
Beyond hearing aids – Benefits of using remote microphone technology and other solutions for children

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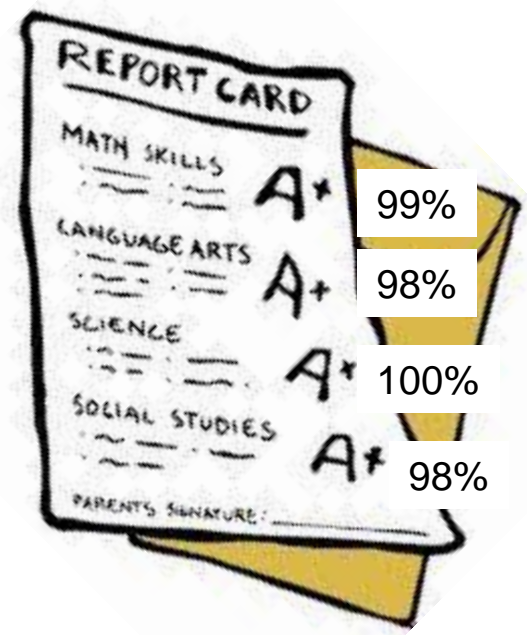
Jackie Keathly



Shoot for the Moon!



66%
73%
69%
56%
78%
87%



99%
98%
100%
98%

Road Map

- Adaptive Digital Broadband Wireless Technology
 - Introduction
 - Study with CI Users
 - How about Hearing Aid Users?
- Audio Streaming



A Noisy World!

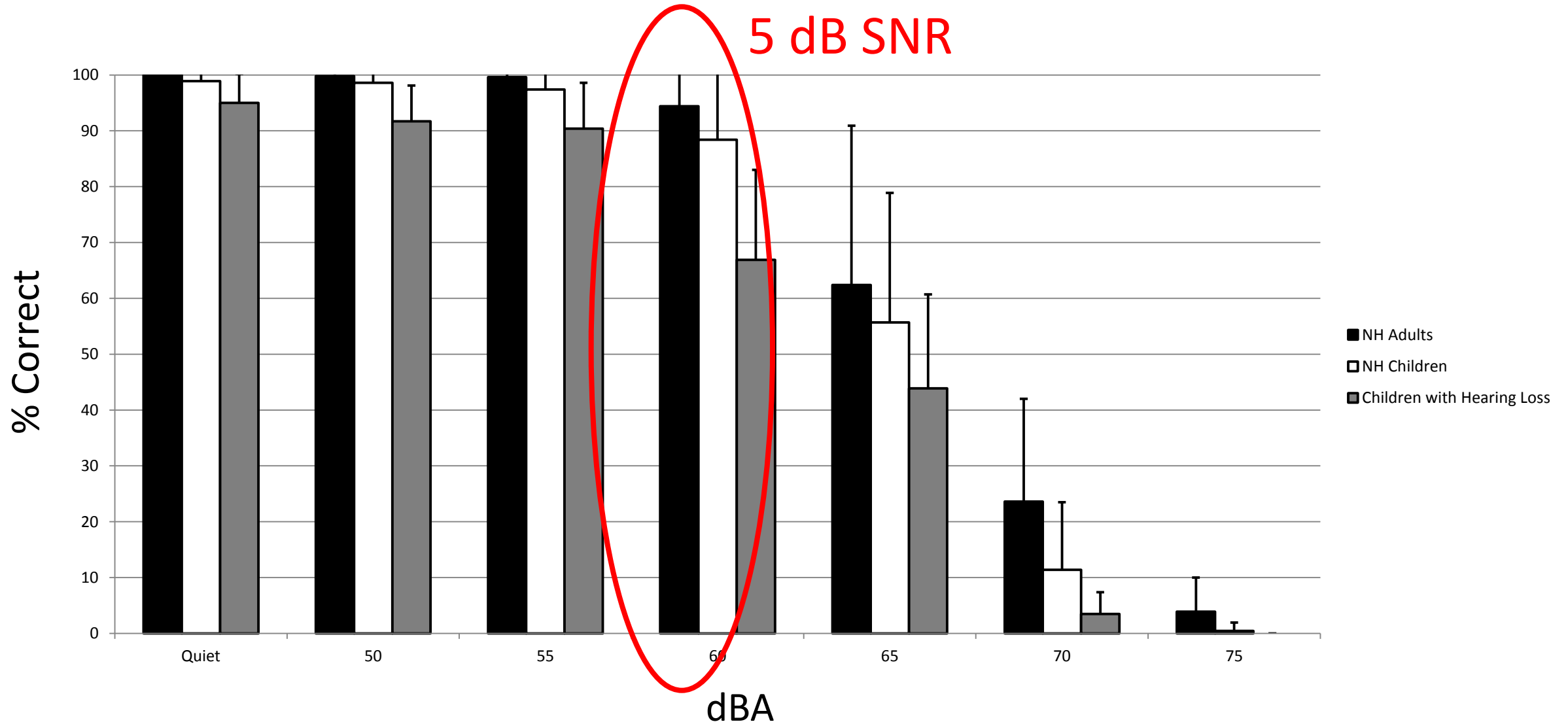
The SNR in these environments is typically -5 to +5 dB

- 42 dB A (with A.C. = 52 dBA)
- Classroom:
 - 66 dBA
- School Assembly:
 - 76 dBA
- School Cafeteria:
 - 82 dBA
- OKC Thunder Basketball Game:
 - 100 dBA



Children with hearing loss need a +15 dB SNR!

Sentence Recognition in Noise



The Evolution of Technology

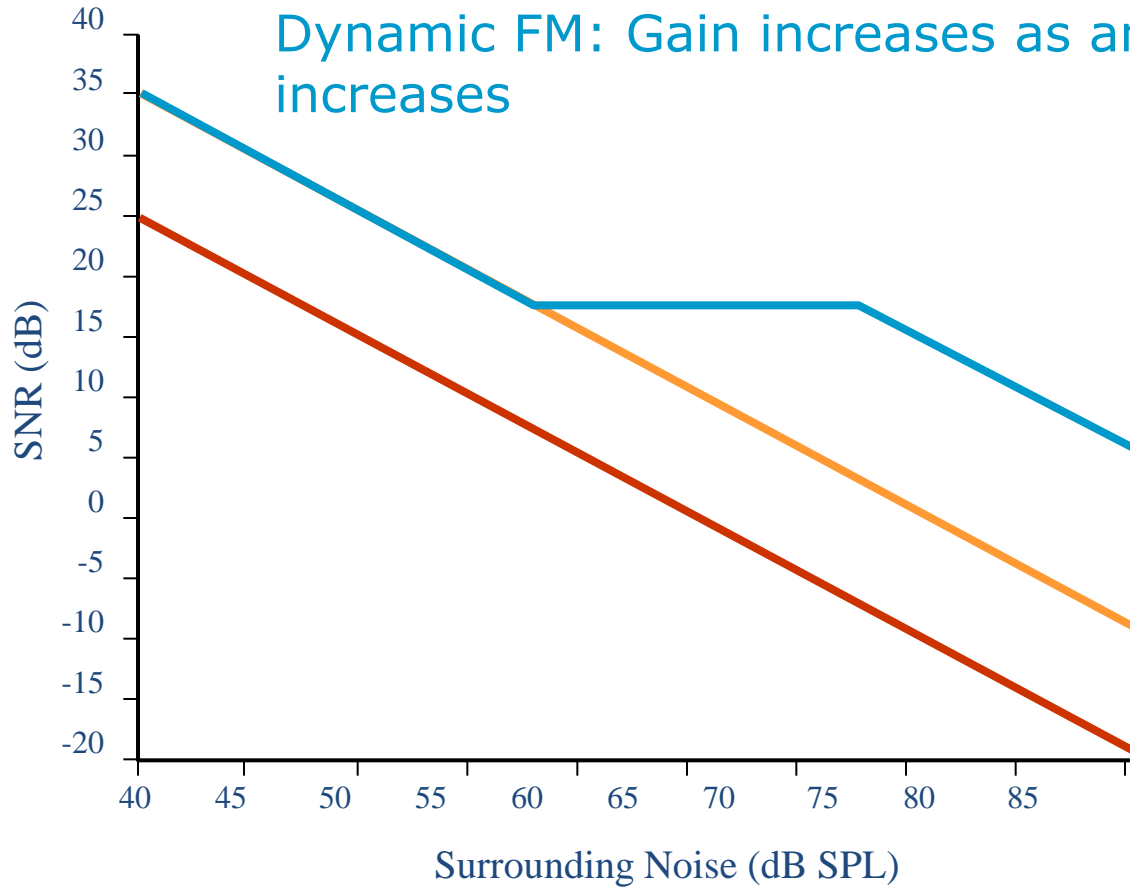
- 1996 First miniaturized ear-level FM receiver
- 2000 Universal ear-level FM receiver
- 2003 Frequency-flexible FM system
- 2008 Dynamic FM - the first adaptive FM system

What about Dynamic FM?

