013)

Phonak Sky (Pediatric HAs)

Phonak Roger Microphones

	Situation	Roger Pen / Roger EasyPen	Roger Clip-On Mic	Roger Touchscreen Mic	Roger Pass-around	Roger Multimedia Hub
Family life	Conversations at home	•	•	•		
	Mealtime	•	•	•		
	At the park	•	•	•		
	In a car	•	•	•		
Social life	Meeting with friends	•	•			
	Sports coaching	•	•	•		
	Music, gaming, TV	•	•			•
	Group and club activities	•	•	•		
School life	Teacher lectures	•		•		
	Small group activities	•		•		
	Classmate comments				•	
	Listening to smartboards, computers or audiobooks					•

Phonak Roger Pen



Roger Pen

- Up to 8 paired phones
- Up to 2 connected phones (Multipoint)
- Only one active phone call at a time

Soundfield with Normal Hearing Students

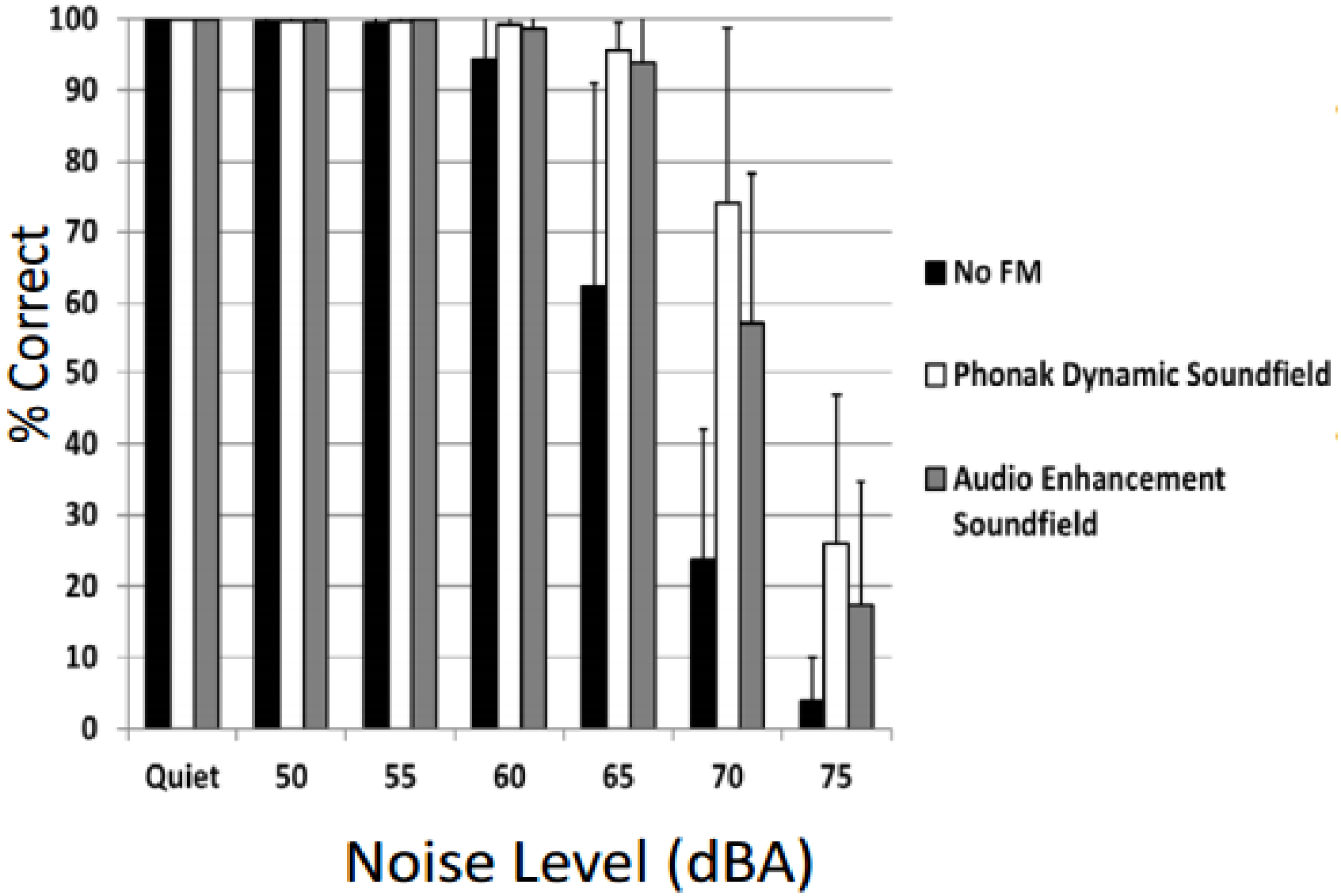
Three year longitudinal study (Rosengren et al, 1999)

- 2054 student K-2nd grade
- 94 classrooms
  - 64 amplified classrooms
  - 30 control classrooms
- Students in amplified classroom had significantly greater improvement in listening and learning behaviors and skills
- Progressed at a faster rate
- Teachers, administrators, parents and students reported positive response

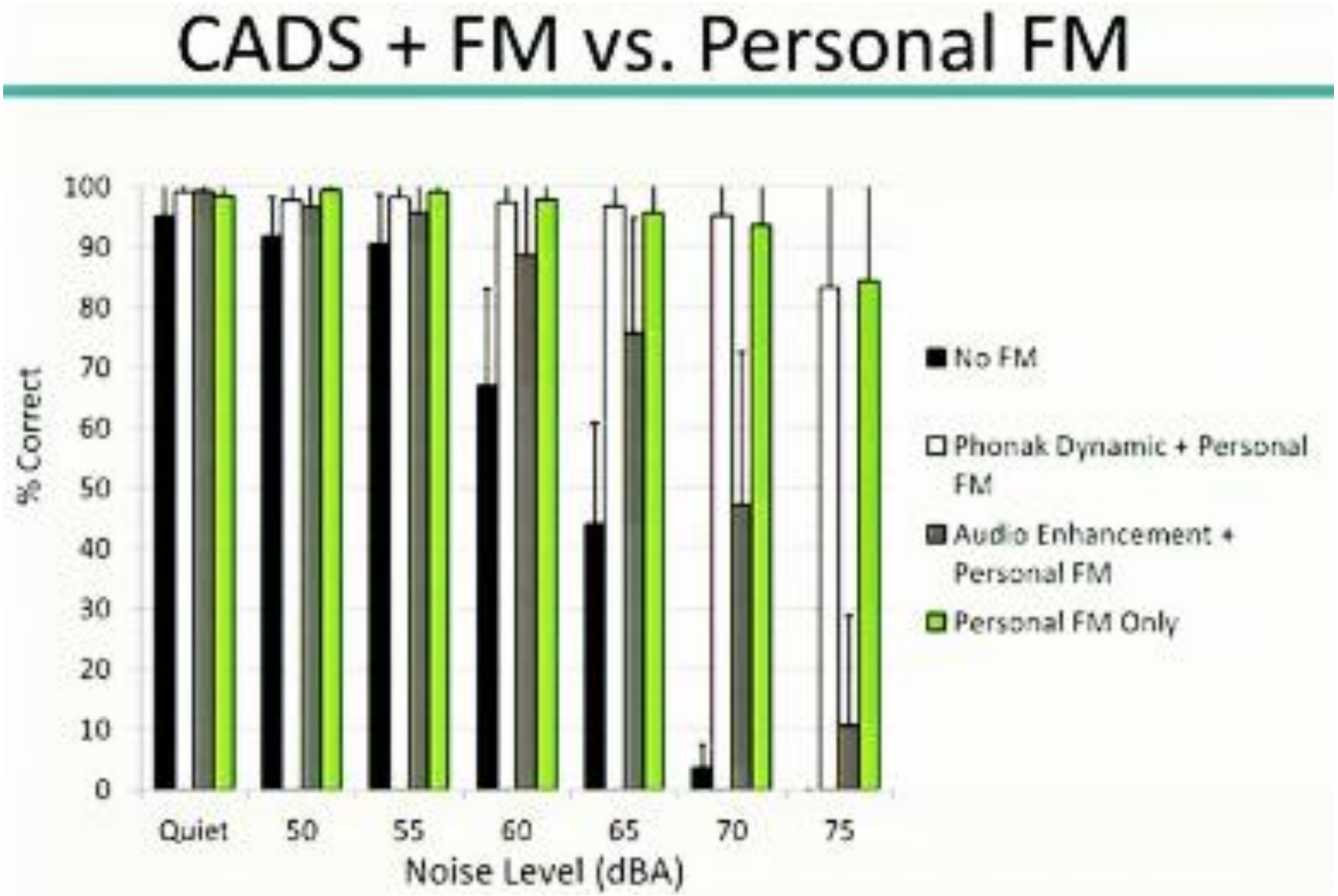
Other studies report

- Decreased discipline problems
- Increased attention
- Less repetition by teacher
- Less teacher vocal strain and fatigue

