

# Evidence for the Use of FM Systems by Older Adults: A Randomized–Controlled Trial

Terry Hnath Chisolm

Hearing Care for Adults 2009

The Challenge of Aging

November 16–18, 2009

Chicago, IL

**This material is based upon work supported by the Department of Veterans Affairs, Veterans Health Administration, and Office of Research and Development, Rehabilitation Research and Development Service and, in part, by Phonak Corporation.**

# Acknowledgments




Rachel McArdle, Ph.D., Chief  
ASPS, Bay Pines VAHC, Bay  
Pines, Florida



Lynette Dornton, Au.D.  
Student, University of South  
Florida

# Acknowledgments

- ▶ This material is the result of work supported with resources and the use of facilities at the Bay Pines VA Healthcare System
  - ▶ Portions of this work were supported by Phonak Corporation
  - ▶ The contents do not represent the views of the Phonak Corporation and/or the Department of Veterans Affairs or the United States Government
- 

# Listening with the “Third” Ear: FM Systems (Ross, 2004)



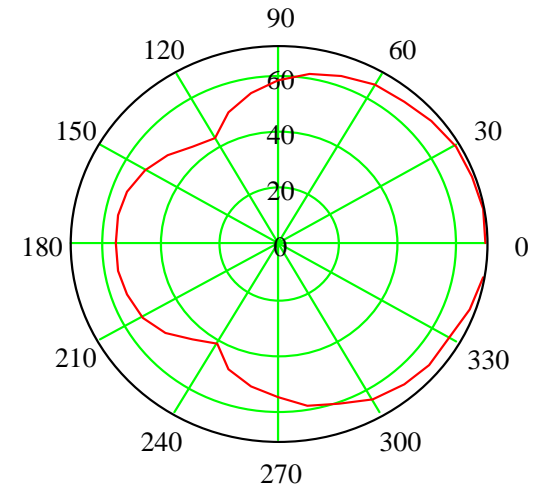
# Advances in Hearing Aid Technology

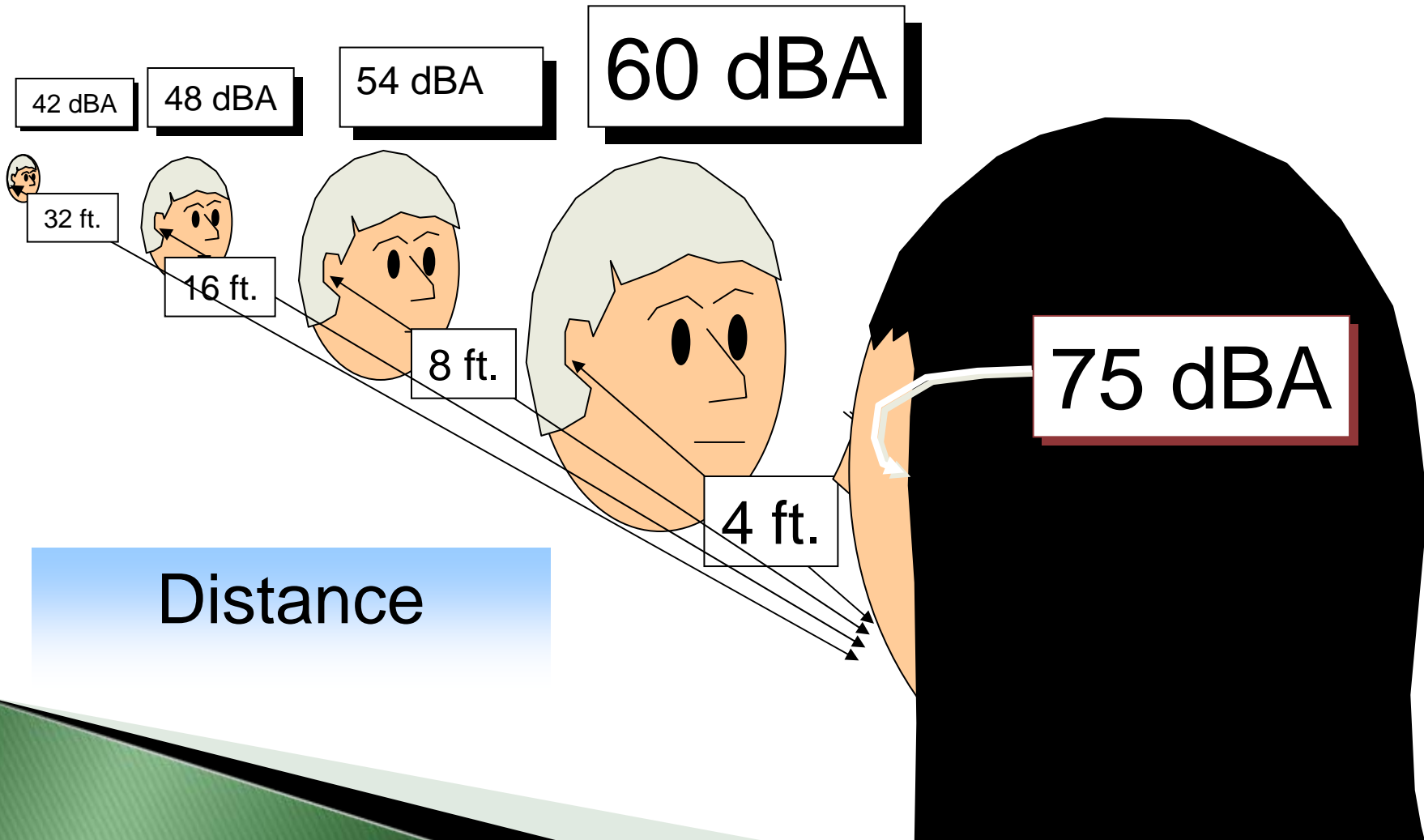


Digital Noise Reduction

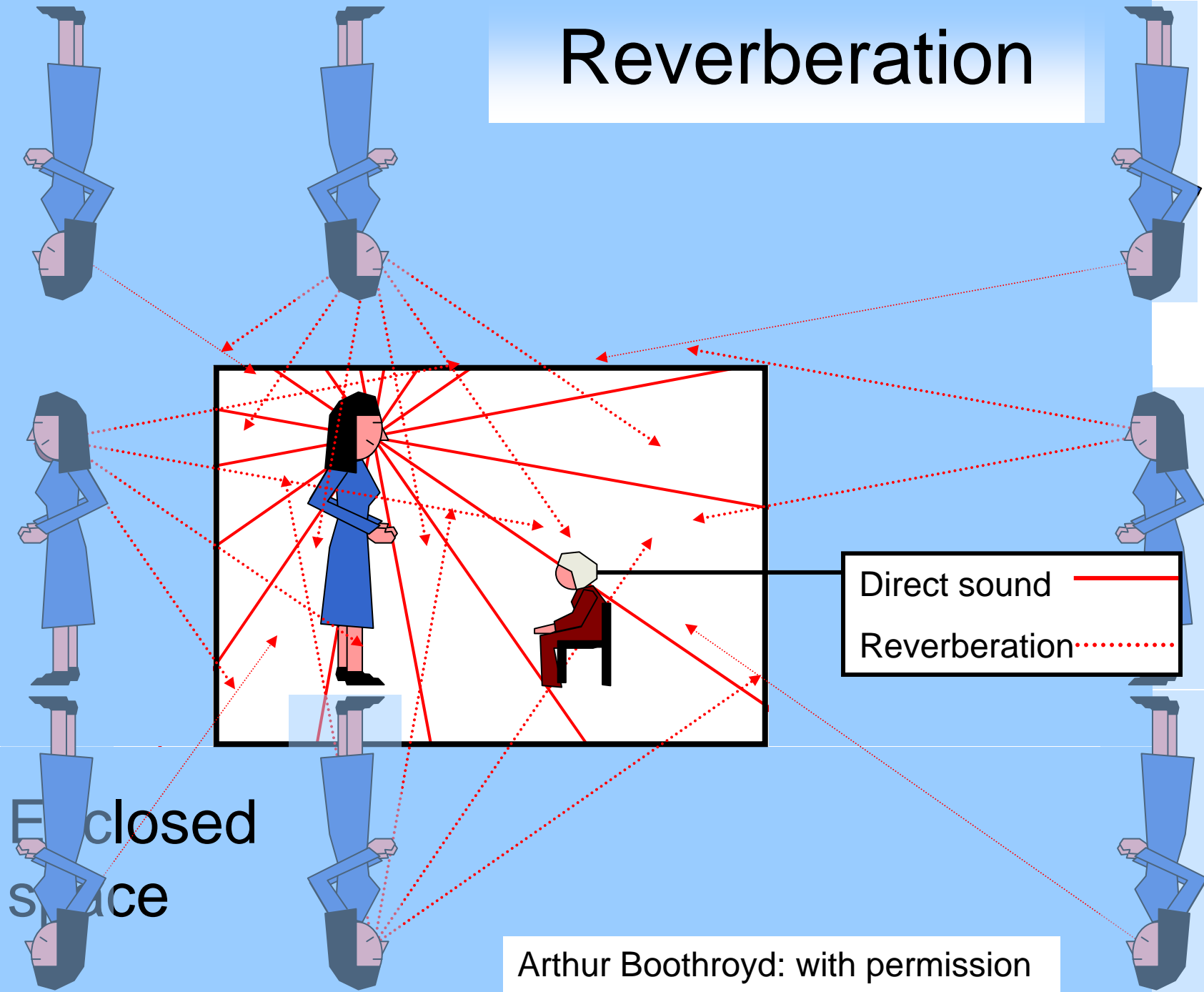


Directional Microphones

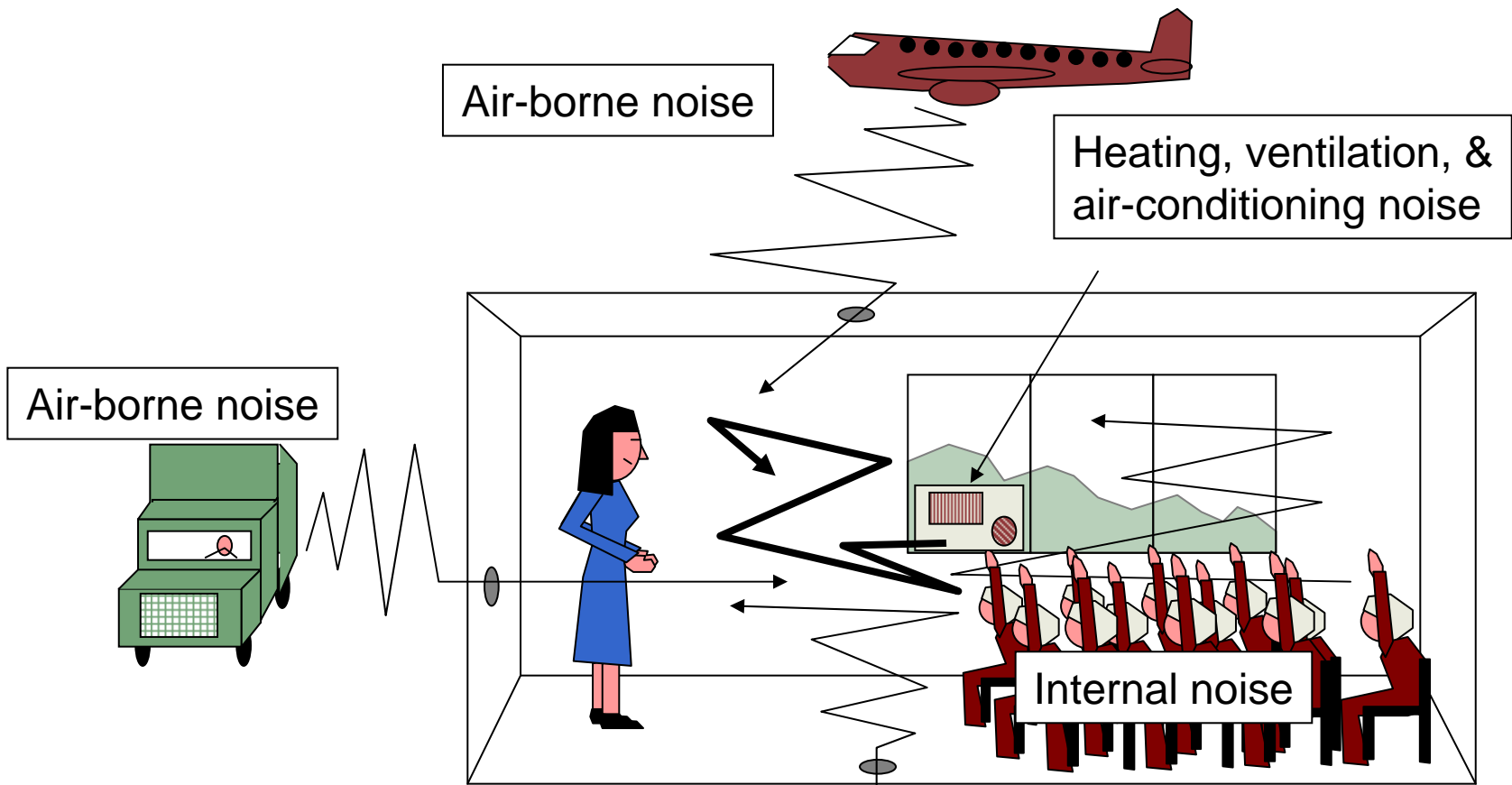




# Reverberation



Arthur Boothroyd: with permission



# Noise: External & Internal

Structure-borne noise



# Effects of Cognitive Aging

(e.g., Pichora-Fuller & Singh, 2006)



# Most common complaint older adults with hearing loss: Understanding Speech in Noise



# Dr. Ross – When 3<sup>rd</sup> Ear Helps (Ross, 2004)

## 1) With one companion in a noisy restaurant

- Mark's wife often reminds him to bring his FM when they go to a restaurant as it make life not only easier for him but also for her.