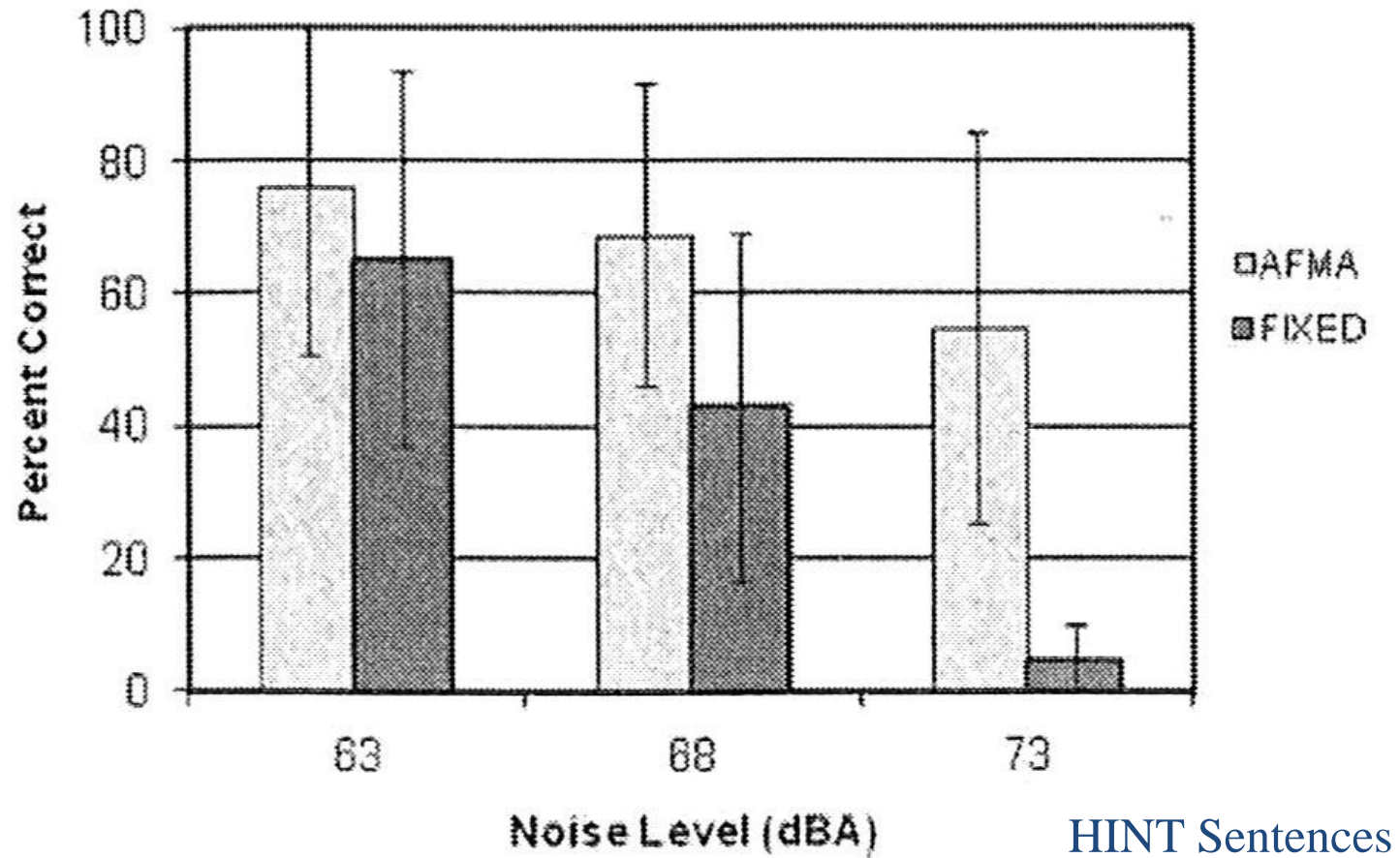
No FM

Traditional FM: Gain is fixed

Dynamic FM: Gain increases as ambient noise increases



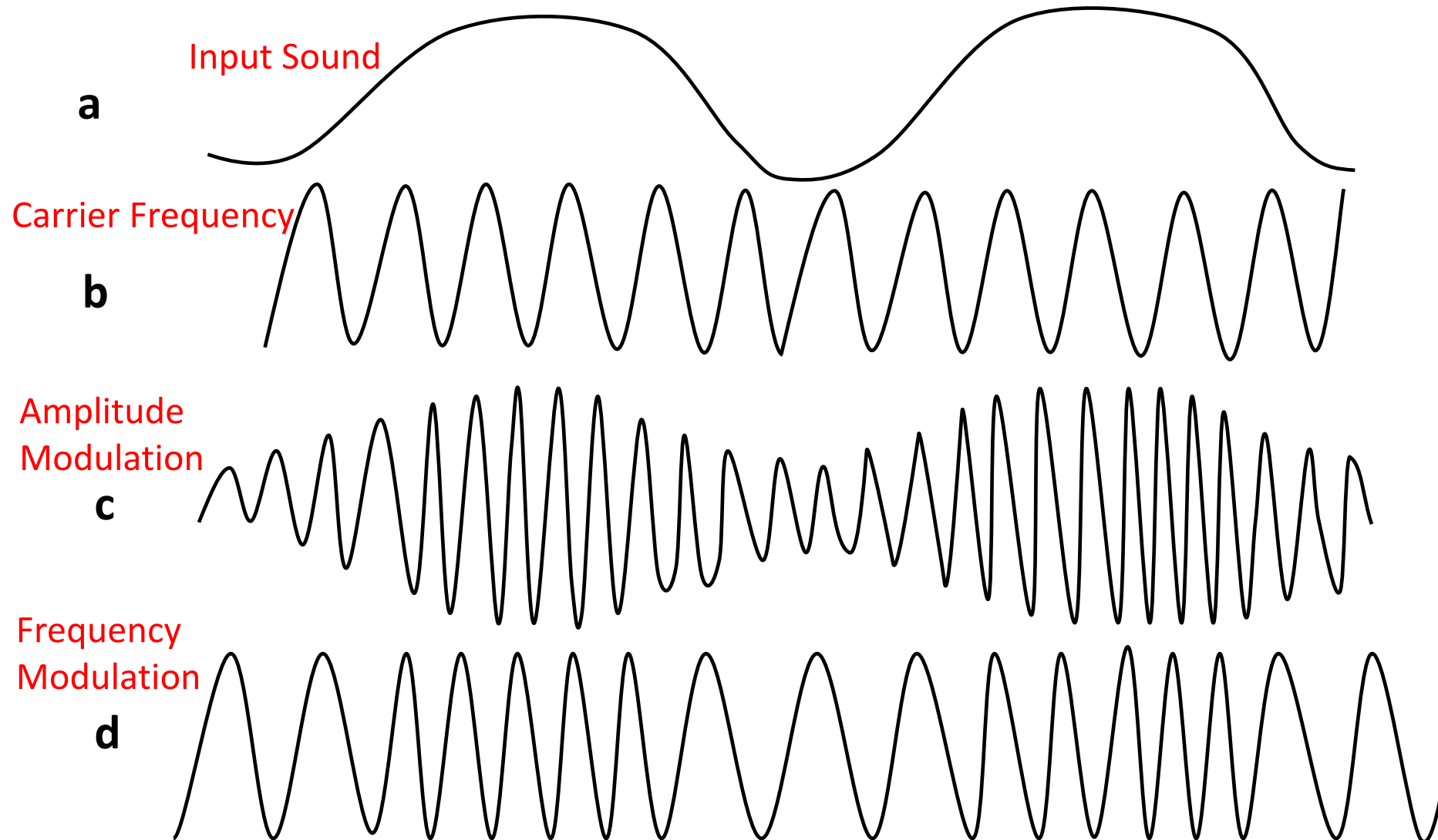
Thibodeau -- Dynamic FM

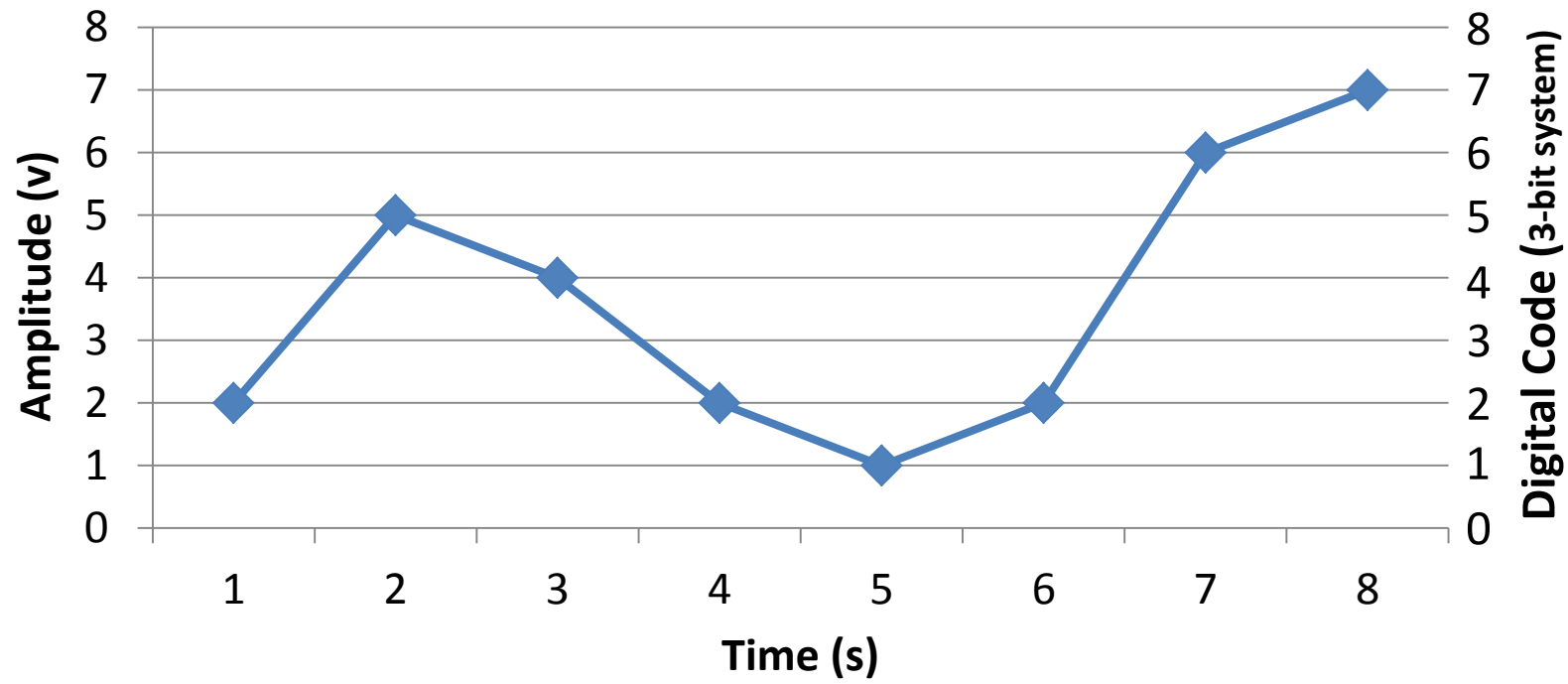


Thibodeau (2010), American Journal of Audiology

- What is a digital RF system?