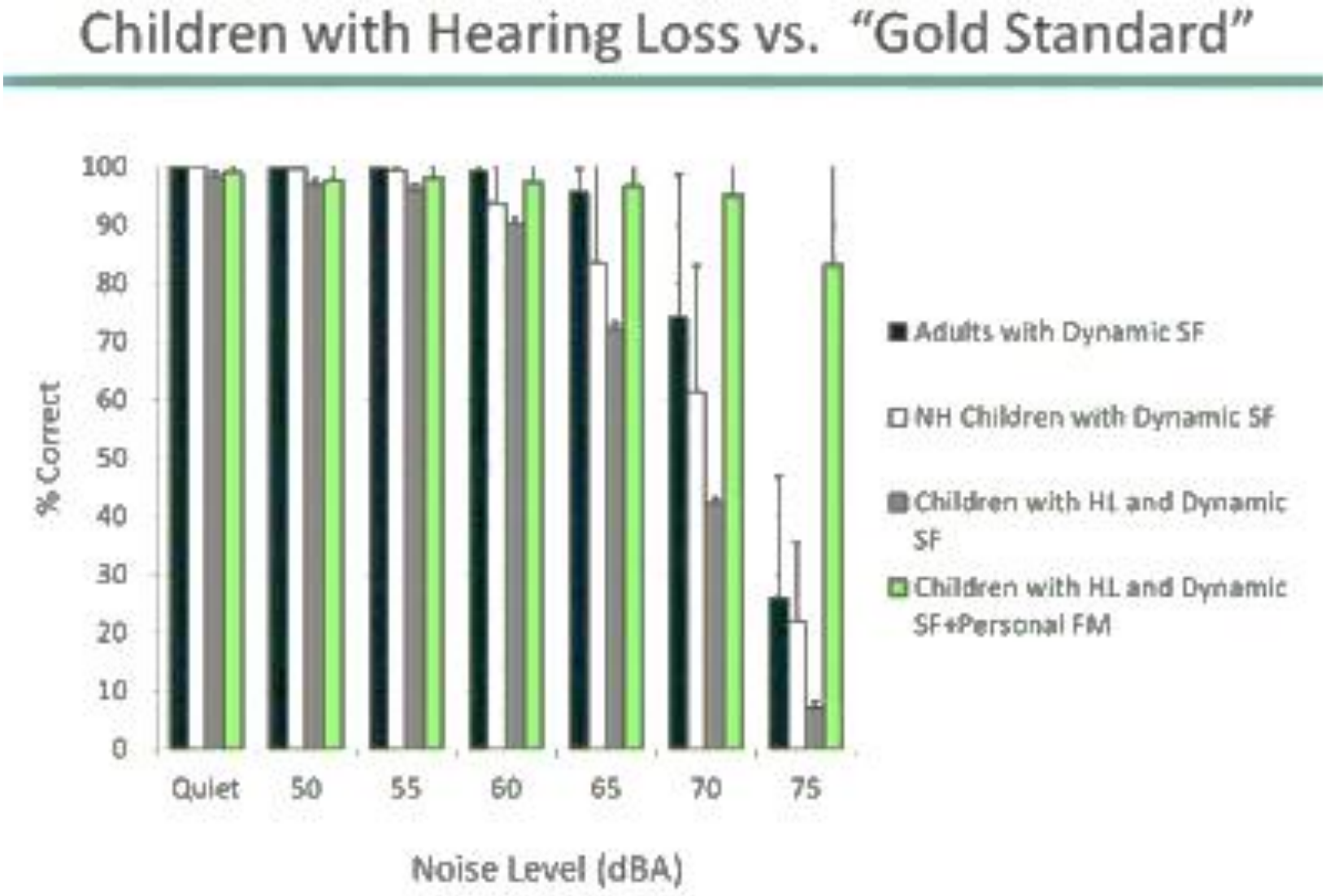
Phonak 5000 Classroom Soundfield



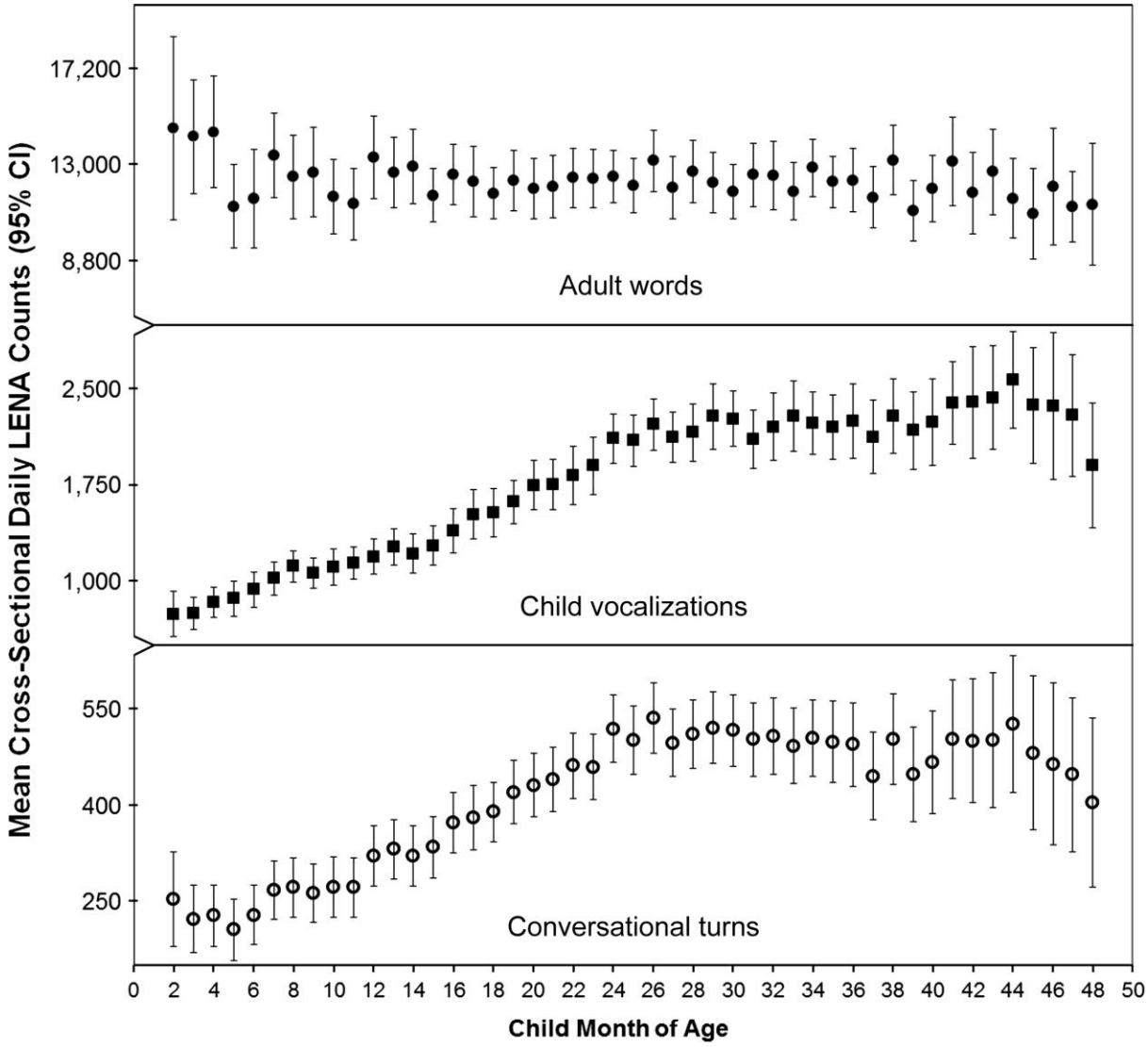
Personal FM with Roger Best Option



Phonak Classroom Soundfield



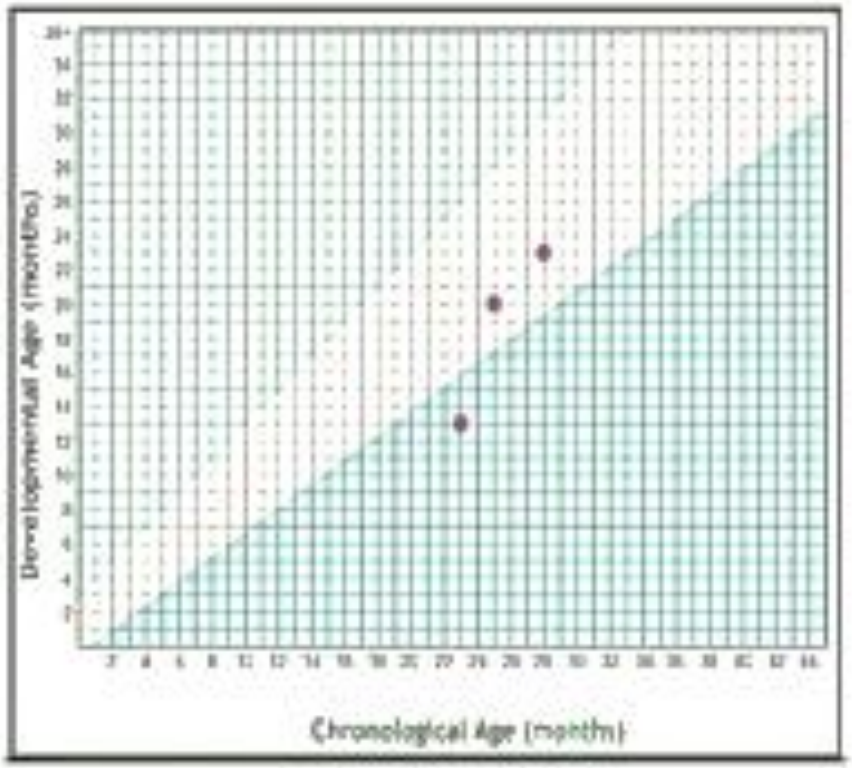
LENA – A Digital Language Recording Device