## 2) With another couple in a restaurant

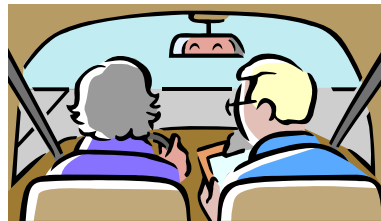
- FM must be placed in a strategic location, as close to everyone as possible. While far from perfect, it works better than trying to hear 3 other people with hearing aids alone.



# Dr. Ross – When 3<sup>rd</sup> Ear Helps (Ross, 2004)

## 3) Driving in a car

- Not a good idea to watch the lips of the speaker– Safety more important than communication.
- Use of FM system allows the passenger to talk to the driver without the driver taking his or her attention off the road.



# Dr. Ross – When 3<sup>rd</sup> Ear Helps (Ross, 2004)



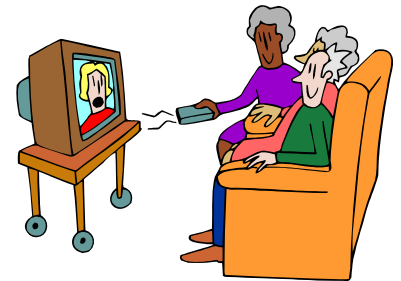
- 4) In a noisy group situation
- Handheld FM microphone best way for a hard hearing person to function tolerably
  - Takes a bit of assertiveness
  - Communication is a two-way street
  - Person with the hearing loss bears the greatest responsibility



# Dr. Ross – When 3<sup>rd</sup> Ear Helps (Ross, 2004)

## 5. Watching T.V.

- Both at home and while traveling
- Wife can read while Mark watches T.V.

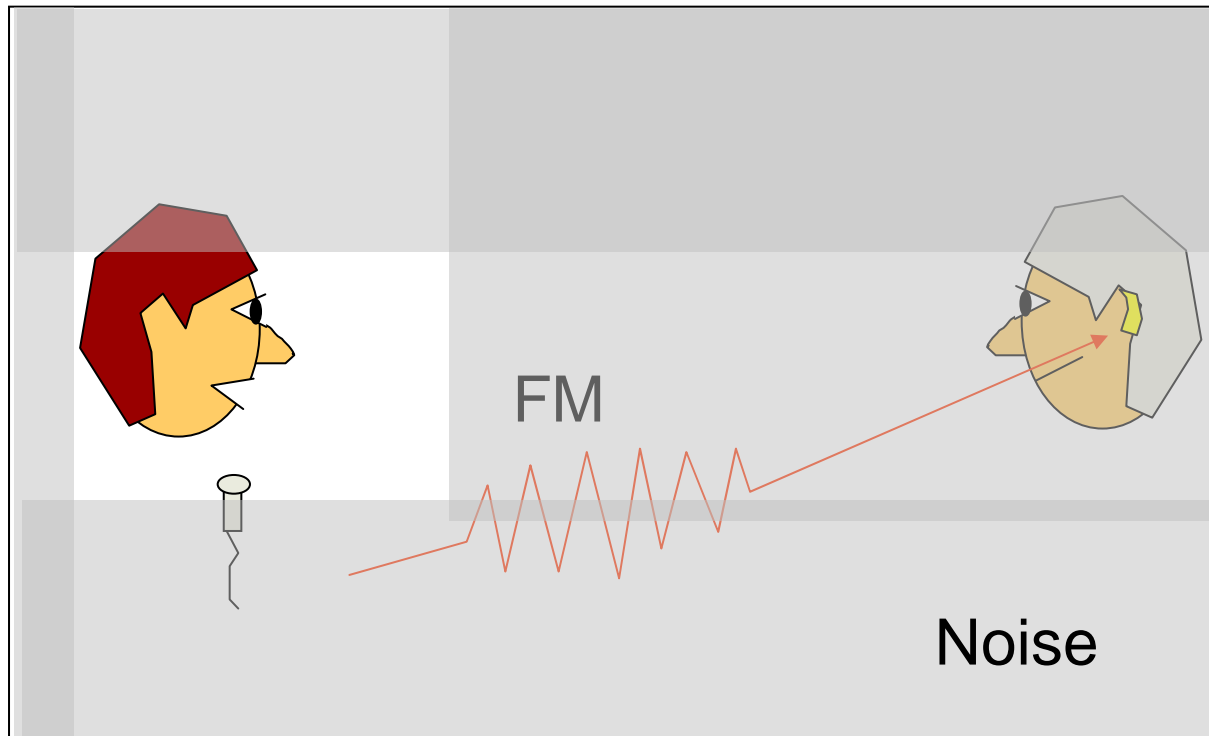


## 6. Many other situations:

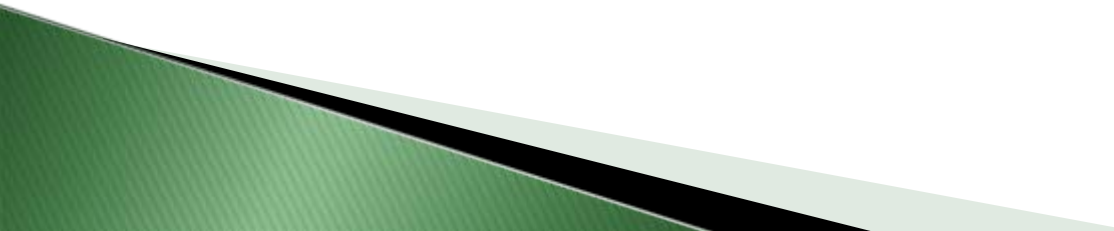
- Small meetings
- Walking down street in noisy city
- Lectures
- Tours
- Etc.

# A 3<sup>rd</sup> Ear: An FM System

Viable Solution for Listening Needs of Adults with Hearing Loss (e.g., Chisolm et al., 2007)



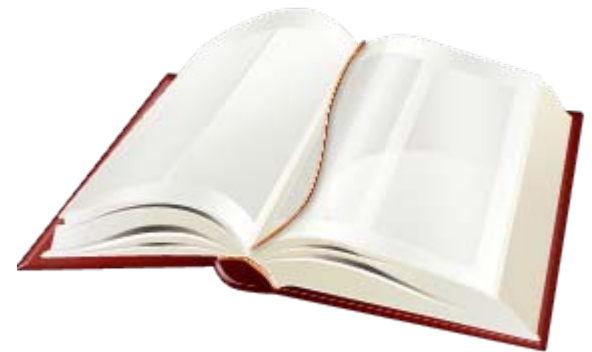
# Questions re: FM Intervention

- ▶ Are outcomes of FM use better than outcomes for hearing aid alone use in older adults?
  - ▶ Does age influence outcomes of FM use?
- 



# Address Questions

- ▶ Exploratory re-examination of data from:
  - Dornton, L. (2009). *Outcomes of FM use in adults with custom hearing aids*. Unpublished Doctor of Audiology Project, University of South Florida.