Frequency Modulation Radio Transmission

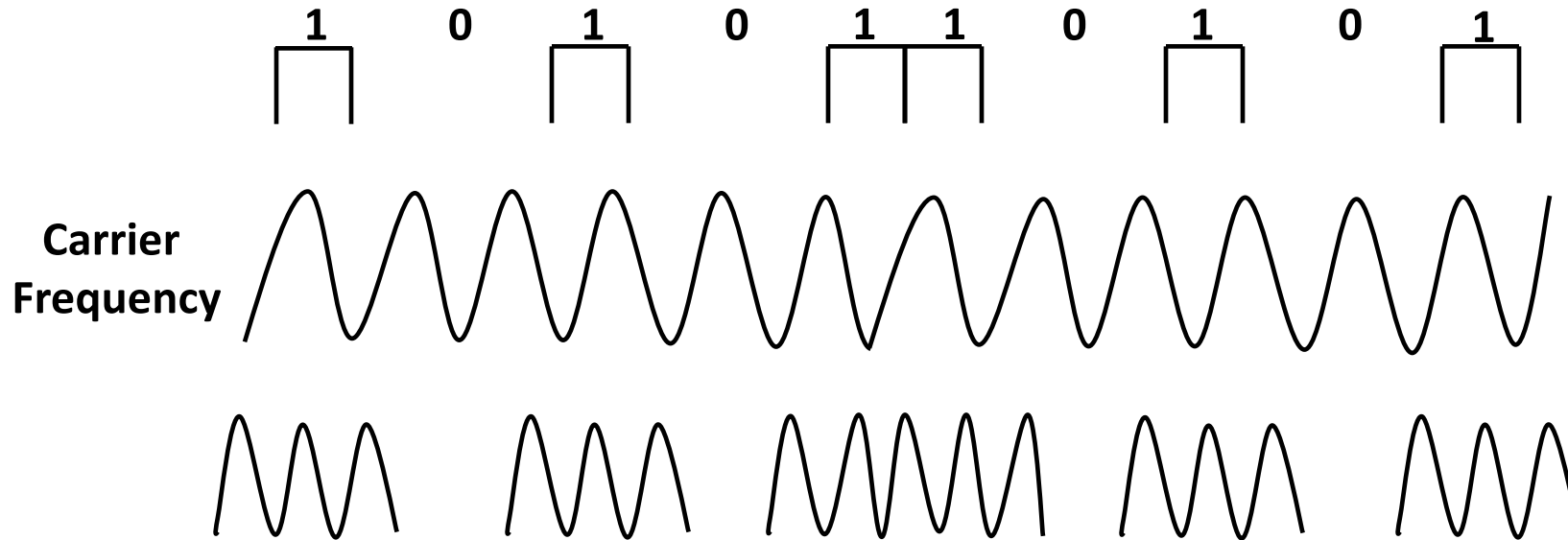




Time	Digital Code	Fours	Twos	Ones
1	2	0	1	0
2	5	1	0	1
3	4	1	0	0
4	2	0	1	0
5	1	0	0	1
6	2	0	1	0
7	6	1	1	0
8	7	1	1	1

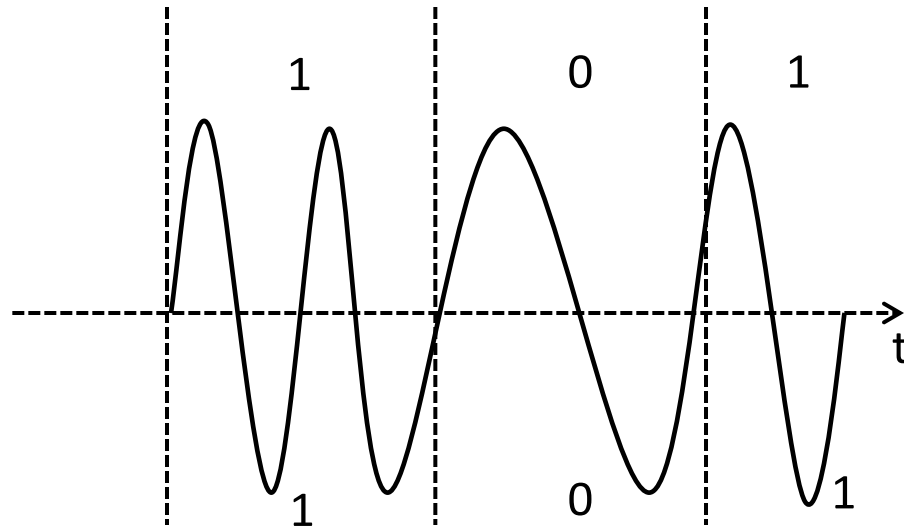
Digital Radio Frequency Transmission

Amplitude Shift Keying



Digital Radio Frequency Transmission

Gaussian Frequency Shift Keying



- Does an adaptive digital wireless system offer benefit for CI users?

Roger Digital Wireless Characteristics

- Audio signals are sampled, digitized and packaged in very short (160 μ s) digital bursts of codes (packets) and broadcast several times, each at different channels between 2.4000 and 2.4835 GHz
 - The 2.4 GHz ISM (Industry, Science and Medical) band is globally license free
- Frequency hopping between channels, in combination with repeated broadcast, avoids interference issues
- The frequency hopping is adaptive, both receivers and transmitters are searching continuously to find free channels and to avoid occupied channels
- End-to-end audio delay is well below 25 ms – 7500 Hz BW
- Digital control of adaptive (Dynamic) gain changes

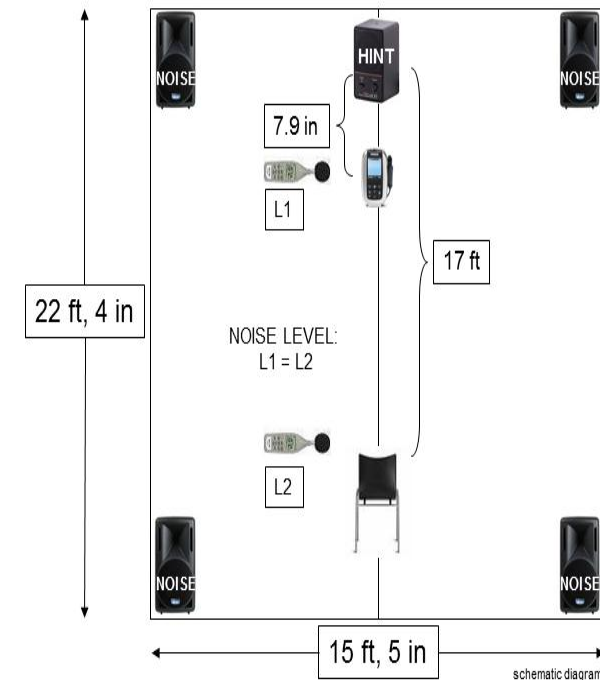
Roger Technology

Does it work for cochlear implant users?

What about hearing aid users?