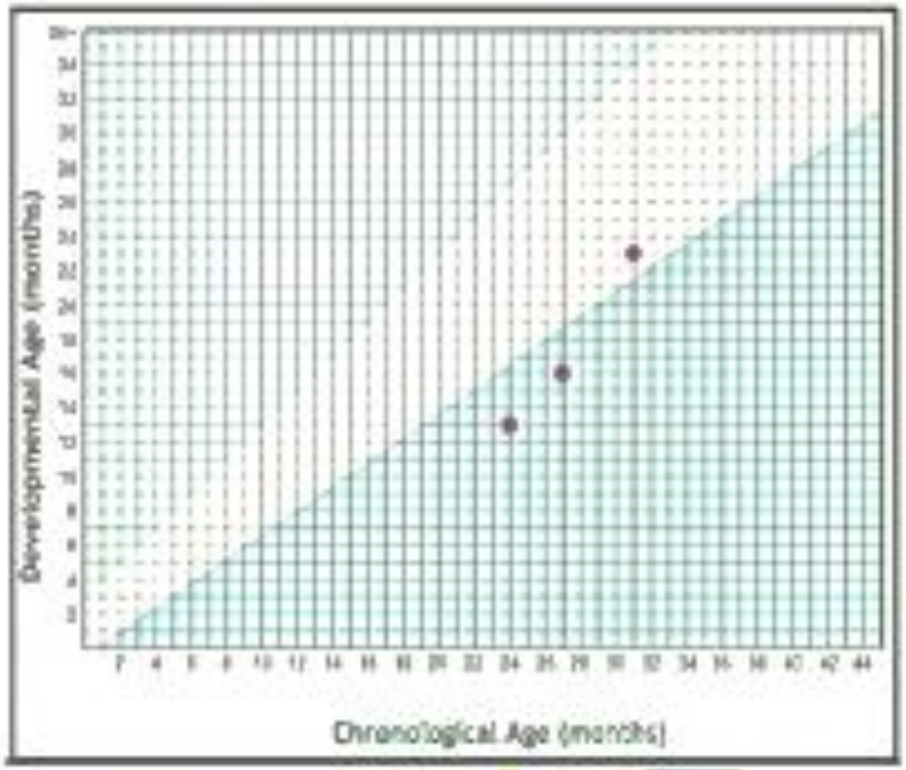


LENA Developmental Snapshots

Language Trends

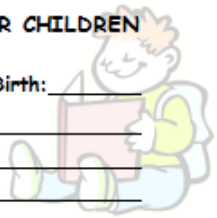
Users of FM (at risk): P1 (left) and P4 (right)





HAT Remote Microphone Questionnaire

Remote Microphone LISTENING EVALUATION FOR CHILDREN



Name:_____ Date of Birth:_____

Completed by:_____ Date:_____

__parent __audiologist __teacher other-specify_____

Length of hearing aid usage·_____ HA/CI brand/model·_____

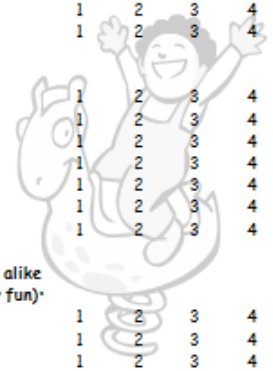
Length of Mic usage·_____ Mic brand/model·_____

___Mic used daily Number of hours per day used _____

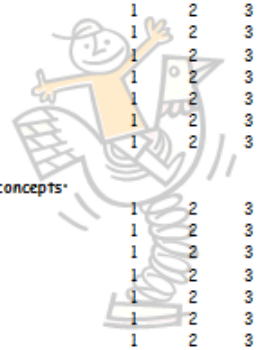
___Mic used occasionally Number of hours per week used _____

Please rate the following skills based on the child's behavior or performance on typical days.
Indicate if performance was obtained ☐ with Mic or ☐ without Mic (baseline).
To score, subtract any NA (not applicable) items from the total, then determine percent for total performance and for each situation.

	SELDOM		SOMETIMES		USUALLY	
1. Child responds to his/her name when spoken to·						
a. In a quiet room, within 3 feet	1	2	3	4	5	NA
b. In a quiet room, at 10 feet	1	2	3	4	5	NA
c. In a noisy room, within 3 feet	1	2	3	4	5	NA
d. In a noisy room, at 10 feet	1	2	3	4	5	NA
e. Without visual cues	1	2	3	4	5	NA
f. From another room	1	2	3	4	5	NA
g. Outside/in the community	1	2	3	4	5	NA
2. Child attends to person speaking·						
a. In a quiet room, within 3 feet	1	2	3	4	5	NA
b. In a quiet room, at 10 feet	1	2	3	4	5	NA
c. In a noisy room, within 3 feet	1	2	3	4	5	NA
d. In a noisy room, at 10 feet	1	2	3	4	5	NA
e. Without visual cues	1	2	3	4	5	NA
f. From another room	1	2	3	4	5	NA
g. Outside/in the community	1	2	3	4	5	NA
3. Child distinguishes between words that sound alike (e.g., bay for day, sink for think, or sun for fun)·						
a. In a quiet room, within 3 feet	1	2	3	4	5	NA
b. In a quiet room, at 10 feet	1	2	3	4	5	NA
c. In a noisy room, within 3 feet	1	2	3	4	5	NA
d. In a noisy room, at 10 feet	1	2	3	4	5	NA
e. Without visual cues	1	2	3	4	5	NA
f. From another room	1	2	3	4	5	NA
g. Outside/in the community	1	2	3	4	5	NA



	SELDOM		SOMETIMES		USUALLY	
4. Child responds accurately to spoken directions and/or questions·						
a. In a quiet room, within 3 feet	1	2	3	4	5	NA
b. In a quiet room, at 10 feet	1	2	3	4	5	NA
c. In a noisy room, within 3 feet	1	2	3	4	5	NA
d. In a noisy room, at 10 feet	1	2	3	4	5	NA
e. Without visual cues	1	2	3	4	5	NA
f. From another room	1	2	3	4	5	NA
g. Outside/in the community	1	2	3	4	5	NA
5. Child comprehends oral instruction & concepts·						
a. In a quiet room, within 3 feet	1	2	3	4	5	NA
b. In a quiet room, at 10 feet	1	2	3	4	5	NA
c. In a noisy room, within 3 feet	1	2	3	4	5	NA
d. In a noisy room, at 10 feet	1	2	3	4	5	NA
e. Without visual cues	1	2	3	4	5	NA
f. From another room	1	2	3	4	5	NA
g. Outside/in the community	1	2	3	4	5	NA



TOTAL SCORE: _____/(175) = ☐ % __with Mic __without Mic

Situational Analysis· Quiet (a,b) _____/(50) = ☐ % Noise (c,d,g) _____/(75) = ☐ %

Auditory only (e) _____/(25) = ☐ % Distance (b,d,f) _____/(75) = ☐ %

Information on Mic Use:

HA/Mic system is easy to operate·	1	2	3	4	5	NA
HA/Mic system has remained in good working order·	1	2	3	4	5	NA
HA/Mic system is comfortable for child to use·	1	2	3	4	5	NA
Child tries to turn HA/Mic system off·	1	2	3	4	5	NA
Feedback (whistling noise) is present with HA/Mic·	1	2	3	4	5	NA

Indicate types of activities the Mic is used for?

__ snacks __ play __ story-time/reading __ playground __ walks

__ listening/language/speech therapy __ shopping __ car

other (describe) _____

For which of the above activities do you think the Mic was most beneficial?

What do you think is the greatest benefit(s) of the Mic system?

What do you think is the greatest challenge(s) with the Mic system?

C.H.A.P.S.

C. H. A. P. S.

Children's Auditory Performance Scale

by Walter J. Smoski, Ph.D., Michael A. Brunt, Ph.D., J. Curtis Tannahill, Ph.D.

Child's Name_____ Age (years____ months____) Date Completed_____
Name of Person
Completing CHAPS_____ Relationship to Child _____

PLEASE READ INSTRUCTIONS CAREFULLY

Answer all questions by comparing this child to other children of similar age and background. Do not answer the questions based only on the difficulty of the listening condition. For example, all 8-year-old children, to a certain extent, may not hear and understand when listening in a noisy room; this would be a difficult listening condition for all children. However, some children may have more difficulty in this listening condition than others. You must judge whether or not THIS child has MORE difficulty than other children in each listening condition cited. Please make your judgment using the following response choices.CIRCLE a number for each item. For ages 7 and above.

LISTENING CONDITION	LESS DIFFICULTY	SAME AMOUNT OF DIFFICULTY	SLIGHTLY MORE DIFFICULTY	MORE DIFFICULTY	CONSIDERABLY MORE DIFFICULTY	SIGNIFICANTLY MORE DIFFICULTY	CANNOT FUNCTION AT ALL
NOISE TOTAL CONDITION SCORE ____							
If listening in a room where there is background noise such as TV, music, others talking, children playing, etc., this child has difficulty hearing and understanding compared to other children of similar age and background							
1. When paying attention	+1	0	-1	-2	-3	-4	-5
2. When being asked a question	+1	0	-1	-2	-3	-4	-5
3. When being given simple instructions	+1	0	-1	-2	-3	-4	-5
4. When being given complicated, multiple instructions	+1	0	-1	-2	-3	-4	-5
5. When not paying attention	+1	0	-1	-2	-3	-4	-5
6. When involved with other activities, i.e., coloring, reading, etc	+1	0	-1	-2	-3	-4	-5
7. When listening with a group of children	+1	0	-1	-2	-3	-4	-5
COMMENTS:							
QUIET TOTAL CONDITION SCORE ____							
If listening in a quiet room (others may be present, but are being quiet), this child has difficulty hearing and understanding compared to other children of similar age and background.							
8. When paying attention	+1	0	-1	-2	-3	-4	-5
9. When being asked a question	+1	0	-1	-2	-3	-4	-5
10. When being given simple instructions	+1	0	-1	-2	-3	-4	-5
11. When being given complicated, multiple instructions	+1	0	-1	-2	-3	-4	-5
12. When not paying attention	+1	0	-1	-2	-3	-4	-5
13. When involved with other activities, i.e., coloring reading, etc.	+1	0	-1	-2	-3	-4	-5
14. When listening with a group of children	+1	0	-1	-2	-3	-4	-5
COMMENTS:							
IDEAL TOTAL CONDITION SCORE ____							
When listening in a quiet room, no distractions, face-to-face, and with good eye contact, this child has difficulty hearing an understanding compared to other children of similar age and background.							
15. When being asked a question	+1	0	-1	-2	-3	-4	-5
16. When being given simple instructions	+1	0	-1	-2	-3	-4	-5
17. When being given complicated, multiple instructions	+1	0	-1	-2	-3	-4	-5
COMMENTS:							
MULTIPLE INPUTS TOTAL CONDITION SCORE ____							
When, in addition to listening, there is also some other form of input, (i.e., visual, tactile, etc.) this child has difficulty hearing and understanding compared to other children of similar age and background.							
18. When listening and watching the speaker's face	+1	0	-1	-2	-3	-4	-5
19. When listening and reading along when material is read aloud by another	+1	0	-1	-2	-3	-4	-5
20. When listening and watching someone provide an illustration, such as a model, drawing, information on the overhead projector or chalkboard, etc.	+1	0	-1	-2	-3	-4	-5
COMMENTS:							