# Participants ( $n = 36$ )

- ▶ All males recruited from Bay Pines VAHC
- ▶ Experienced hearing aid users (at least 1-month with current custom hearing aids)
  - (D-mics and t-Coils)
- ▶ Reporting a problem FM may assist

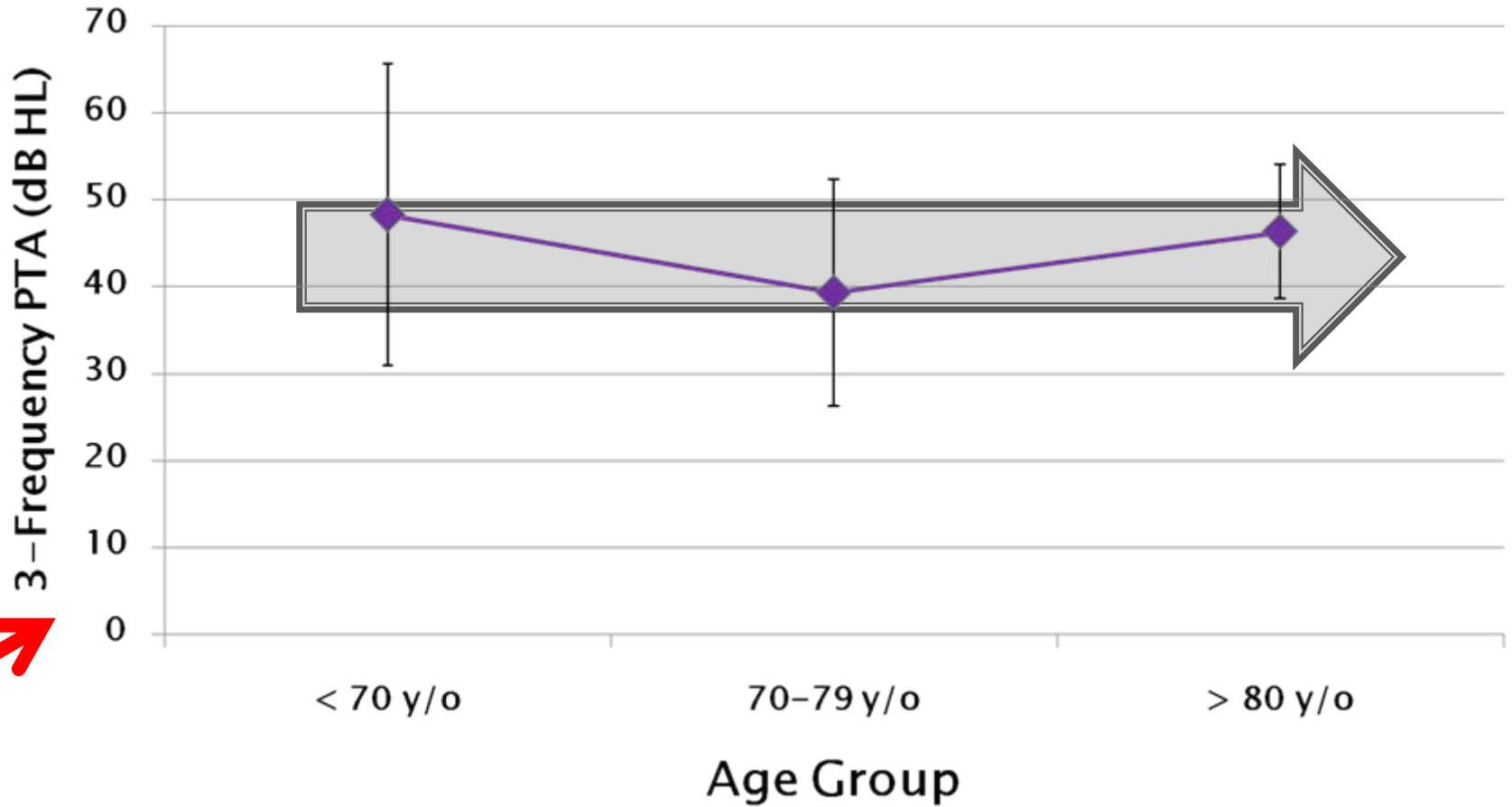
# Participants ( $n = 36$ )

- ▶ Randomly assigned
  - Hearing Aids Alone (HA;  $n = 18$ )
  - Hearing Aids + FM (HA+FM;  $n = 18$ )
  
- ▶ Age Range: 53–85 y/o
  - HA-Only: Mean = 76.6 y/o (SD = 6.8)
  - HA+FM: Mean = 72.5 y/o (SD = 9.5)