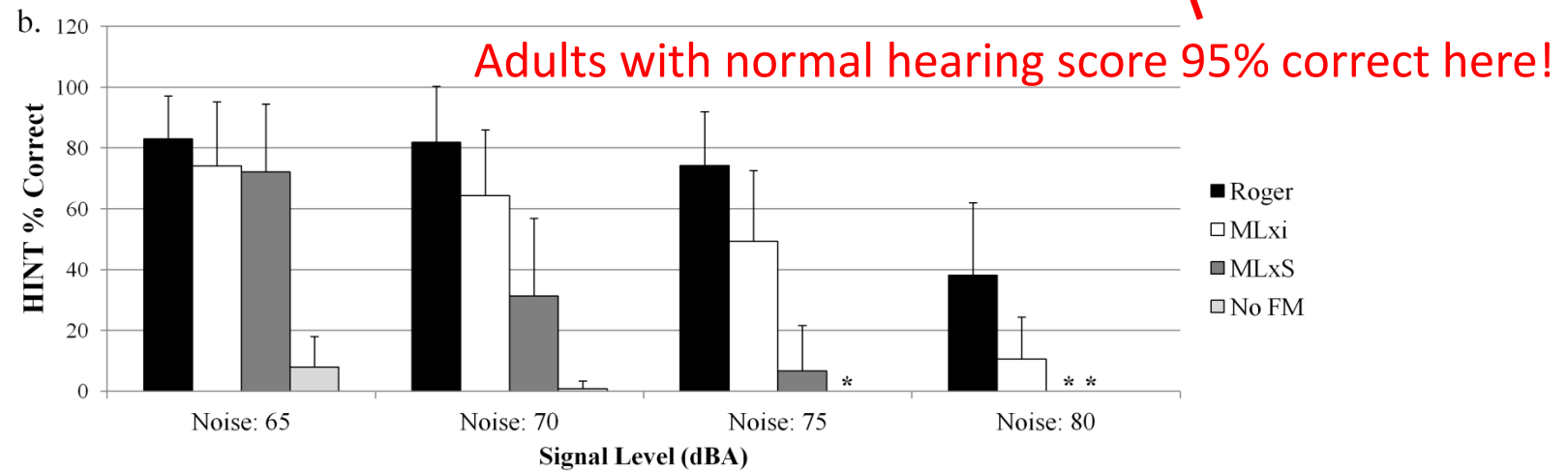
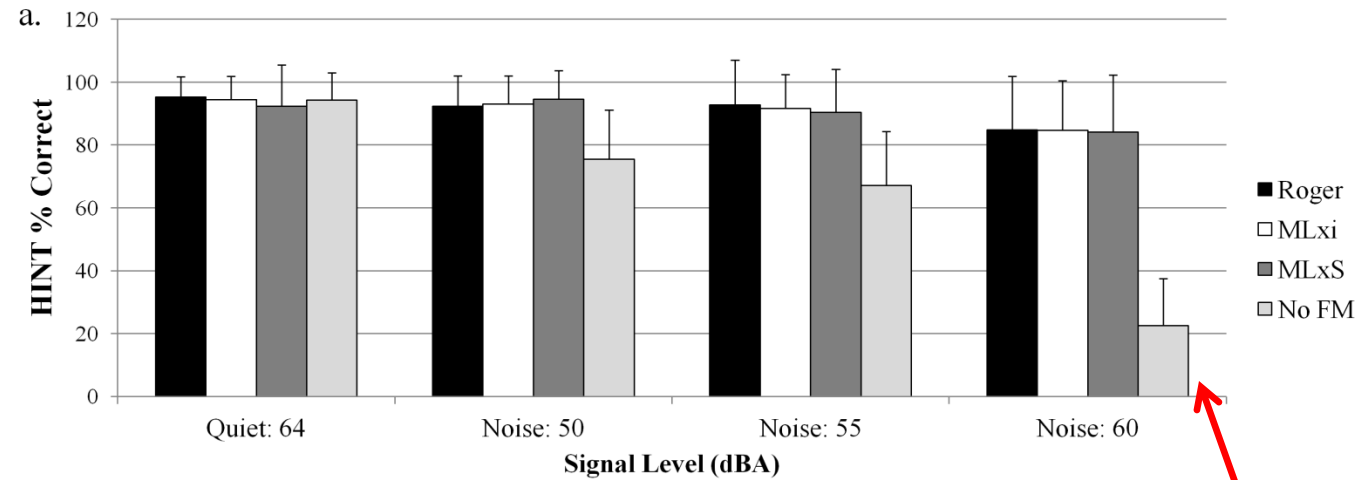
Study Objectives

- Evaluate speech recognition in quiet and in noise with speech (HINT) at 85 dBA at transmitter and classroom noise at 50, 55, 60, 65, 70, 75, 80 dBA
- Evaluated 3 RF remote microphone systems:
 - Fixed-gain FM – MLxS
 - Adaptive FM – MLxi
 - Digital RF – Roger
- Ensure consistency of signal and a lack of interference.



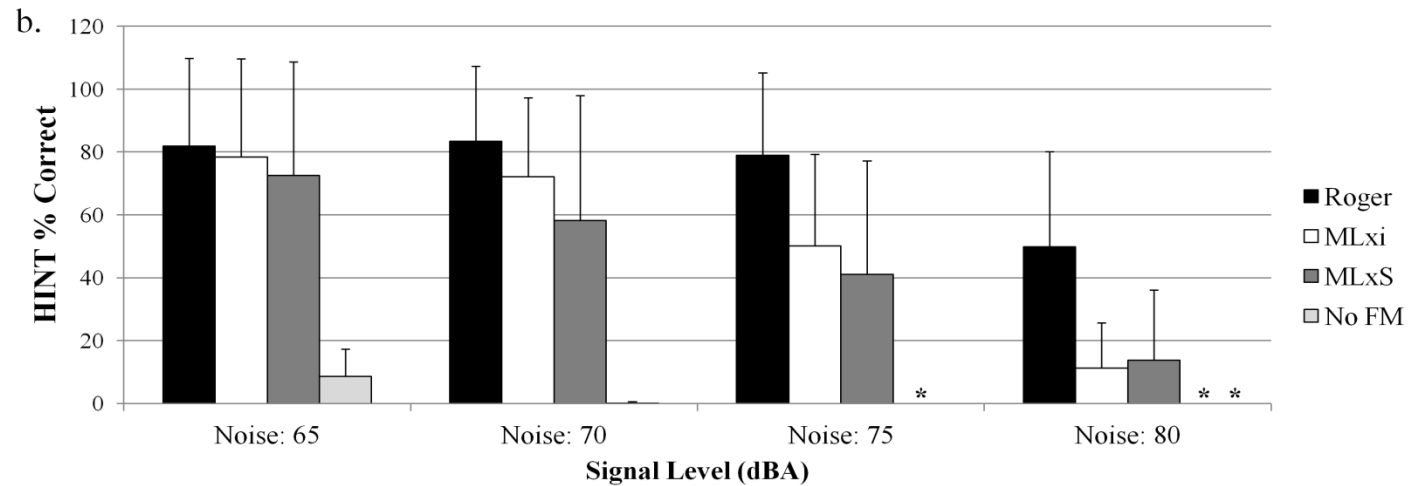
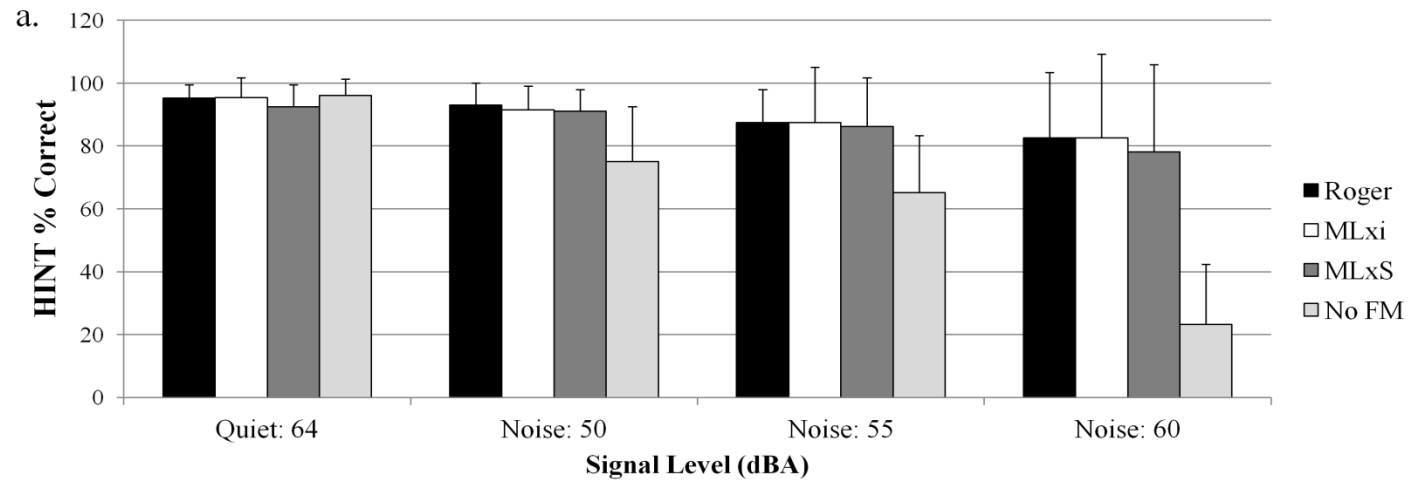
Results

Advanced Bionics Recipients (n = 16)