Additional copies of this form are available in pads of 100 from The Educational Audiology Association 1-800-460-7322 4319 Ehrlich Road, Tampa, FL 33624

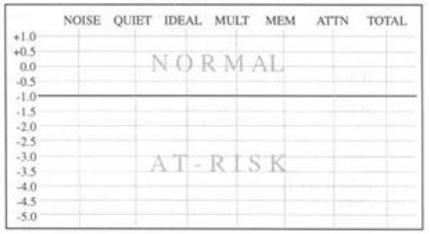
LISTENING CONDITION	LESS DIFFICULTY	SAME AMOUNT	SLIGHTLY MORE	MORE DIFFICULTY	CONSID. MORE	SIGNIFIC. MORE	CAN'T FUNCTION
AUDITORY MEMORY SEQUENCING TOTAL CONDITION SCORE ____							
If required to recall spoken information, this child has difficulty hearing and understanding compared to other children of similar age and background							
21. Immediately recalling information such as a word, word spelling, numbers	+1	0	-1	-2	-3	-4	-5
22. Immediately recalling simple instructions	+1	0	-1	-2	-3	-4	-5
23. Immediately recalling multiple instructions	+1	0	-1	-2	-3	-4	-5
24. Not only recalling information, but also the order and sequence of the information	+1	0	-1	-2	-3	-4	-5
25. When delayed recollection (1 hour or more) of words, word spelling, numbers, etc. is required	+1	0	-1	-2	-3	-4	-5
26. When delayed recollection (1 hour or more) of simple instructions is required	+1	0	-1	-2	-3	-4	-5
27. When delayed recollection (1 hour or more) of multiple instructions is required	+1	0	-1	-2	-3	-4	-5
28. When delayed recollection (24 hours or more) is required	+1	0	-1	-2	-3	-4	-5
COMMENTS:							
AUDITORY ATTENTION SPAN TOTAL CONDITION SCORE ____							
If extended periods of listening are required, this child has difficulty paying attention, that is, being attentive to what is being said compared to other children of similar age and background.							
29. When the listening time is less than 5 minutes	+1	0	-1	-2	-3	-4	-5
30. When the listening time is 5-10 minutes	+1	0	-1	-2	-3	-4	-5
31 When the listening time is over 10 minutes	+1	0	-1	-2	-3	-4	-5
32. When listening in a quiet room	+1	0	-1	-2	-3	-4	-5
33 When listening in a noisy room	+1	0	-1	-2	-3	-4	-5
34. When listening first thing in the morning	+1	0	-1	-2	-3	-4	-5
35. When listening near the end of the day, i.e., before supper time	+1	0	-1	-2	-3	-4	-5
36. When listening in a room where there are also visual distractions	+1	0	-1	-2	-3	-4	-5
COMMENTS:							

SCORING: The CHAPS can be scored two ways. Add the circled responses for each condition and place the sum in the Total Condition Score box in each listed listening condition. Be careful to note "+" and "-" values when adding. Transcribe these sums as indicated below and determine the average score for each listening condition. The Total Condition Scores can be compared to the indicated PASS and FAIL ranges and the appropriate box checked. In addition, the average condition scores can be plotted on the graph to display performance as compared to the normal range. See the CHAPS manual for more complete validity and interpretation information.

LISTENING CONDITION	TOTAL CONDITION SCORE	AVERAGE CONDITION SCORE	Pass	Risk
NOISE	____ ÷ 7 =	____		
QUIET	____ ÷ 7 =	____		
IDEAL	____ ÷ 3 =	____		
MULTIPLE	____ ÷ 3 =	____		
MEMORY	____ ÷ 8 =	____		
ATTENTION	____ ÷ 8 =	____		
TOTAL	____ ÷ 36 =	____		

TOTAL CONDITION SCORE:
PASS RANGE +36 to -11
AT-RISK RANGE -12 to -130

CHAPS Listening Condition Analysis: Transfer Average Condition Scores by entering "X" on graph (round 0.5 scores up to next decimal)



NOTE: Children who score in the at-risk range on the CHAPS will not necessarily require a special academic support program in school. Research found that 45% of students scoring in the at-risk range required no special support services. 50% of students scoring in the at-risk range had below grade level reading ability. 55% required some type of special support or accommodations to achieve success in school.

L.I.F.E. Revised Questionnaire

Listening Inventory For Education - Revised (L.I.F.E.-R.)

Student Appraisal of Listening Difficulty: Before-LIFE Questions for Students

By Karen L. Anderson, PhD, Joseph J. Smaldino, PhD, & Carrie Spangler, AuD

Name _____ Grade ____ Date(s) completed _____

Teacher _____ School _____

☐ Hearing Aid ☐ CI user Type of Classroom Hearing Technology _____

Trial period ☐ No ☐ Yes Length _____ Responses consider performance ☐ with ☐ without FM system in use

Before-LIFE Questions for Students:

Answer these questions PRIOR to administration of the L.I.F.E.-Revised materials.

Check all the answers that apply. If you have an answer that is not provided please add it under "other."

1. **Mark the items that best describe your classroom listening location. My location:**
   - O is in the first / second row of the classroom
   - O is in the middle row of the classroom
   - O is in the back row of the classroom
   - O puts my good ear toward the teacher when teaching
   - O puts my bad ear toward the teacher when teaching
   - O near a source of noise in the classroom
   - O is near a source of noise from outside the classroom
   - O is close to where the teacher stands to talk to the class

   Other _____

2. **What sounds (noises) do you hear when you are in the classroom?** (sounds may happen only some of the time)
   - O Fan noise inside classroom
   - O Noise from heating/cooling system inside the classroom
   - O Noise from a fish tank inside the classroom
   - O Noise from computers inside the classroom
   - O Noise from other students inside the classroom
   - O Sounds from students outside your classroom but inside of the school building
   - O Sounds from the florescent lights

   Other _____

3. **When you are sitting in your usual location in the classroom, how well do you hear the teacher when teaching?**
   - O Pretty well, the teacher is easy to hear
   - O Well, I can hear almost everything
   - O Not well, I miss some stuff
   - O Not well at all, I miss a lot of what the teacher says

4. **What is the best description of your teacher's location in the classroom when teaching:**
   - O Teaches from the same place almost all the time
   - O Walks around for a short time maybe once or twice a day
   - O Teaches from different locations about half of the time
   - O Teaches from different locations more than half of the time

5. **How do you know when you did not hear or understand the teacher completely?**
   - O I have a hard time getting started on my work because I do not understand what the teacher wants me to do.
   - O I know I should ask the teacher to repeat what was said.
   - O I look around to see what other students are doing.
   - O I follow the teacher's instruction incorrectly.
   - O I watch the teacher's lips to understand what was said
   - O I answer questions inappropriately or do not answer
   - O I ask another student what the teacher said
   - O I do not know when I did not hear or understand the teacher

   Other _____

6. **How do you feel about listening with _____ in your class(es)** (technology device(s))?
   - O I am excited to hear and understand better in the classroom
   - O I am nervous
   - O I feel shy
   - O Happy
   - O I don't have any feelings about it

   Other _____

Preschool S.I.F.T.E.R.

PRESCHOOL S.I.F.T.E.R.

Screening Instrument for Targeting Educational Risk in Preschool Children (age 3-Kindergarten)

by Karen L. Anderson, Ed.S. & Noel Matkin, Ph.D.

Child _____ Teacher _____ Age _____

Date Completed ___/___/___ School _____ District _____

The above child is suspect for hearing problems which may affect his/her ability to listen, pay attention, develop language, follow teacher instruction and learn normally. This rating scale has been designed to sift out children who are at risk for educational delay and who may need further evaluation. Based on your knowledge of this child, circle the number that best represents his/her behavior. If the child is a member of a class that has students with special needs, comparisons should be made to normal learning classmates or normal developmental milestones. Please share additional comments about the child on the reverse side of this form.

1. How well does the child understand basic concepts when compared to classmates (e.g., colors, shapes, etc.)?	ABOVE 5 4	AVERAGE 3 2	BELOW 1
2. How often is the child able to follow two-part directions?	ALWAYS 5 4	FREQUENTLY 3 2	SELDOM 1
3. How well does the child participate in group activities when compared to classmates (e.g., calendar, sharing)?	ABOVE 5 4	AVERAGE 3 2	BELOW 1
4. How distractible is the child in comparison to his/her classmates during large group activities?	SELDOM 5 4	OCCASIONAL 3 2	FREQUENT 1
5. What is the child's attention span in comparison to classmates?	LONGER 5 4	AVERAGE 3 2	SHORTER 1
6. How well does the child pay attention during a small group activity or story time?	ABOVE 5 4	AVERAGE 3 2	BELOW 1
7. How does the child's vocabulary and word usage skills compare to classmates?	ABOVE 5 4	AVERAGE 3 2	BELOW 1
8. How proficient is the child at relating an event when compared to classmates?	ABOVE 5 4	AVERAGE 3 2	BELOW 1
9. How does the child's overall speech intelligibility compare to classmates (i.e., production of speech sounds)?	ABOVE 5 4	AVERAGE 3 2	BELOW 1
10. How often does the child answer questions appropriately (verbal or signed)?	ALMOST ALWAYS 5 4	FREQUENTLY 3 2	SELDOM 1
11. How often does the child share information during group discussions?	ALMOST ALWAYS 5 4	FREQUENTLY 3 2	SELDOM 1
12. How often does the child participate with classmates in group activities or group play?	ALMOST ALWAYS 5 4	FREQUENTLY 3 2	SELDOM 1
13. Does the child play in socially acceptable ways (i.e., turn taking, sharing)?	ALMOST ALWAYS 5 4	FREQUENTLY 3 2	SELDOM 1
14. How proficient is the child at using verbal language or sign language to communicate effectively with classmates (e.g., asking to play with another child's toy)?	ABOVE 5 4	AVERAGE 3 2	BELOW 1
15. How often does the child become frustrated, sometimes to the point of losing emotional control?	NEVER 5 4	SELDOM 3 2	FREQUENTLY 1

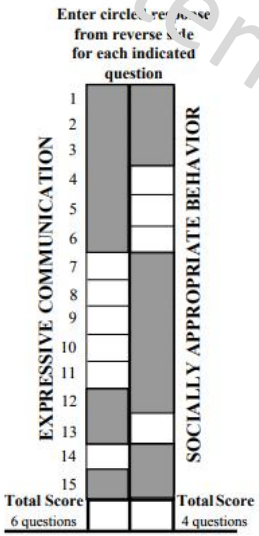
PRE-ACADEMICS | ATTENTION | COMMUNICATION | CLASS PARTICIPATION | SOCIAL BEHAVIOR

TEACHER COMMENTS: (frequent absences, health problems, other problems or handicaps in addition to hearing?)