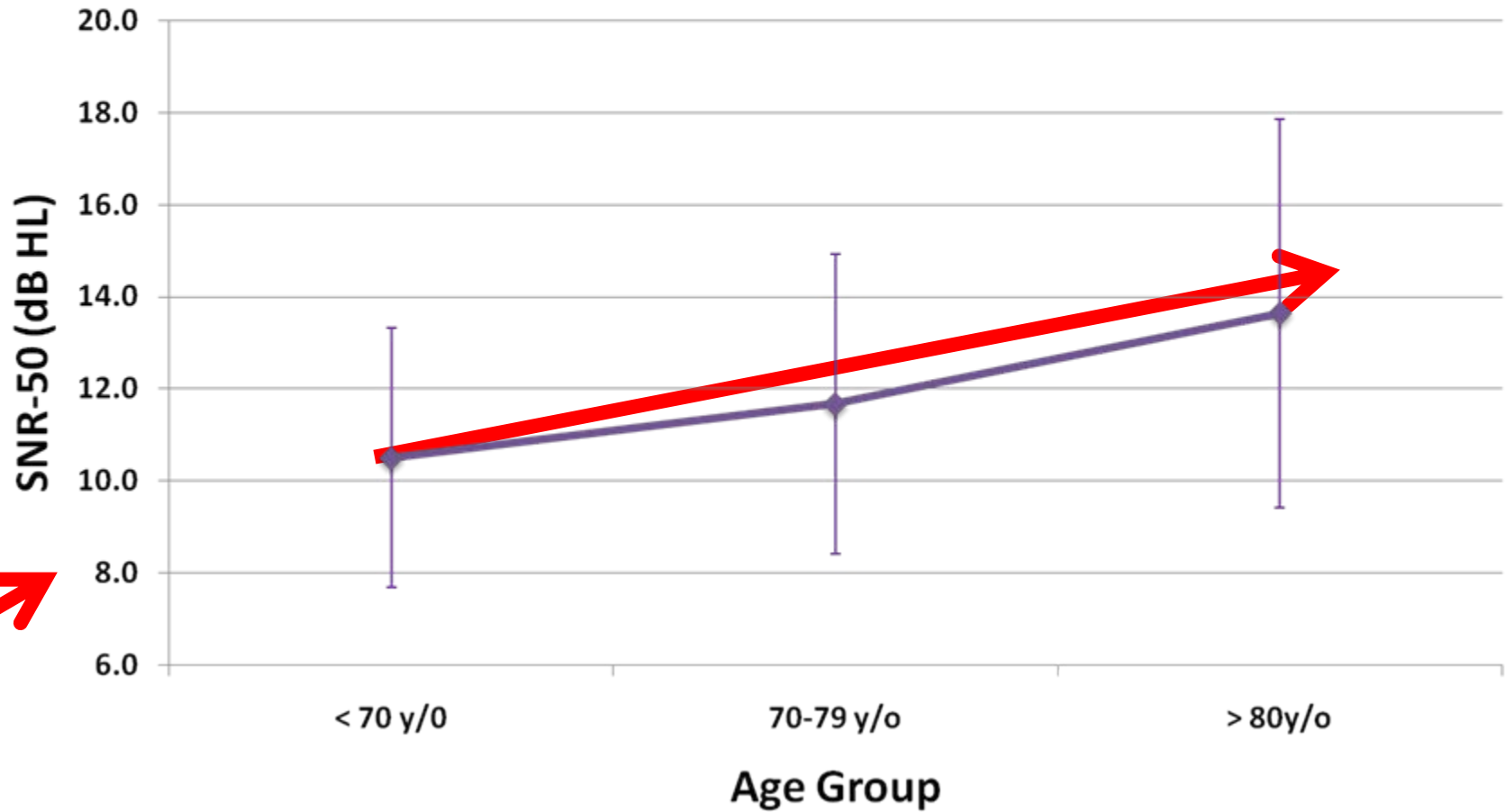
# 3 Age Groups

- ▶ **< 70 y/o** ( $n = 8$ )
  - HA-alone ( $n = 3$ )
  - HA+ FM ( $n = 5$ )
- ▶ **70–79 y/o** ( $n = 16$ )
  - HA-Alone ( $n = 7$ )
  - HA+FM ( $n = 9$ )
- ▶ **> 80 y/o** ( $n = 12$ )
  - HA-Alone ( $n = 8$ )
  - HA+FM ( $n = 4$ )

# Hearing Loss as a Function of Age Group



# SNR-50 as a Function of Age Group



# Devices



Hearing Aids

<b>Hearing Aids</b>	<b>Number</b>
INTERTON INSTINCT NS30 ITC	1
INTERTON INSTINCT NS40 HS 4	4
INTERTON INSTINCT NS60 FS	1
MICRO-TECH RADIUS 12 HS 4	4
MICRO-TECH RADIUS 12 ITC	1
MICRO-TECH RADIUS 12 ITE 3	3
MICRO-TECH RADIUS 16 HS 2	2
MICRO-TECH RADIUS 16 ITE 3	3
PHONAK CLARO HS	1
PHONAK PERSEO 23 DAZ HS 3	3
PHONAK SAVIA 33 DSZ FS 3	3
SIEMENS ARTIS ITC	1
SIEMENS ARTIS HS	1
SIEMENS MUSIC D FS	1
SIEMENS TRIANO HS	1
SIEMENS TRIANO ITC	1
SIEMENS TRIANO ITE 3	3
STARKEY DESTINY 1600 ITE	1
UNITRON EVO FS	1
<b>Total</b>	<b>36</b>



# FM System

MyLink



- ▶ The MyLink– FM receiver which uses induction loop technology to interface with any hearing aid containing a telecoil

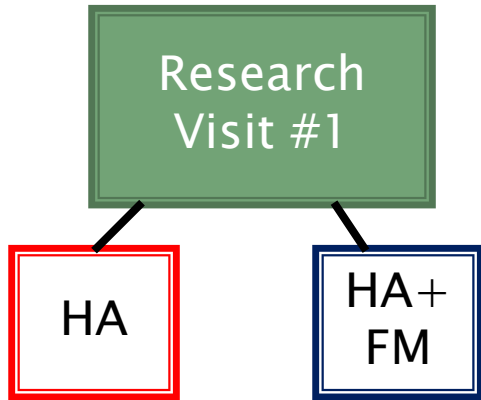
ZoomLink



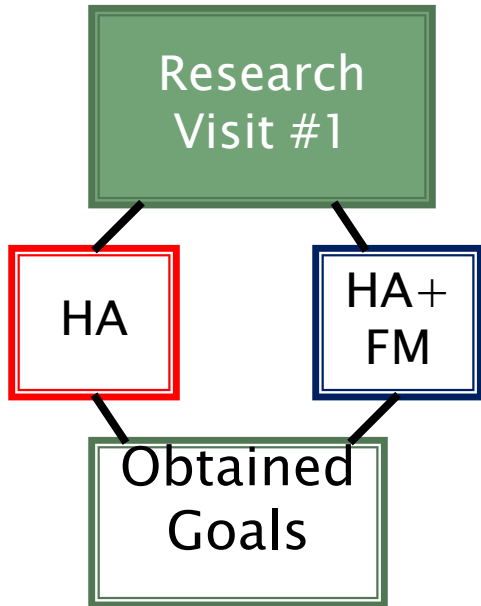
- ▶ ZoomLink– FM transmitter with Omni-Zoom– and SuperZoom capabilities

# Procedure (2 visits)

# Procedure (2 visits)



# Procedure (2 visits)



# Client Oriented Scale Of Improvement



Name : \_\_\_\_\_

Audiologist : \_\_\_\_\_

Date : 1. Needs Established \_\_\_\_\_

2. Outcome Assessed \_\_\_\_\_

## Degree of Change

## Final Ability

Person can hear

10% 25% 50% 75% 95%

### SPECIFIC NEEDS

Category New \_\_\_\_\_  
Return \_\_\_\_\_

Indicate Order of Significance

Able to hear and understand the wife while at a restaurant

Understand T.V. at a level that is comfortable for wife

Able to understand wife when she is driving the car.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Worse	No Difference	Slightly Better	Better	Much Better	CATEGORY	Final Ability				
						Hardly Ever	Occasionally	Half the Time	Most of the Time	Almost Always



- Categories
1. Conversation with 1 or 2 in quiet
  2. Conversation with 1 or 2 in noise
  3. Conversation with group in quiet
  4. Conversation with group in noise
  5. Television/Radio @ normal volume
  6. Familiar speaker in phone
  7. Unfamiliar speaker on phone
  8. Hearing phone ring from another room
  9. Hear front door bell or knock
  10. Hear traffic
  11. Increased social contact
  12. Feel Embarrassed or stupid
  13. Feeling left out
  14. Feeling upset or angry
  15. Church or meeting
  16. Other