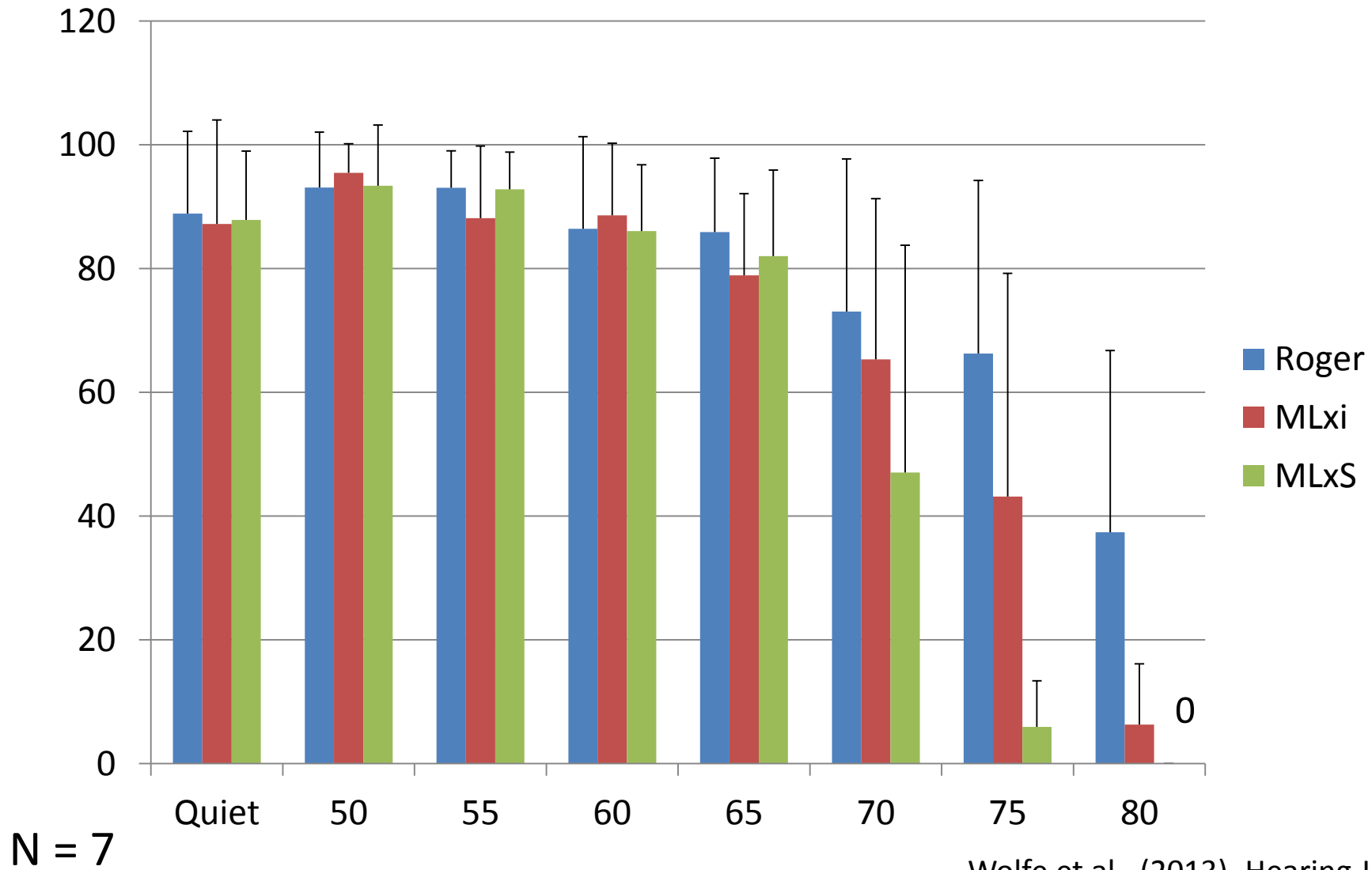


Results

Cochlear Recipients (n = 21)



MED-EL and Roger





What about hearing aids?

Speech Recognition Benefits of Digital Adaptive Broadband Wireless Transmission Technology

Linda M. Thibodeau

AAA, 2013

Annaheim, CA

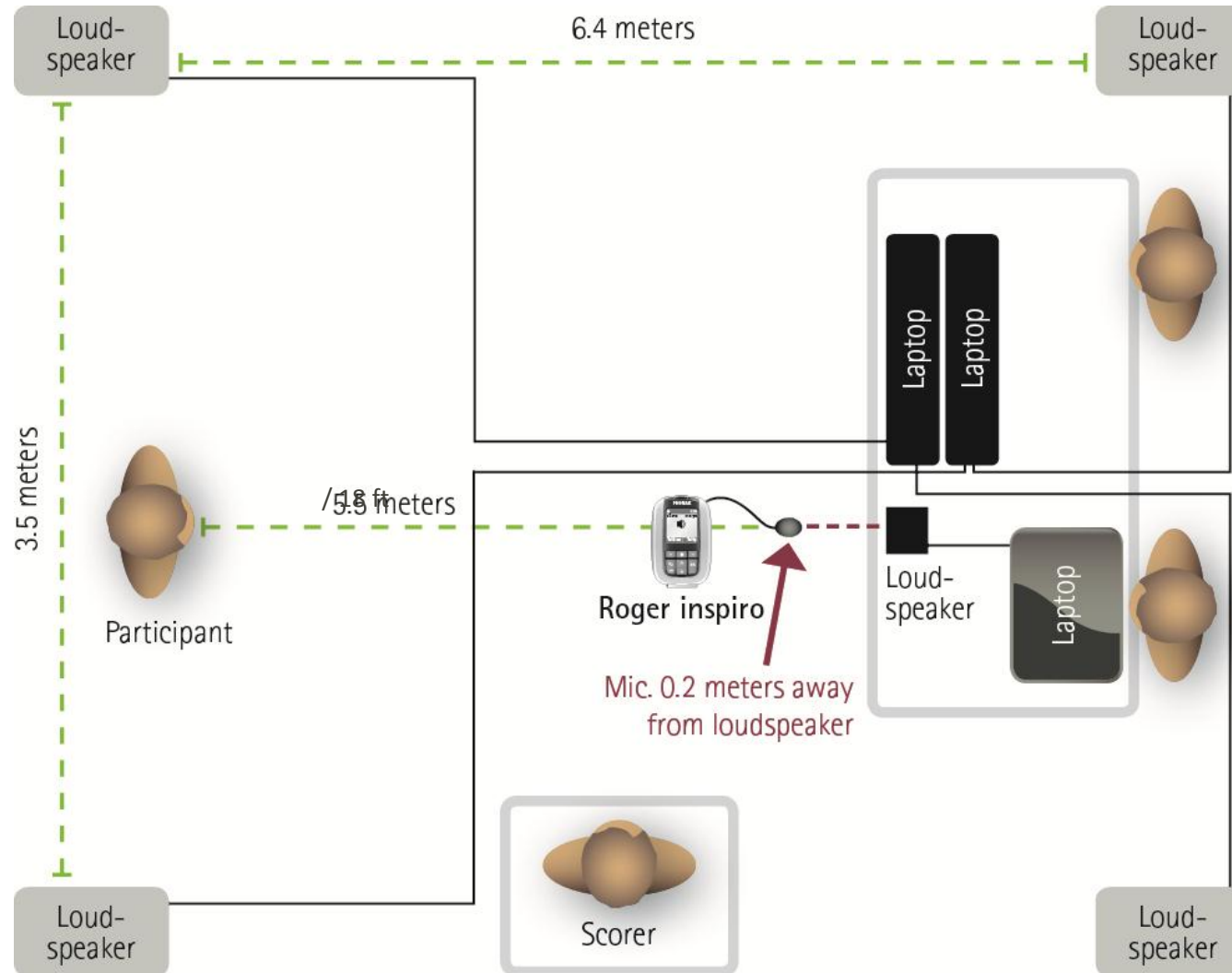
Research outline



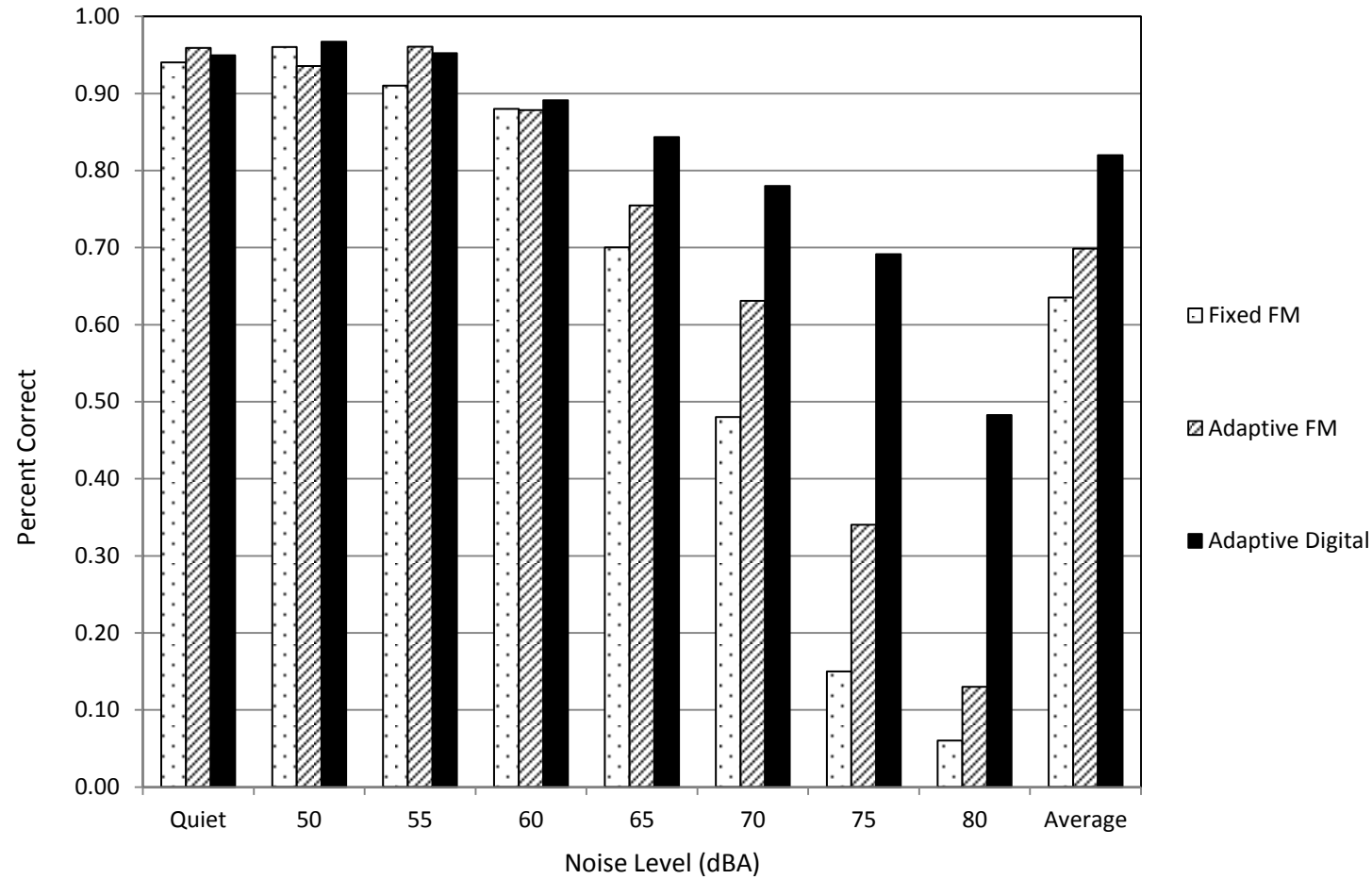
- Dr. Linda Thibodeau
- University of Texas at Dallas
- Speech in noise testing
- 11 listeners using their own BTE's
- Ages 15 to 78
- Traditional FM vs Dynamic FM vs Roger
- Randomized, blinded
- Different noise levels