The Preschool S.I.F.T.E.R. is a SCREENING TOOL ONLY. The primary goal of the Preschool S.I.F.T.E.R. is to identify those children who are at-risk for developmental or educational problems due to hearing problems and who merit further observation and investigation. Analysis has revealed that two factors, expressive communication and socially appropriate behavior, discriminate children who are normal from those who are at-risk. The greater the degree of hearing problem, the greater the impact on these two factors and the higher the validity of this screening measure. If a child is found to be at-risk then the examiner is encouraged to calculate the total score in each of the five content areas. Analysis of the content area score may assist in developing a profile of the child's strengths and special needs. The profile may prove beneficial in determining appropriate areas for evaluation and developing an individual program for the child.

SCORING

There are two steps to the scoring process. First, enter scores for each of the indicated questions in the spaces provided and sum the total for the 6 questions for the expressive communication factor and then the 4 questions for the socially appropriate behavior factor. If the child's scores fall into the At-Risk category for either or both of these factors, then sum the 3 questions in each content area to develop a profile of the child's strengths and potential areas of need.



EXPRESSIVE COMMUNICATION (check one)

PASS (14 - 30) score range ☐

AT-RISK (6 -13) score range ☐

SOCIALLY APPROPRIATE BEHAVIOR (check one)

PASS (12 - 20) score range ☐

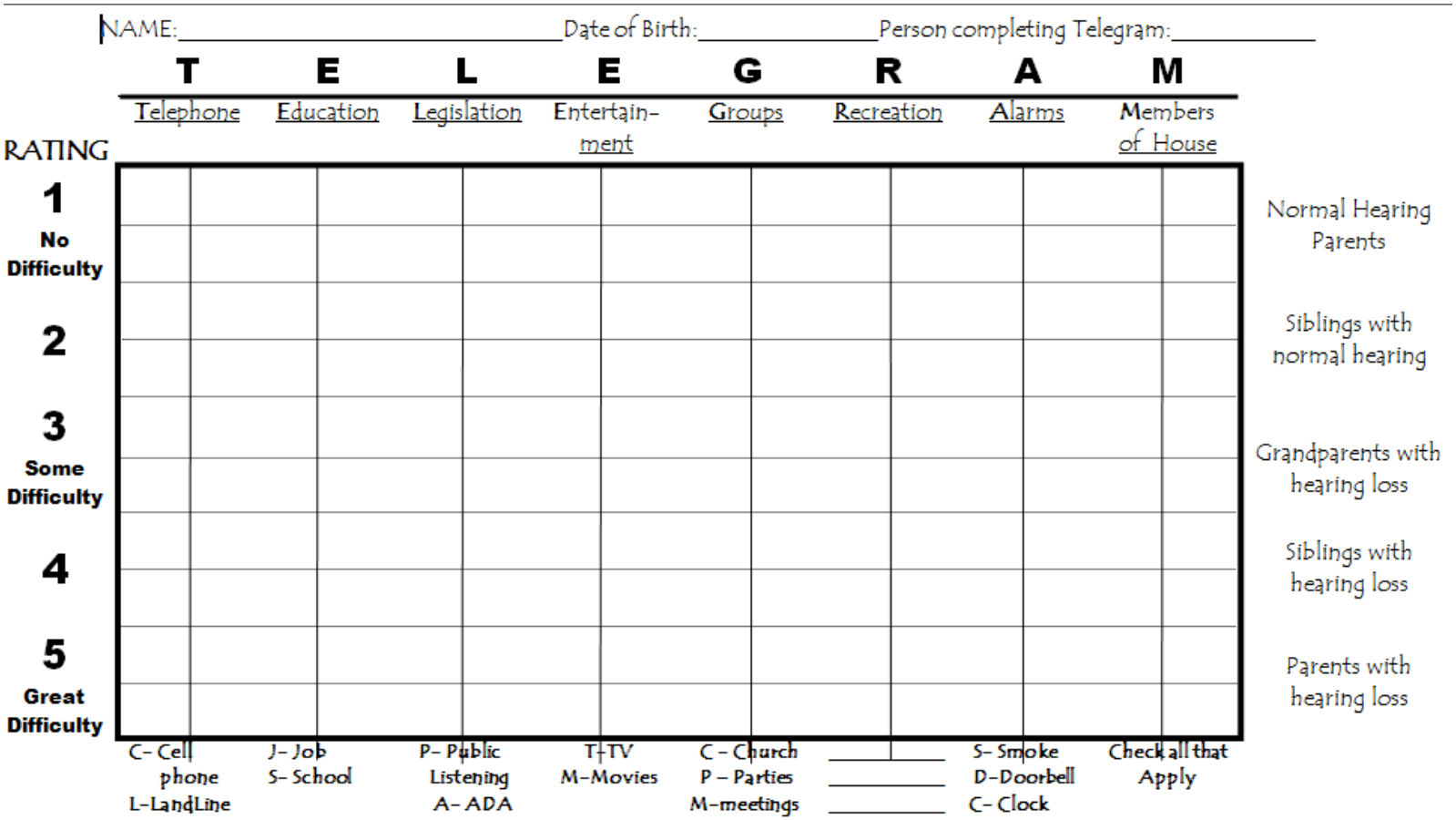
AT-RISK (4 -11) score range ☐

SKILLS PROFILE

CONTENT AREA	TOTAL SCORE (enter)	PASS RANGE	AT-RISK RANGE	SCREENING RESULTS (circle)	
PREACADEMICS		7 - 15	3 - 6	Pass	At-Risk
ATTENTION		9 - 15	3 - 8	Pass	At-Risk
COMMUNICATION		9 - 15	3 - 8	Pass	At-Risk
CLASS PARTICIPATION		7 - 15	3 - 6	Pass	At-Risk
SOCIAL BEHAVIOR		9 - 15	3 - 8	Pass	At-Risk

Sum the responses to the 3 questions in each content area from the reverse side. Enter the total score for each content area in the Total Score column above.

TELEGRAM Assessment



Functional Listening Evaluation (FLE)

- Determines listening abilities affected by noise, distance, and visual input in student's natural listening environment
- Simulates listening ability in situations that represent actual listening conditions in student's classroom– not sound booth
- Student's teachers, parents, and others gain understanding affects of adverse listening conditions encountered by student
- Useful in justifying accommodations, such as assistive listening devices, sign language or oral interpreters, note takers, captioning, special seating, and room acoustic modifications
- Functional Listening Evaluation or Functional Listening Eval
- Purchase recorded FLE at Successforkidswithhearingloss.com

(Ying , 1990), (Ross, Bracken & Maxon, 1992)

FLE (cont.)

Test administration takes approximately 30 minutes, including set up, with sentences and 20 minutes with words

1.	Auditory-Visual	Close	Quiet
2.	Auditory	Close	Quiet
3.	Auditory-Visual	Close	Noise
4.	Auditory	Close	Noise
5.	Auditory-Visual	Distant	Noise
6.	Auditory	Distant	Noise
7.	Auditory	Distant	Quiet
8.	Auditory-Visual	Distant	Quiet

FLE: 12 Year Old Female w/o HA

Noise		Distant		Visual Input	
Quiet	Noise	Close	Distant	AV	Aud
50.0	46.0	50.0	12.0	90.0	50.0
90.0	70.0	90.0	28.0	70.0	46.0
12.0	4.0	46.0	4.0	20.0	4.0
28.0	20.0	70.0	20.0	28.0	12.0
45.0	35.0	64.0	16.0	52.0	28.0

Self-Calculating FLE Form

THE FUNCTIONAL LISTENING EVALUATION

Name:_____ Date:_____ Examiner:_____ Age/DOB:_____

AUDIOMETRIC RESULTS

Hearing Sensitivity: Pure Tone Ave: Right Ear____dB Left Ear____dB

PTA used: ☐ 500, 1K, 2K ☐ 1K, 2K, 4K

Word Recognition: Right Ear____% @ ___dBHL Left Ear____% @ ___dBHL

Sound Field: Aided ☐ Unaided ☐

Quiet _____% @ _____dBHL

Noise _____% @ _____dBHL @ _____S/N

FUNCTIONAL LISTENING EVALUATION CONDITIONS

Amplification: ☐ None ☐ Hearing Aid(s) ☐ Cochlear Implant(s)

☐ Bone- conduction device

Hearing Assistance Technology: ☐ Personal FM ☐ Classroom

☐ Other_____

Classroom Noise Level: Unoccupied _____dBA SPL; Occupied _____dBA SPL

Assessment Material: _____

Distance (distant condition): ___ft

Noise Stimulus: ☐ Multitalker ☐ Classroom ☐ Other_____

Speech level @ listener's ear: ____dBA SPL ; @ 1 ft from examiner: ____dBA SPL

Noise level @ listener's ear: ____dBA SPL

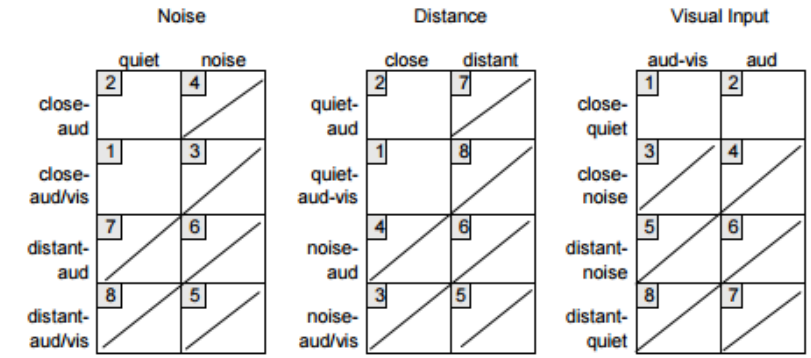
Approximate speech to noise levels: close +____dB distant -____dB

Modifications in protocol:

FUNCTIONAL LISTENING SCOREBOX

	close/quiet	close/noise	distant/quiet	distant/noise
auditory-visual	1	3	8	5
auditory	2	4	7	6

INTERPRETATION MATRIX



Average scores: 0.0% quiet 0.0% noise | 0.0% close 0.0% distant | 0.0% aud-vis 0.0% aud

With Hearing Assistance Technology :

Average scores: 0.0% quiet 0.0% noise | 0.0% close 0.0% distant | 0.0% aud-vis 0.0% aud

INTERPRETATION AND RECOMMENDATION

Revised 2011 by C.D. Johnson. Based on Functional Listening Evaluation by C.D. Johnson & P. Von Almen, 1993.