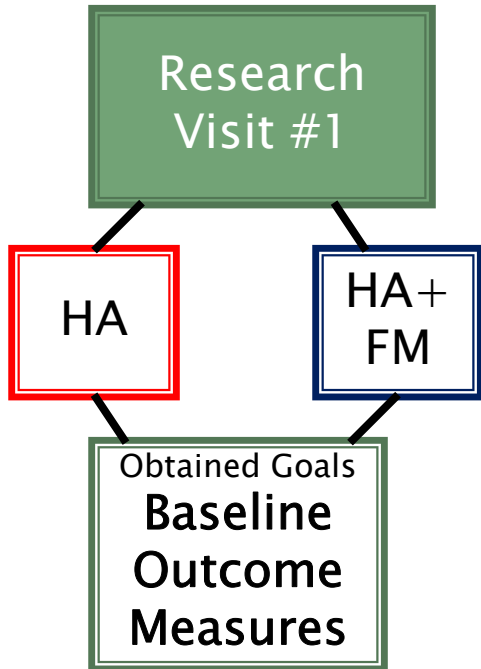
# Percentage of COSI Goals Per Category, Age, & Intervention

Age Group	< 70		70-79		80+	
	HA	HA+FM	HA	HA+FM	HA	HA+FM
1 or 2 Quiet		7.1%	5.0%		4.5%	
1 or 2 Noise	12.5%	14.3%	15.0%	16.0%	18.2%	18.2%
Group Quiet	12.5%			4.0%		
Group Noise	50.0%	28.6%	50.0%	32.0%	36.4%	18.2%
TV/Radio	12.5%	21.4%	20.0%	24.0%	13.6%	36.4%
Telephone					4.5%	
Meeting	12.5%	28.6%	10.0%	4.0%	4.5%	9.1%
Other				20.0%	18.2%	18.2%

# COSI Goals Per Category

Age Group	< 70		70-79		80+	
	HA	HA+FM	HA	HA+FM	HA	HA+FM
1 or 2 Quiet		7.1%	5.0%		4.5%	
1 or 2 Noise	12.5%	14.3%	15.0%	16.0%	18.2%	18.2%
Group Quiet	12.5%			4.0%		
Group Noise	50.0%	28.6%	50.0%	32.0%	36.4%	18.2%
TV/Radio	12.5%	21.4%	20.0%	24.0%	13.6%	36.4%
Telephone					4.5%	
Meeting	12.5%	28.6%	10.0%	4.0%	4.5%	9.1%
Other				20.0%	18.2%	18.2%

# Procedure (2 visits)

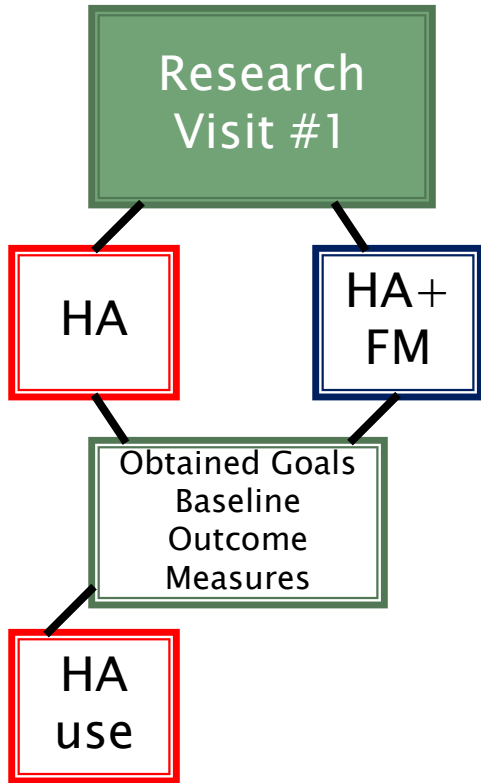




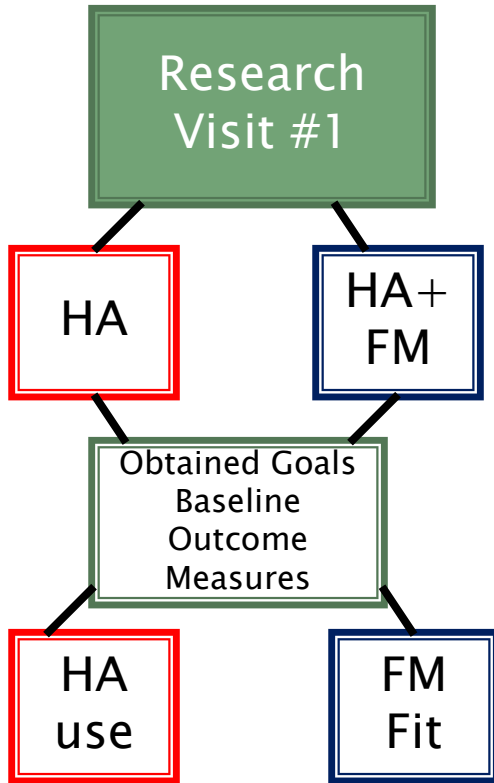
# Outcomes

- ▶ Ability to meet individualized goals of device use (Client Oriented Scale of Improvement; COSI; Dillon et al., 1997)
- ▶ Satisfaction with devices (MarkeTrak; Kochkin, 1990)
- ▶ Benefit in terms of self-perception of reductions in restrictions in auditory abilities (Speech, Spatial, & Qualities Questionnaire, SSQ; Gatehouse & Noble, 2004)

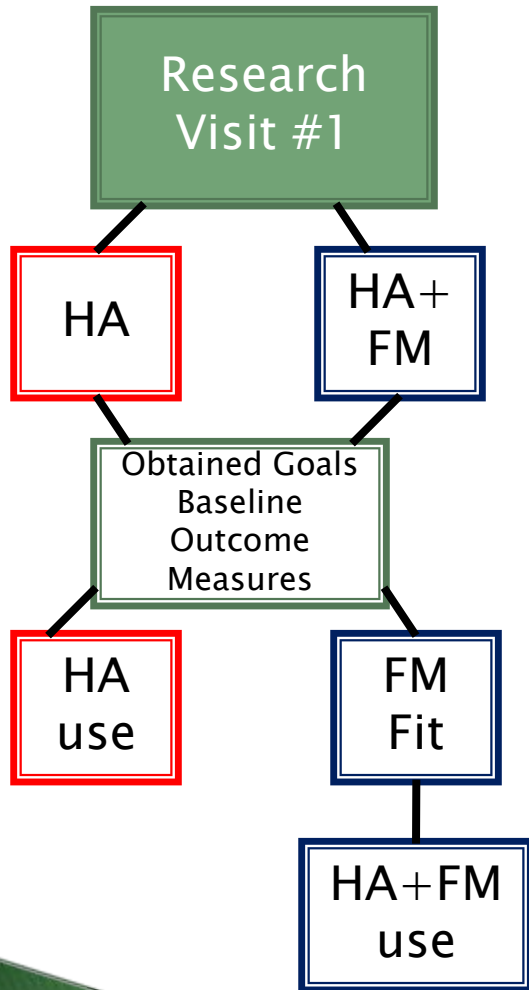
# Procedure (2 visits)