The test set-up

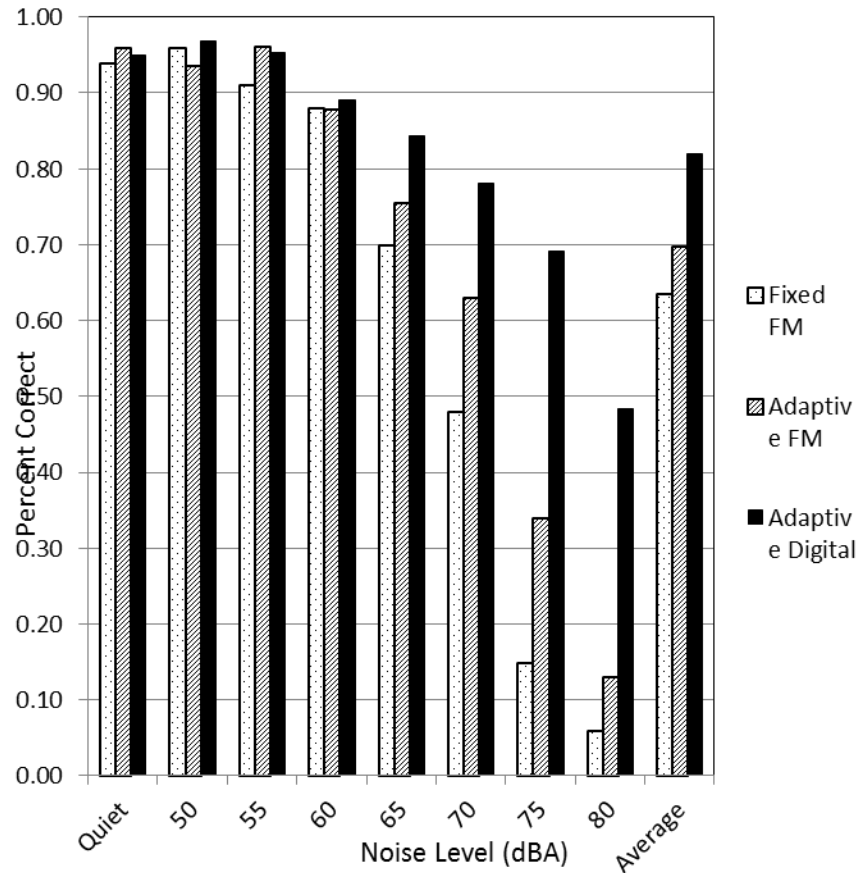


HINT Results (N=10)