FLE at Successforkidswithhearingloss.com

- Self-calculating FLE response form can be used with any stimuli material
- Cheryl DeConde Johnson has made available this response form and Common Children's Phrases (standard and nonsense version)
- A recorded version of the FLE using sentences that controls the noise level (+5 S/N) is available from Supporting Success for Children with Hearing Loss.
- 10-minute classroom noise file for educator use, however FLE presenters should use a sound level meter to measure levels of speech and noise are measured during the evaluation

(from http://successforkidswithhearingloss.com/tests)

Successforkidswithhearingloss.com

- Links to other useful functional questionnaires at http://successforkidswithhearingloss.com/tests
  - ELF
  - CHILD
  - LIFE
  - CHAPS

UWO PedAMP

- Marlene Bagatto, AuD, PhD, developed pediatric functional outcome protocol
- University of Western Ontario Pediatric Audiological Monitoring Protocol (UWO PedAMP)
  - Ontario Infant Hearing Program (OIHP)
  - Amplification Benefit Questionnaire
  - Hearing Aid Fitting Summary
  - Aided Speech Intelligibility Index (SII) Normative Values
  - LittlEARS Auditory Questionnaire (Tsiakpini et al, 2004)
  - Parent's Evaluation of Aural/Oral Performance of Children (PEACH) (Ching & Hill, 2005)

Trends Amplif 2011;15[1-2]:57
http://tia.sagepub.com/content/15/1/57.long
https://connect.sonova.com/p8ghn82evbg/

UWO PedAMP

Contents of the UWO PedAMP

Tool	Purpose	Description
Amplification Benefit Questionnaire	• Acceptance & use of hearing aids • Satisfaction with services	11 items 5 point rating scale
Hearing Aid Fitting Details	• Quality of hearing aid fitting	RECD, MPO, Speech Intelligibility Index (SII)
LittlEARS Auditory Questionnaire *Tsiakpini et al, 2004*	• Receptive & semantic auditory behaviour • Expressive vocal behaviour	35 items Yes/no response
Parents' Evaluation of Aural/Oral Performance of Children (PEACH) *Ching & Hill, 2005*	• Communication in quiet & noise • Responsiveness to environment	13 items 5 point rating scale

https://www.dslio.com/?page_id=283

LittlEARS (Parent Yes/No) Questionnaire

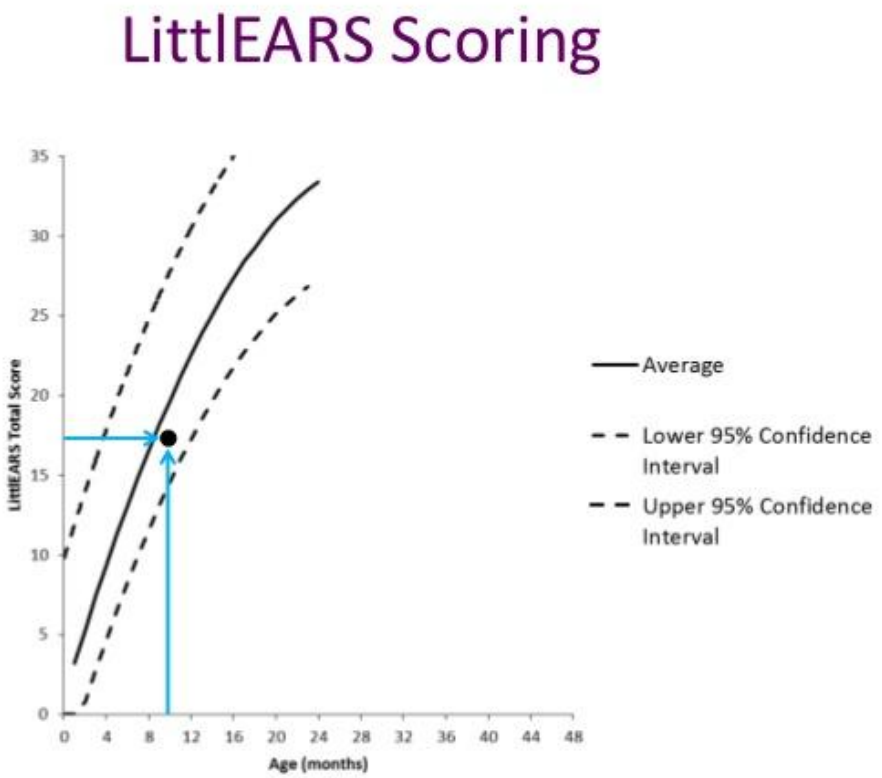
	Auditory Response	Example	Answer
1	Does your child respond to a familiar voice?	Smiles; looks towards source; talks animatedly.	☐Yes ☐No
2	Does your child listen to somebody speaking?	Listens; waits and listens; looks at the speaker for a longer time.	☐Yes ☐No
3	When somebody is speaking, does your child turn his/her head towards the speaker?		☐Yes ☐No
4	Is your child interested in toys producing sounds or music?	Rattle, squeezing toy	☐Yes ☐No
5	Does your child look for a speaker he/she cannot see?		☐Yes ☐No
6	Does your child listen when the radio/CD/tape player is turned on?	Listening: turns towards the sound, is attentive, laughs or sings/talks "along."	☐Yes ☐No
7	Does your child respond to distant sounds?	When being called from another room	☐Yes ☐No
8	Does your child stop crying when you speak to him/her without him/her seeing you?	You try to comfort the child with a soft voice or song without eye contact.	☐Yes ☐No
9	Does your child respond with alarm when hearing an angry voice?	The child becomes sad and starts crying.	☐Yes ☐No
10	Does your child "recognize" acoustic rituals?	Musical box by bed; lullaby; water running into the tub.	☐Yes ☐No
11	Does your child look for sound sources located at the left, right or back?	You call or say something, the dog barks, etc. and the child looks and finds the sources.	☐Yes ☐No
12	Does your child react to his/her name?		☐Yes ☐No
13	Does your child look for sound sources located above or below?	A clock on the wall, or something falling on the floor.	☐Yes ☐No
14	When your child is sad or moody, can he/she be calmed down or influenced by music?		☐Yes ☐No
15	Does your child listen on the telephone and does he/she seem to recognize that somebody is talking?	When grandma or daddy calls, the child takes the receiver and "listens."	☐Yes ☐No
16	Does your child respond to music with rhythmical movements?	The child moves arms/legs to the music.	☐Yes ☐No
17	Does your child know that a certain sound is related to a certain object or event?	The child hears the sound of an aeroplane and looks towards the sky, or hears a car and looks towards the street.	☐Yes ☐No

	Auditory Response	Example	Answer
18	Does your child appropriately respond to short and simple remarks?	"Stop!" "Yuck!" "Don't!"	☐Yes ☐No
19	Does your child respond to "No" by typically interrupting his/her current activity?	A strongly pronounced "no, no!" – although the child does not see you (!) – is effective.	☐Yes ☐No
20	Does your child know family members' names?	Where is ...: Daddy, Jane, Mark, ...	☐Yes ☐No
21	Does your child imitate sounds when asked?	"Aaa", "ooo", "iii"	☐Yes ☐No
22	Does your child follow simple commands?	"Come here!"; "Take off your shoes!"	☐Yes ☐No
23	Does your child understand simple questions?	"Where is your tummy?"; "Where is daddy?"	☐Yes ☐No
24	Does your child bring items when asked?	"Bring me the ball!" etc.	☐Yes ☐No
25	Does your child imitate sound or words you say?	"Say: woof woof!"; "Say: c-a-r"	☐Yes ☐No
26	Does your child produce the right sound to a toy?	"Vurrm" with car, "moo" with cow	☐Yes ☐No
27	Does your child know that certain sounds belong to certain animals?	Woof woof = dog; meow = cat; cock-a-doodle-do = cockerel/rooster	☐Yes ☐No
28	Does your child try to imitate environmental sounds?	Animal sounds, sounds of household appliances, police car siren.	☐Yes ☐No
29	Does your child correctly repeat a sequence of short and long syllables you have said?	"La-la-laaa"	☐Yes ☐No
30	Does your child select the right object from a number of objects when asked?	You are playing with toy animals and ask for the "horse"; you are playing with coloured balls and ask for the "red ball."	☐Yes ☐No
31	Does your child try to sing along when hearing a song?	Nursery rhymes	☐Yes ☐No
32	Does your child repeat certain words when asked?	"Say 'Bye - Bye' to grandma"	☐Yes ☐No
33	Does your child like being read to?	From book or picture book	☐Yes ☐No
34	Does your child follow complex commands?	"Take off your shoes and come here."	☐Yes ☐No
35	Does your child try to sing with familiar songs?	Lullaby	☐Yes ☐No

Total score = all questions checked with "yes"	

LittlEARS

- Birth and up
- Questionnaire for the parent with 35 age-dependant questions that assesses auditory development.