# Procedure (2 visits)



# Procedure (2 visits)



# Critical Component in FM Intervention

**Systematic Counseling, coaching, and instruction (30-45 min)  
(Chisolm et al, 2007)**



# Individualized Instructions

- ▶ Oral
- ▶ Written



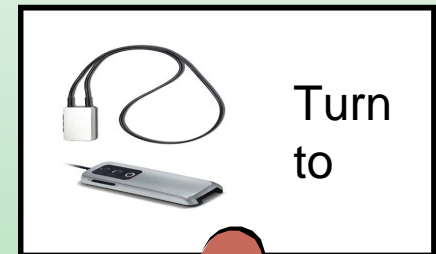
# Role-playing

- ▶ Demonstrate appropriate use of devices for various listening situations



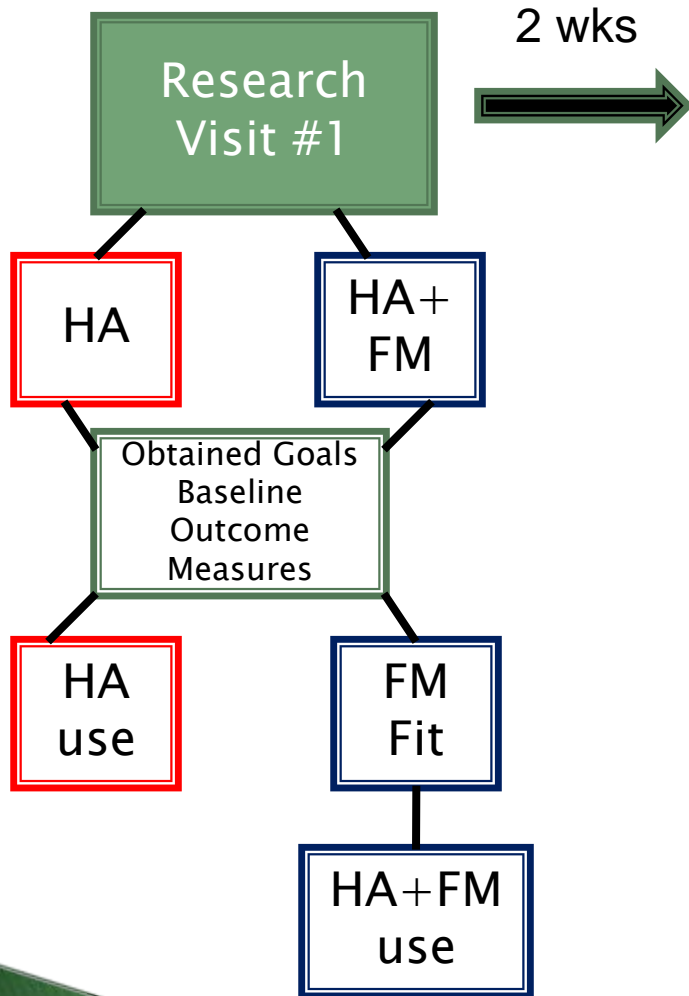
# Graphic Support

- ▶ Helps the patient remember instrument system options and settings.
- ▶ Easily carried in a pocket
- ▶ Quick reference guide
- ▶ Reduces new user frustrations