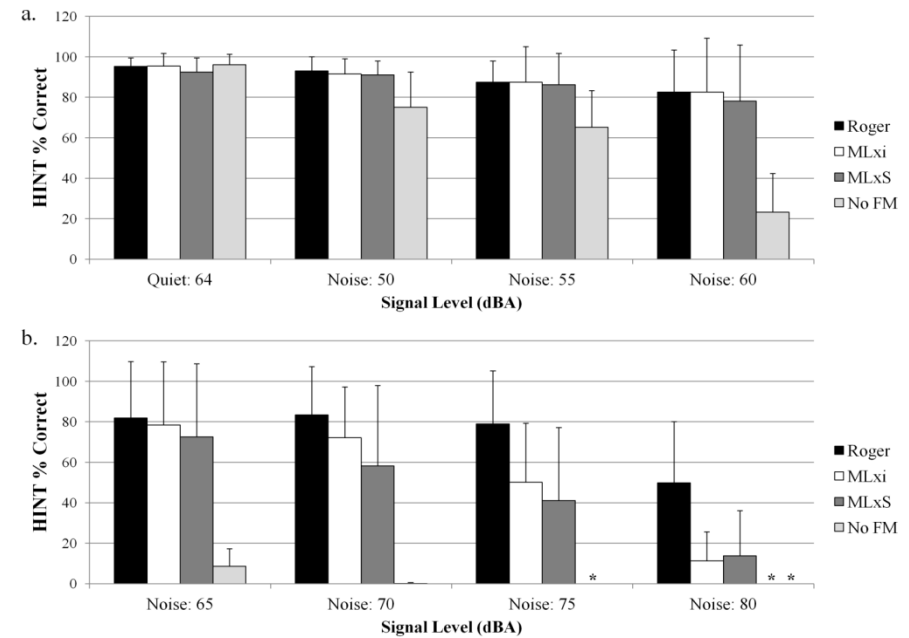


Hearing Aid & CI Users

Hearing Aids



Cochlear Implants



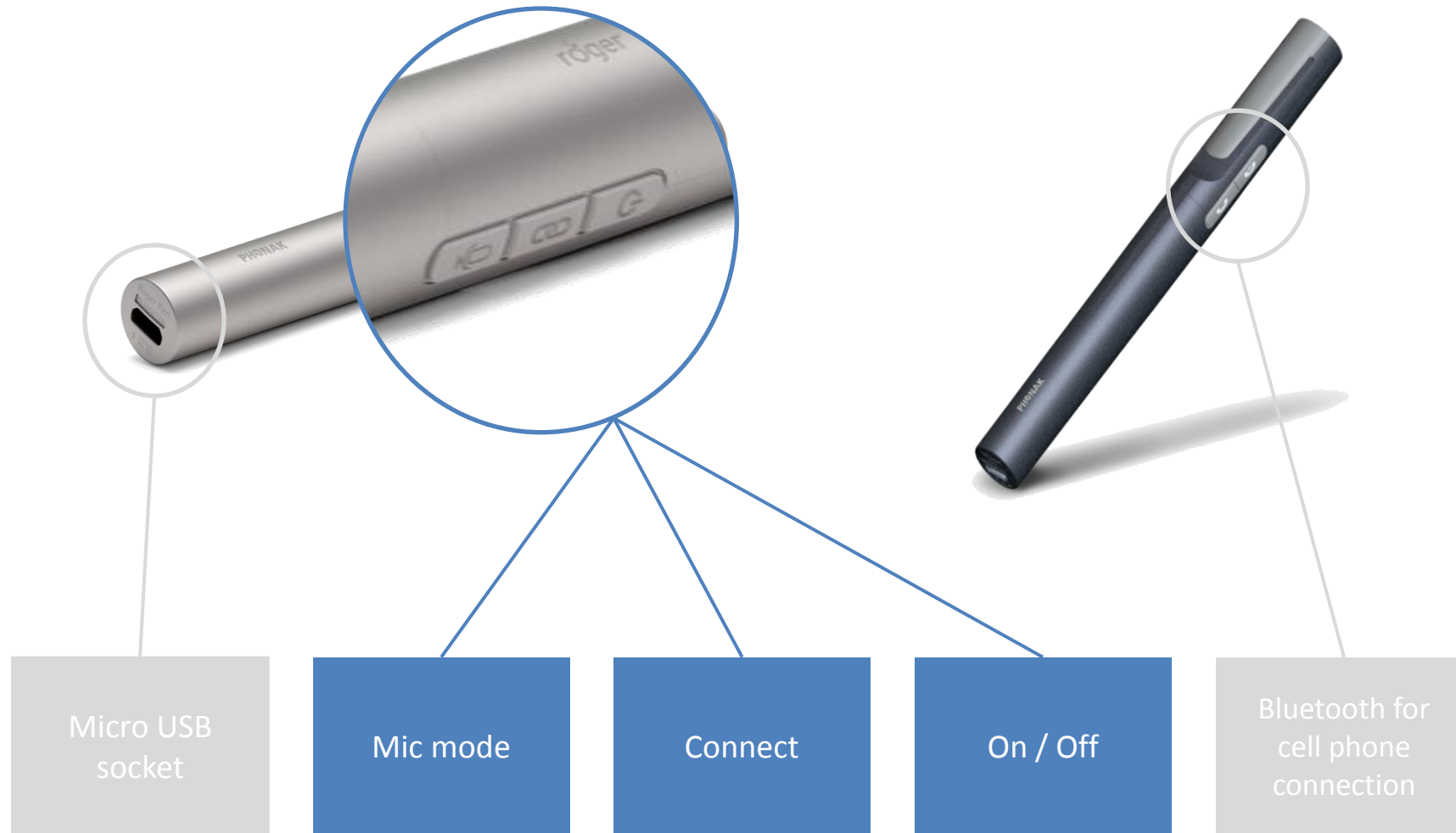
Roger Pen



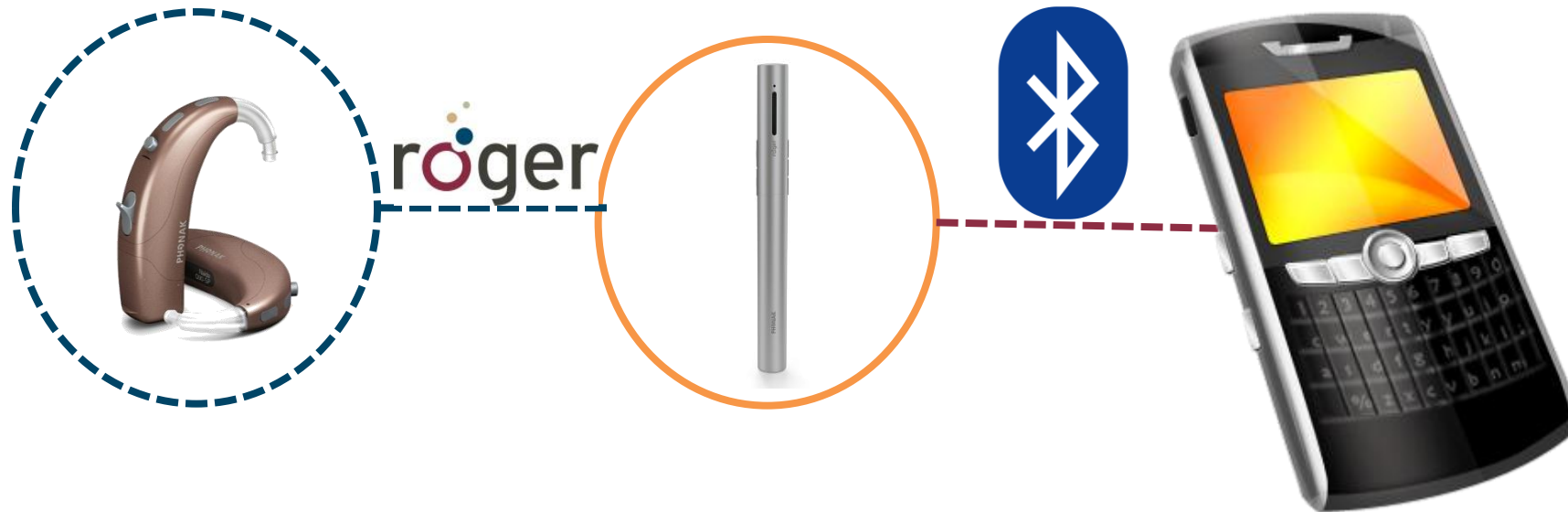
Roger Pen in detail



Roger Pen in detail



Wideband Bluetooth



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

How to use the Roger Pen

Interview
style



Hand held or
lanyard



Conference



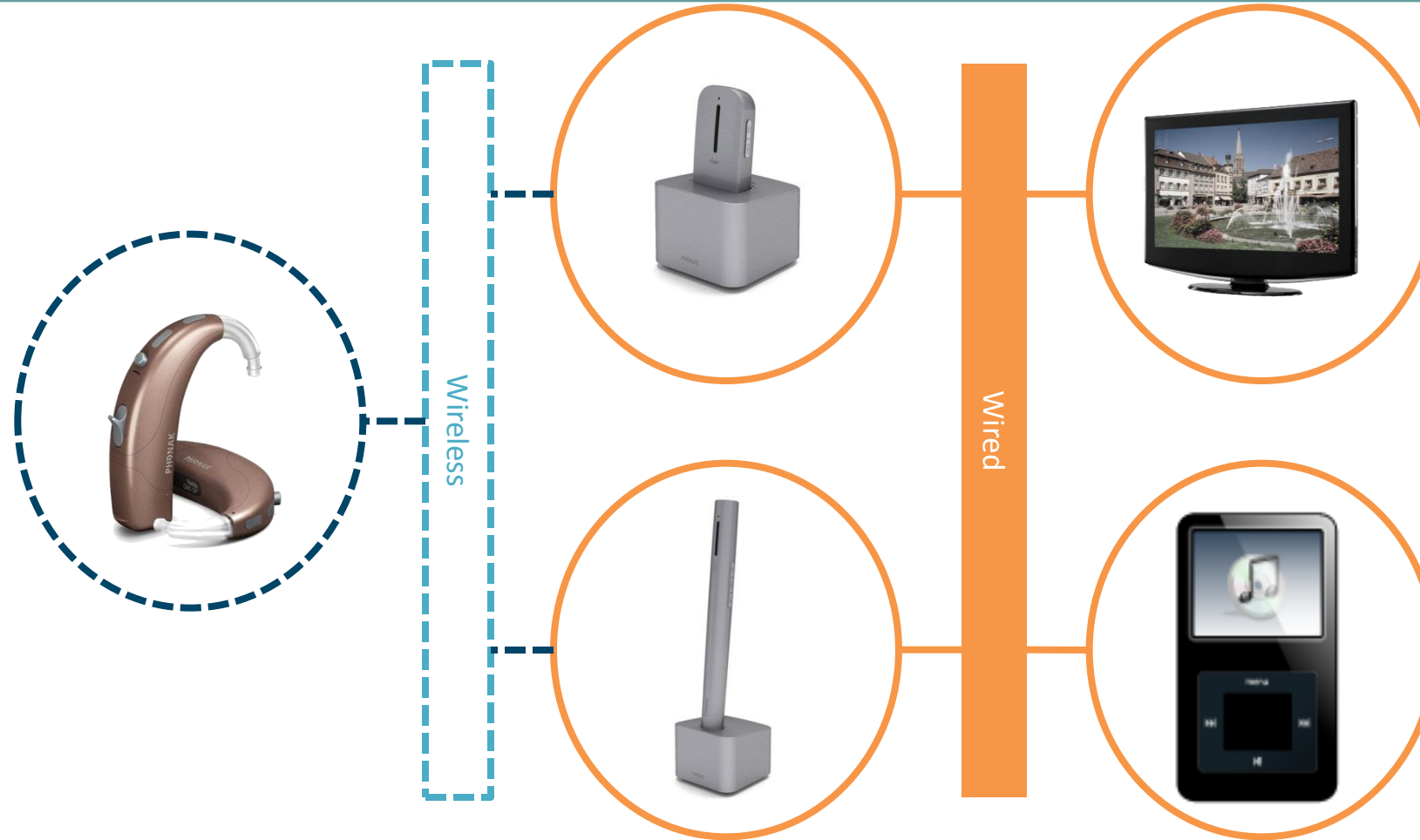
Roger Clip-On Mic



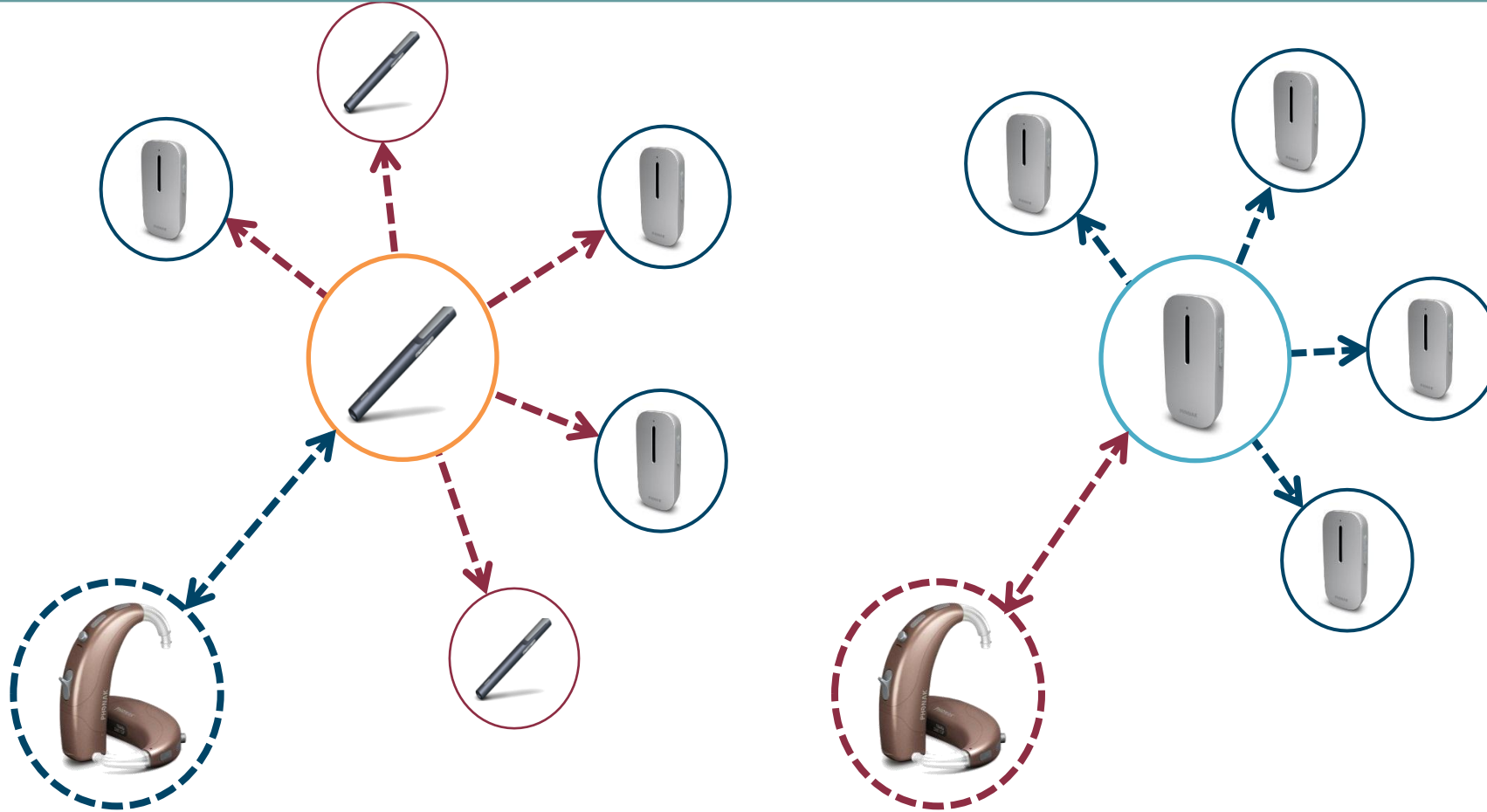
Best use for Clip-On Mic



Roger Pen and Clip-On Mic docking station



Forming a multi-talker network

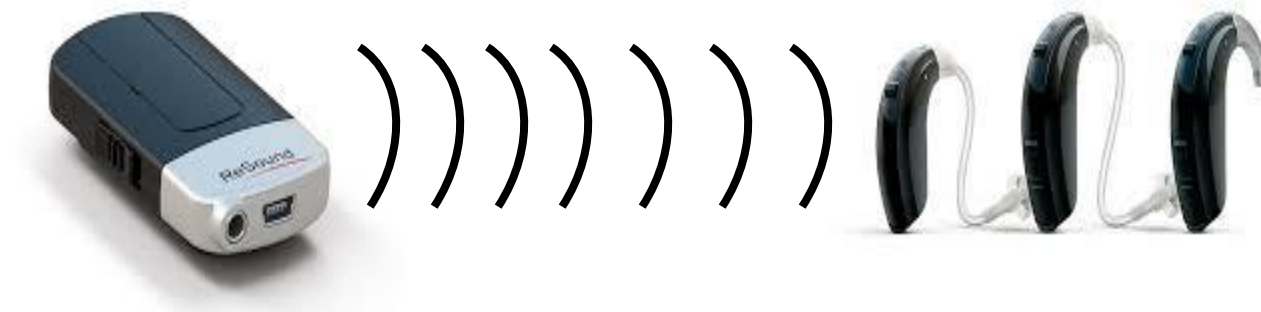


Design integrated Roger receivers for CI