Amplification Benefit Questionnaire – Infant

Infant Hearing Program Amplification Benefit Questionnaire

Child's Name:_____ DOB:_____ GA:_____ Sex:_____

Date: _____ Respondent: _____ Notes:_____

ADMINISTRATION FORMAT:

Independently at Home	*Independently in Office*	*Interview-style*	*Translator Required*
☐	☐	☐	☐

TIMING

1. About how many MONTHS ago was your child first fitted with the PRESENT hearing aids?
   _____ months ago

ACCEPTANCE/USE OF HEARING AIDS

2. How much does your child wear his/her hearing aids in a typical day?

Not At All	*Less than 1 Hour*	*1 to 4 Hours*	*4 to 8 Hours*	*Always*
☐	☐	☐	☐	☐

3. Your child is happy to wear the hearing aids.

Never	*Rarely*	*Sometimes*	*Most of the time*	*Always*
☐	☐	☐	☐	☐

AUDITORY PERFORMANCE

4. Overall, how often do you think your child hears sounds with the hearing aids?

Never	*Rarely*	*Sometimes*	*Most of the time*	*Always*
☐	☐	☐	☐	☐

5. How often do you think your child hears *soft* sounds with the hearing aids?

Never	*Rarely*	*Sometimes*	*Most of the time*	*Always*
☐	☐	☐	☐	☐

6. How often is your child uncomfortable with *loud* sounds with the hearing aids?

Never	*Rarely*	*Sometimes*	*Most of the time*	*Always*
☐	☐	☐	☐	☐

EFFECTIVENESS OF SERVICE DELIVERY

7. Can you tell if/when the hearing aids are not working? (e.g., whistling, no sound)

Never	*Rarely*	*Sometimes*	*Most of the time*	*Always*
☐	☐	☐	☐	☐

8. Do you know how to check problems with the hearing aids when they occur? (e.g., dead battery, water or wax in earmold tubing)

Never	*Rarely*	*Sometimes*	*Most of the time*	*Always*
☐	☐	☐	☐	☐

OVERALL SATISFACTION

9. Considering everything, do you think the hearing aids are worth the effort?

Never	*Rarely*	*Sometimes*	*Most of the time*	*Always*
☐	☐	☐	☐	☐

10. Considering everything, how satisfied are you with the hearing aid services you have received for your child, in the Infant Hearing Program?

Never Satisfied	*Rarely Satisfied*	*Sometimes Satisfied*	*Most of the time Satisfied*	*Always Satisfied*
☐	☐	☐	☐	☐

SERVICE IMPROVEMENT

11. Could the hearing aid services for your child be better? Please tell us how.

_____
_____
_____
_____
_____

The University of Western Ontario PEDAMP Pediatric Audiological Monitoring Protocol
The University of Western Ontario Pediatric Audiological Monitoring Protocol Version 1.0, Revision 2
©2010 Child Amplification Laboratory, National Centre for Audiology, UWO

P.E.A.C.H (Parent Questionnaire)

Parents' **E**valuation of **A**ural/oral performance of **Ch**ildren

Child's name: _____

Date of Birth: _____

Parent/Care giver completing PEACH: _____

Date completed: _____

Developed by Teresa Ching & Mandy Hill

USE OF DEVICE & LOUDNESS DISCOMFORT
Questions 1 - 3

1. I would like to know how often your child is wearing his/her hearing aids and/or cochlear implant. Can you tell me about your child's routine for wearing his/her hearing aids/cochlear implant in the last week?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Pediatric (Functional Assessment)

- Preschool to 7 years
- 15 question parent survey targeting the child's everyday environment
- Scoring for 5 subscales (Use, Quiet, Noise, Telephone, Environment)

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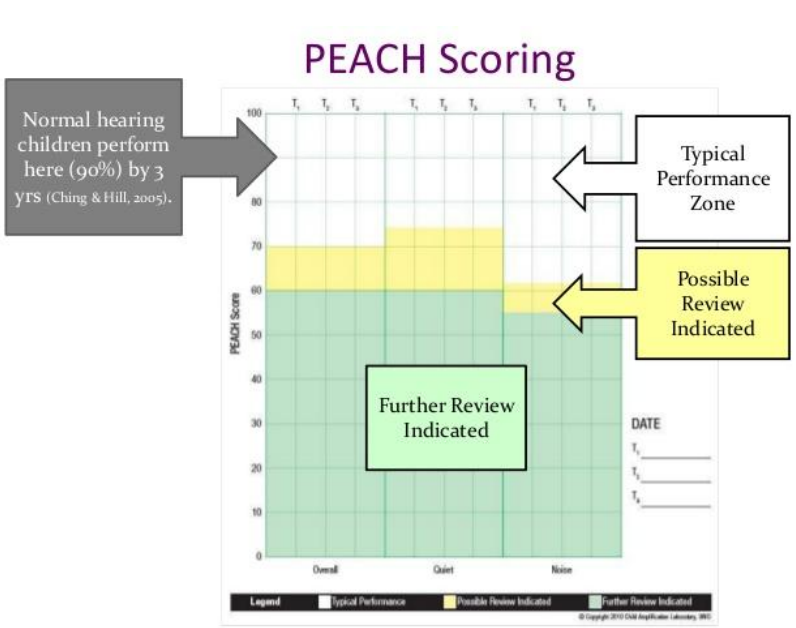
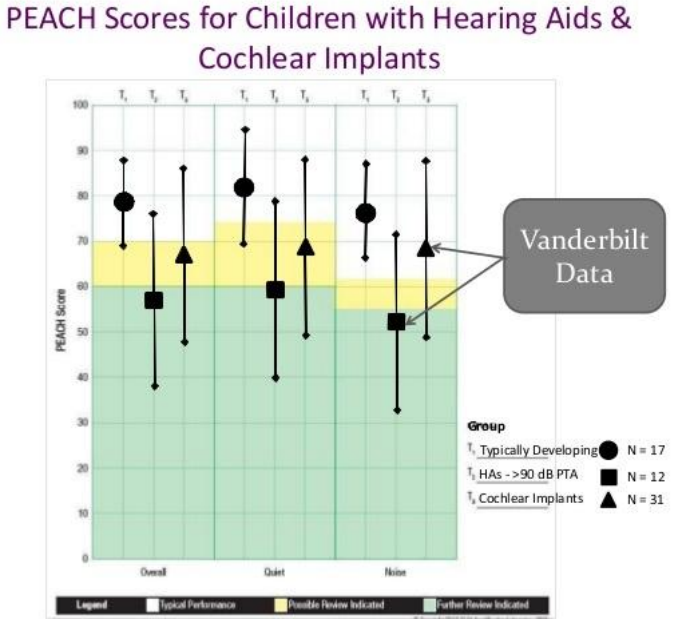




AB IT-MAIS (free iPad app)

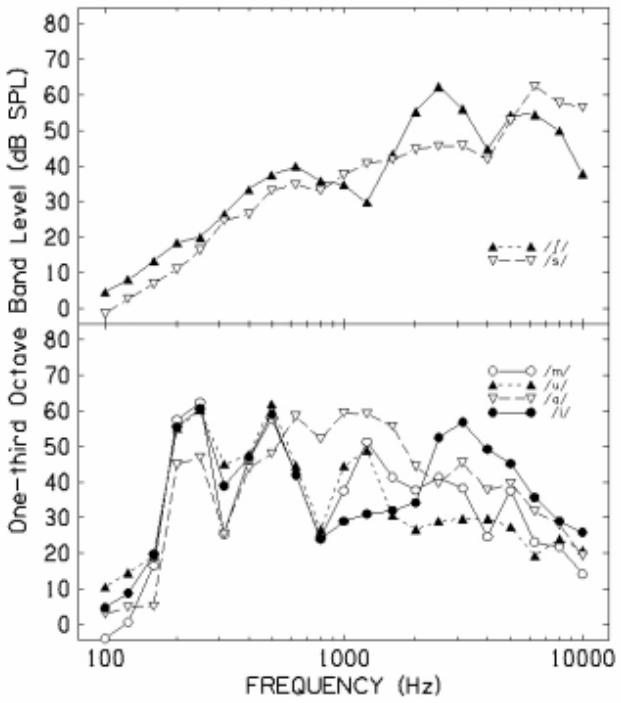
- 3 to 4 years and up
- Parental interview with ten questions that evaluates meaningful use of sound in everyday situations (attachment with hearing instrument, ability to alert to sound, ability to attach meaning to sound)

Ling 6 (HL) CD from Phonak

A specific tool: Ling 6 (HL) (Scollie et al, 2012)

- Pre-recorded female utterances of each sound.
- Norms for detection in dB HL in sound field.
- Scoring corrections, a score sheet, and a CD.

- Normally hearing listeners:
  - Detect the sounds between – 10 and 10 dB HL.
  - Have average test-retest reliability of 1 – 2 dB and a range of test re-test of one to two step sizes.



Ling 6 (HL) (free CD from Phonak)

Sample Case:

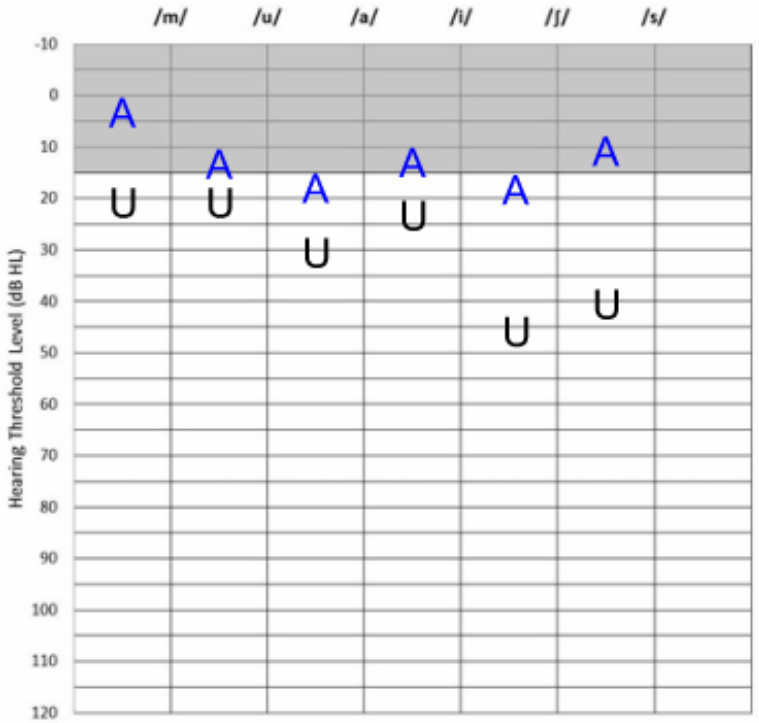
- Age 3 y 6 mo
  - Moderate SNHL bilaterally
- Fitting: DSL5
- Standard audiometry, good reliability on Ling6
- Video of a similarly aged child with normal hearing.