- Roger 17



- What about Roger versus wireless streaming?



Technology

Phonak Bolero



Phonak Roger X



Resound Verso



Phonak Roger Pen

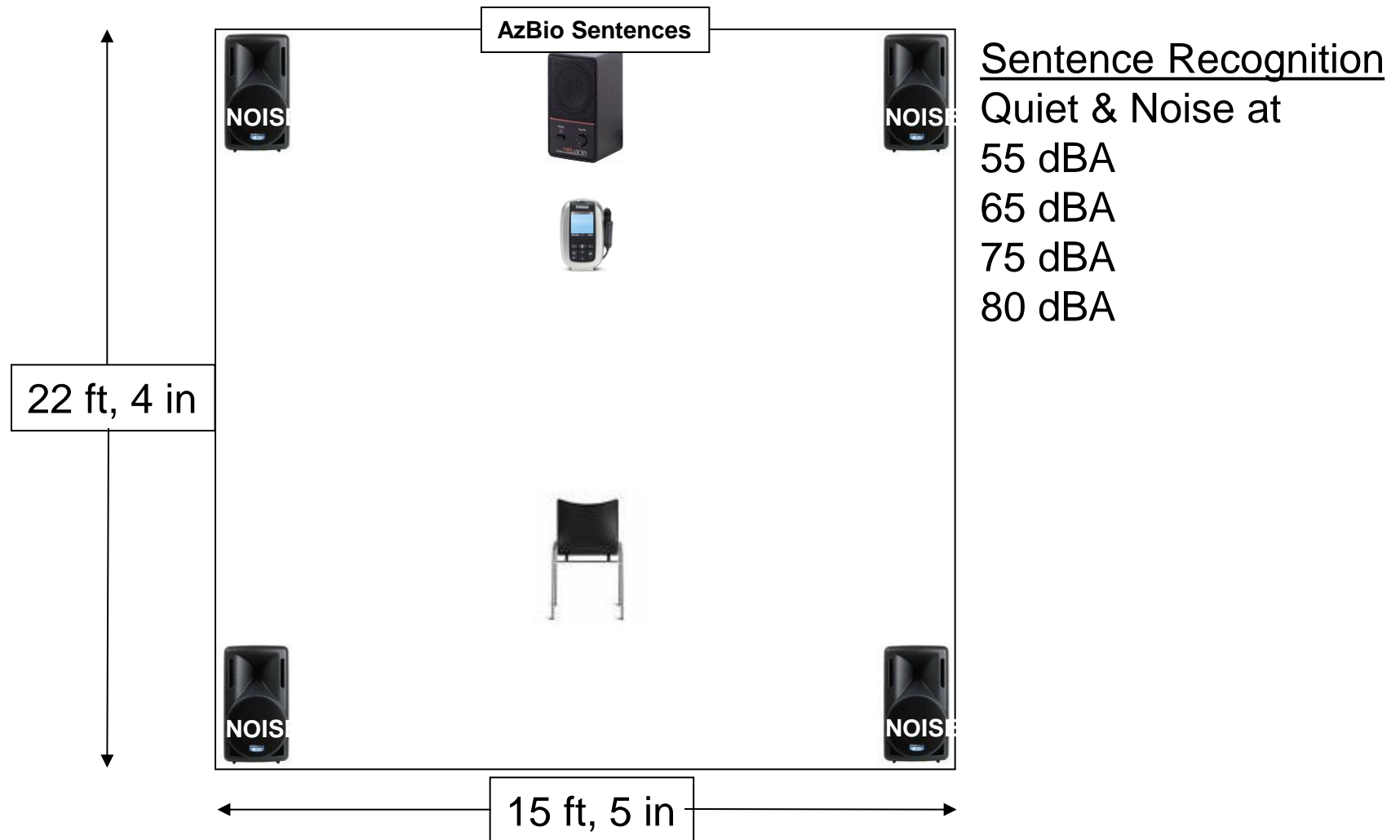


Resound Unite Mic

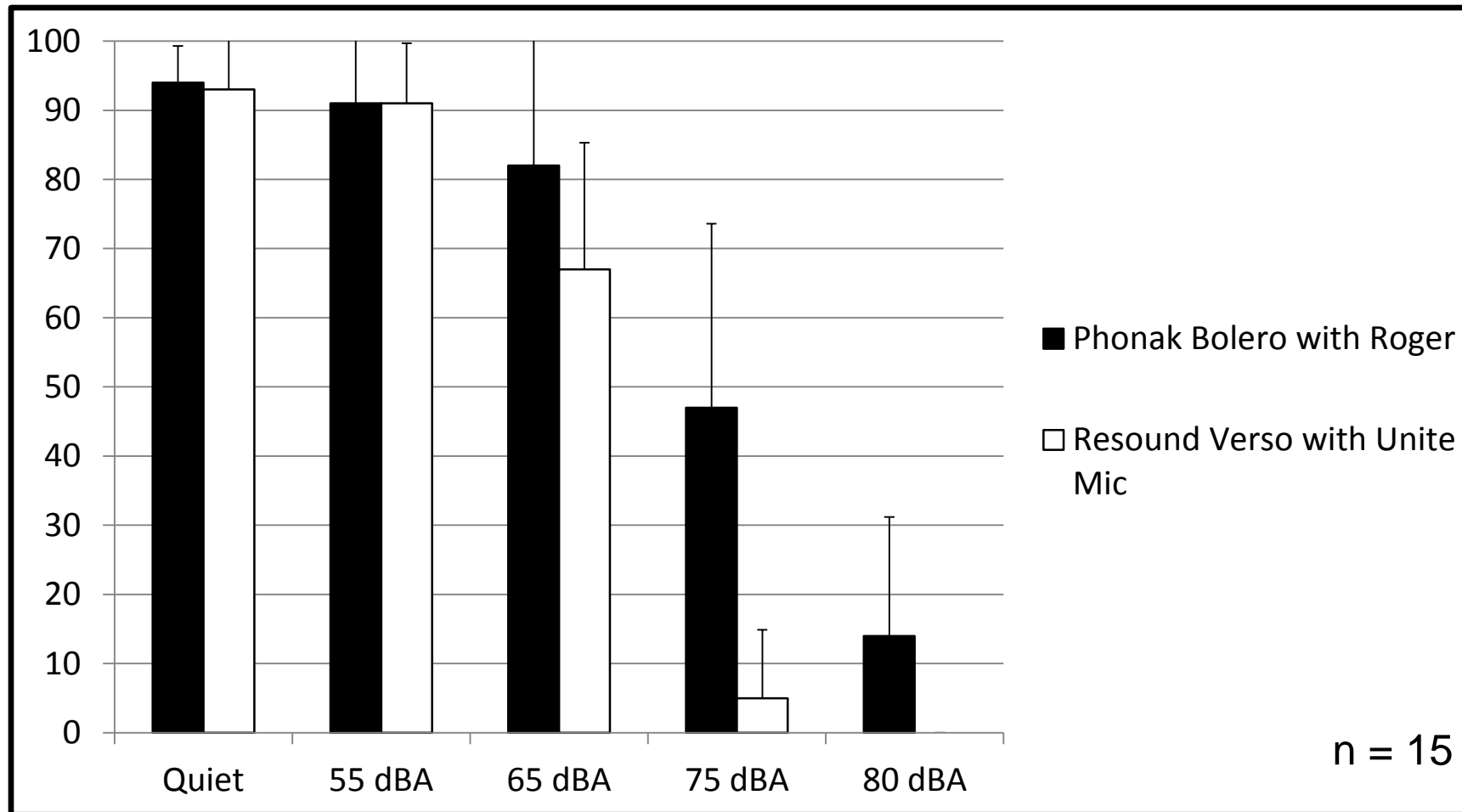


Evaluated sentence recognition both with and without wireless technology

Study of Wireless Technologies



Results



Conclusions/Clinical Implications

- Great outcomes are possible when we properly use the best hearing technology available today.
- Roger > Dynamic FM > Fixed-gain FM
- Roger likely beats wireless streaming because of adaptive increases in gain.
- Shoot for the moon!

Thank You for Your Attention!