Ling-6(HL) Scoring Sheet

Name: _____ D.O.B: _____
Date: _____ Respondent: _____
Notes on testing conditions: _____

Test method:	❑Standard	❑CPA	❑VRA	
Reliability:	❑ Good	❑ Fair	❑ Poor	
Test type:	❑Aided	❑Unaided	❑CI	❑ Bone conducted ❑ BAHA
Masking (unaided ear)?	❑n/a	❑ Yes	❑ No	

Plot the corrected threshold values in dB HL below.

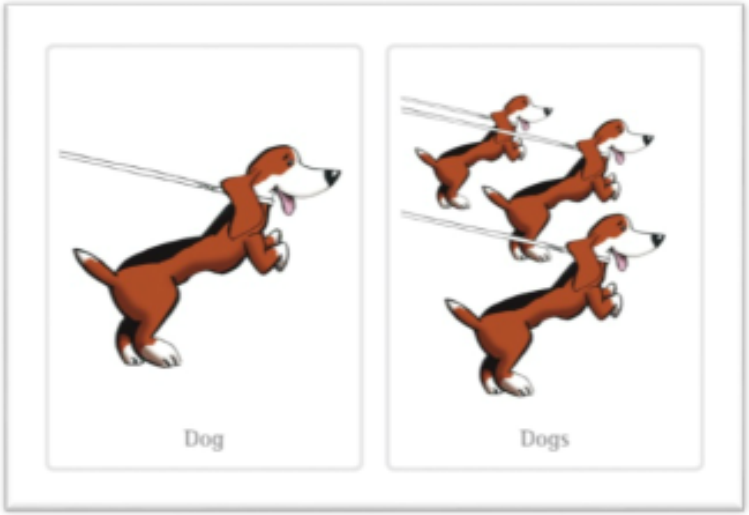


Grey region shows the normal hearing range.
Values assume binaural sound field testing at zero degrees azimuth.

UWO Plurals Test (free CD from Phonak)

Presentation

- Present at an overall level of about 55 dB(A).
  - This represents speech at a slightly soft level.
- A background noise is built in. Ten randomized lists are provided.
- Use **picture flip cards** to administer using a pointing response. This is helpful if the child's own productions of the word would be unclear.
  - Tip: pre-sort the cards into the correct random order for the list(s) you will use.



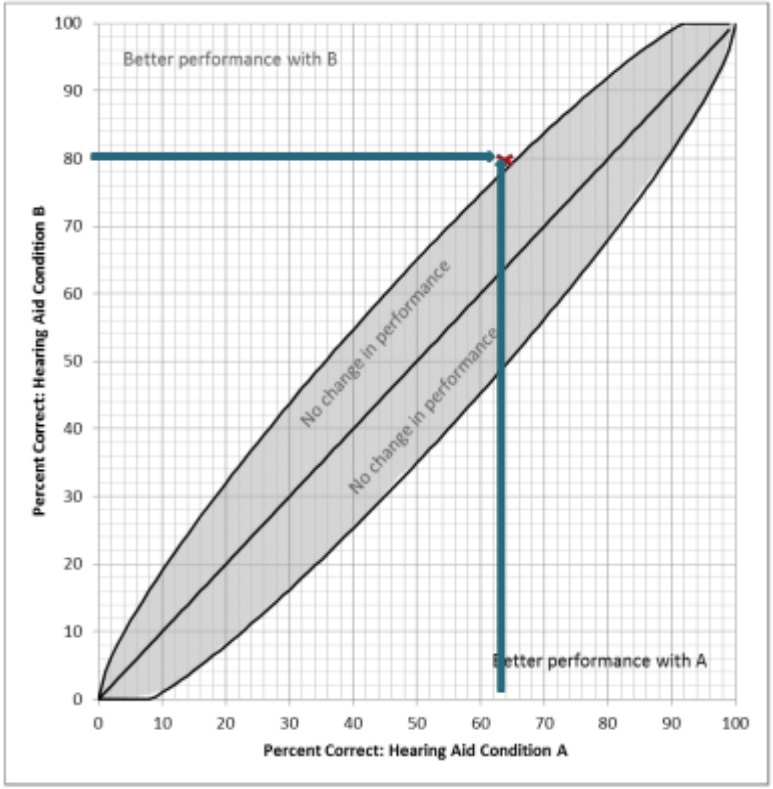
UWO Plurals Test (free CD from Phonak)

Score sheet

The plotted score falls outside the shaded region and is therefore significantly better.

The re-adjustments improved the score significantly.

Note that this test does not assess correct speech sound identification.



(Glista et al, 2012, 2009)

BKB-SIN (for children 5 or older)

- Indicates ability to understand speech in noise
- 10 sentences presented twice and averaged
- Increasing noise levels with each sentence presentation
- Helps audiologist select appropriate hearing aid and hearing assistance technologies

Phrases in Noise Test (PINT) – 3 - 6 years of age

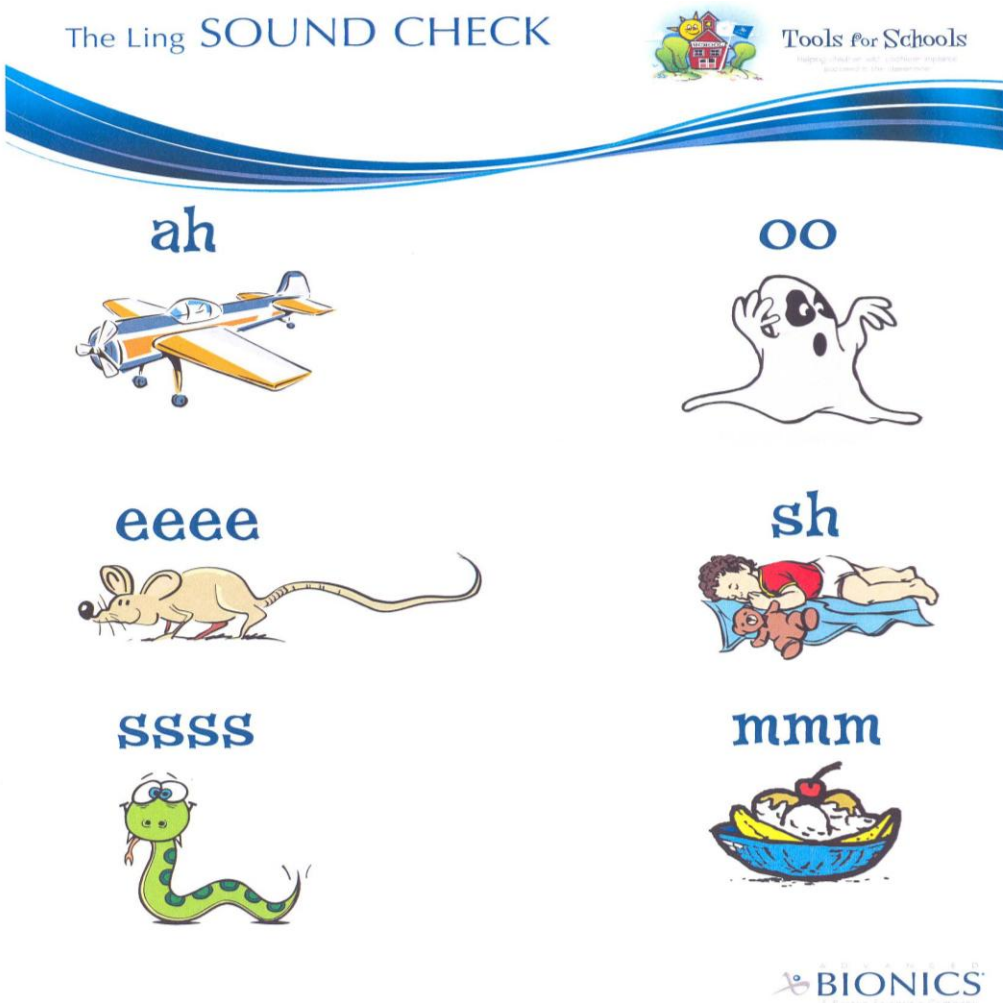
- Assess “educational need” for assistive technology benefit from hearing assistive technology
- On CD similar in nature and scoring to BKB-SIN
- Use either in sound room or in classroom
- Correlates well with Preschool Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R.) rated by teachers

- Email Dr. Erin Schafer at untschaferlab@gmail.com

(Schafer et al, 2012)

Ling 6 Sound Check

- Evaluate student at variety of distances to determine maximum distance Ling sounds heard
- Ling 6 Sound Check Chart
- Ling 6 Behavioral Daily Checklist
- Ling 6 Recording Chart



C.H.A.T.

- Phonak launched the Child Hearing Assessment Toolkit (C.H.A.T.)
- Cloud-based tool allows professionals working in education to managing patient assessments
- Try C.H.A.T. at www.chatbyphonak.com
- More info found at http://ow.ly/mpf9t

Where is HAT Headed?

- Integrated HAT receivers in hearing devices
  - MFi
  - Telecoils
- Increasing use of wireless remote mics
- Increasing installation of classroom soundfield amplification
- Integration of WiFi, IoT, smartphones
- AI, machine learning

Questions/Comments