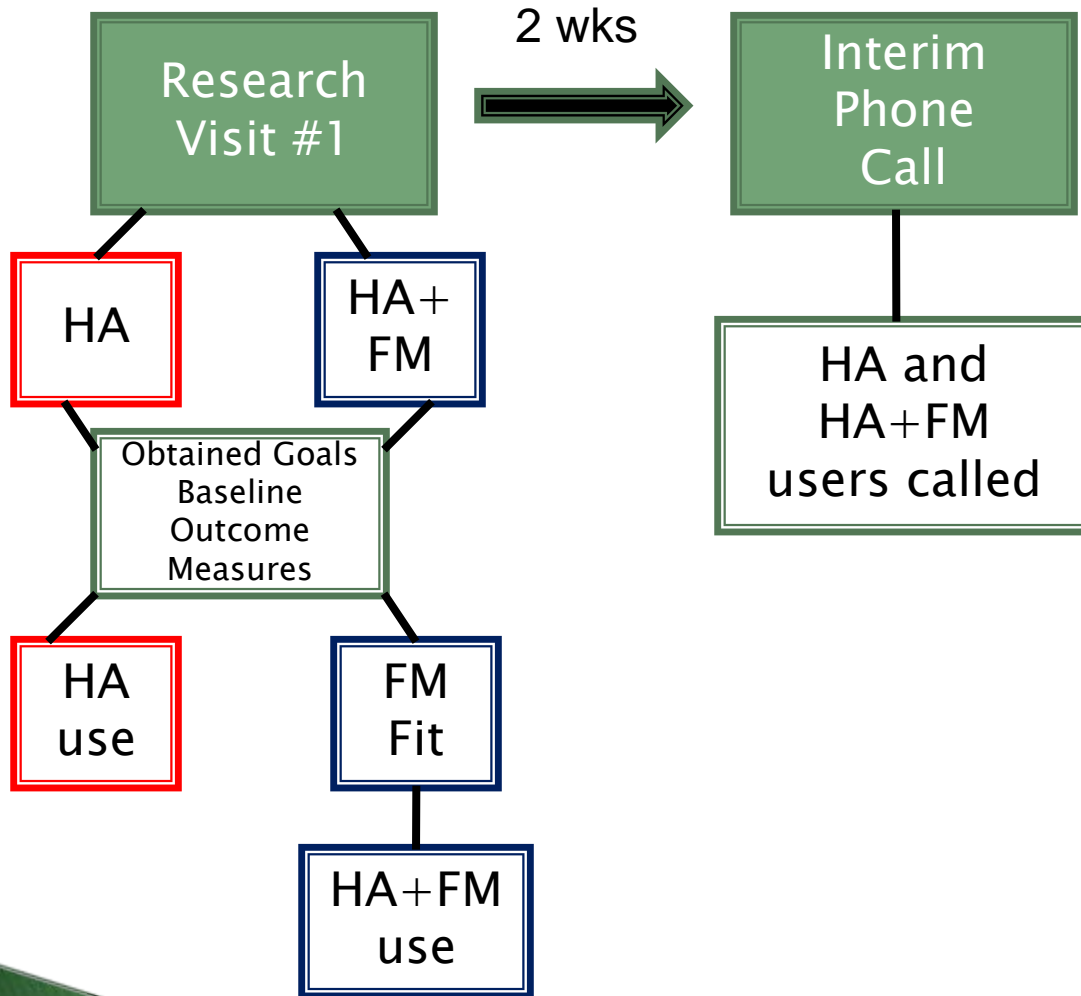




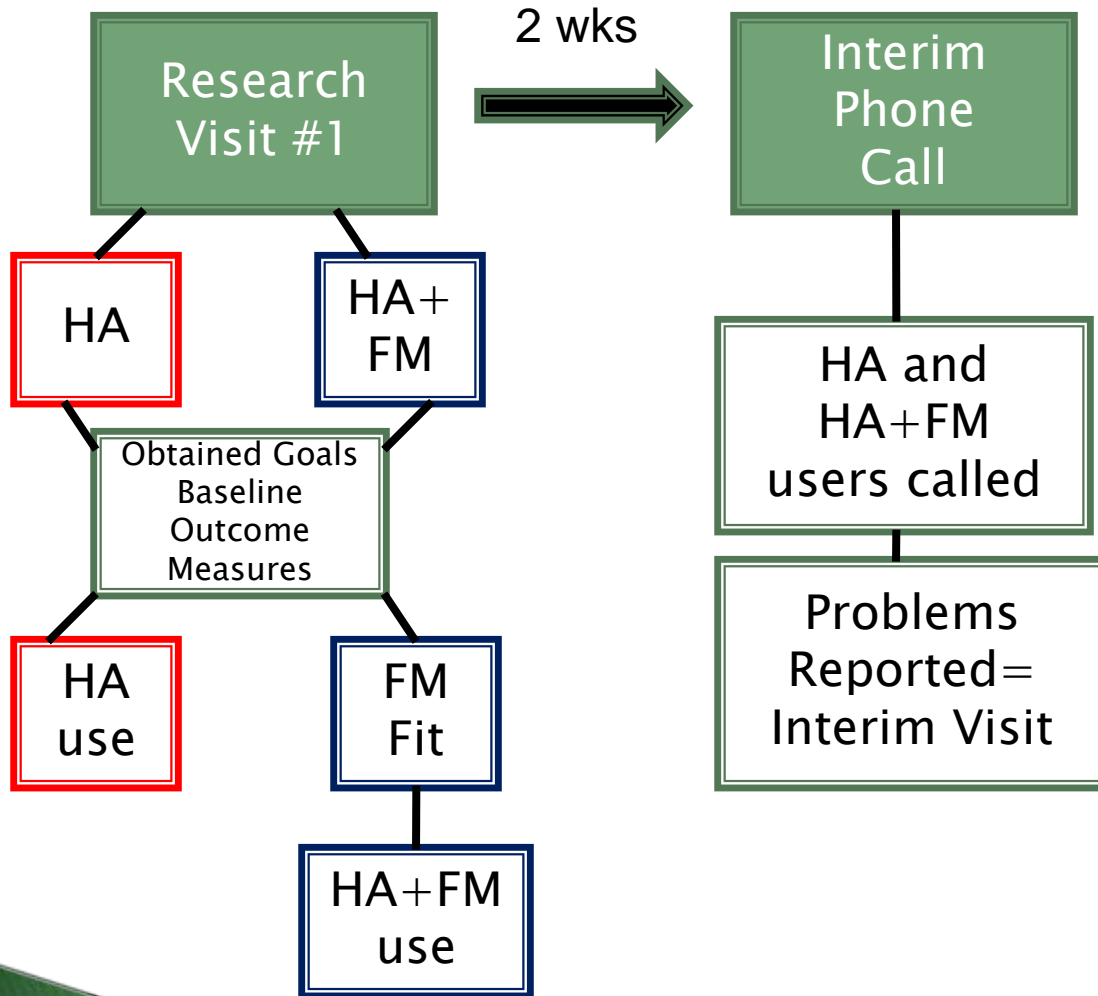
# Procedure (2 visits)



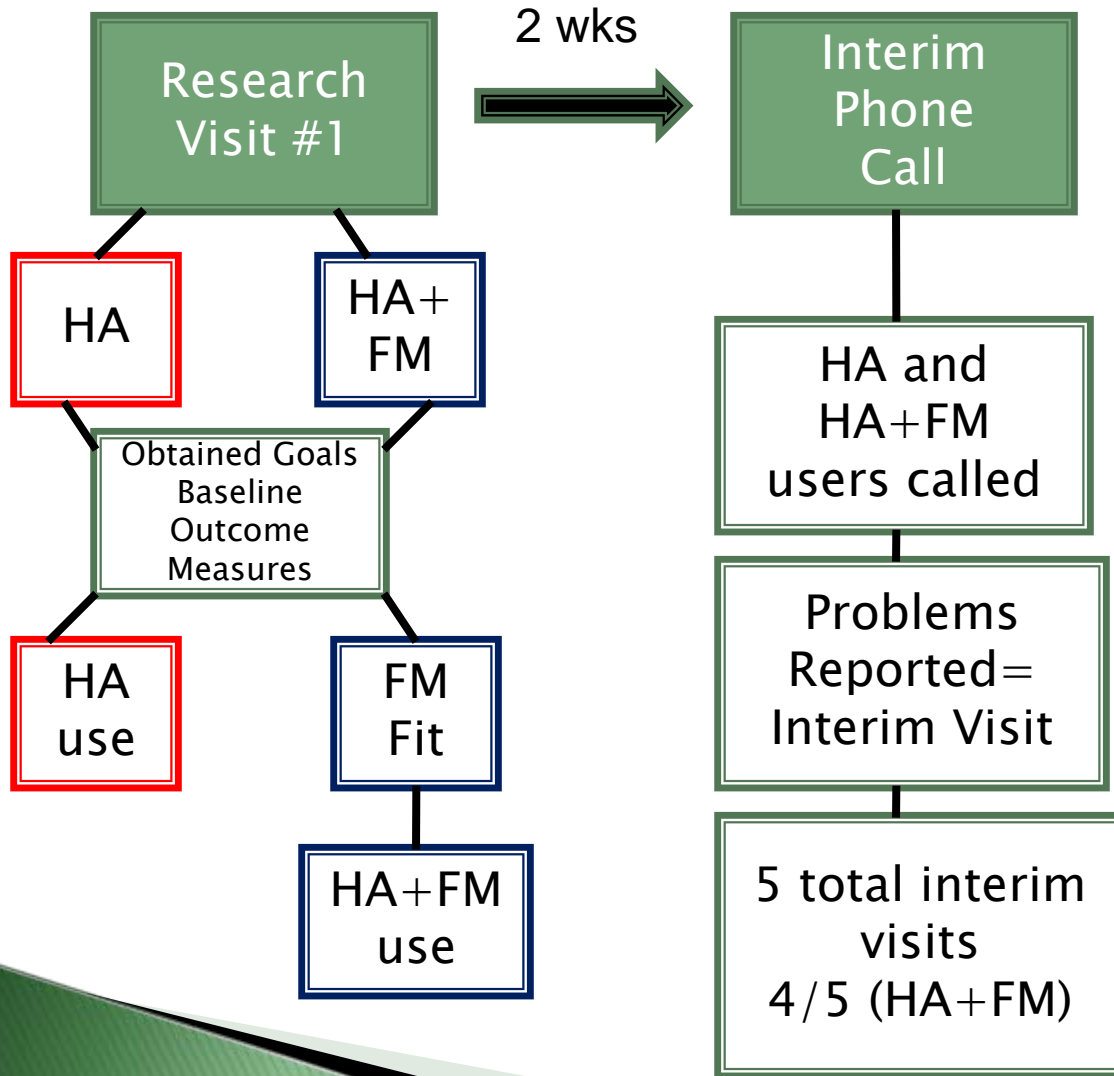
# Procedure (2 visits)



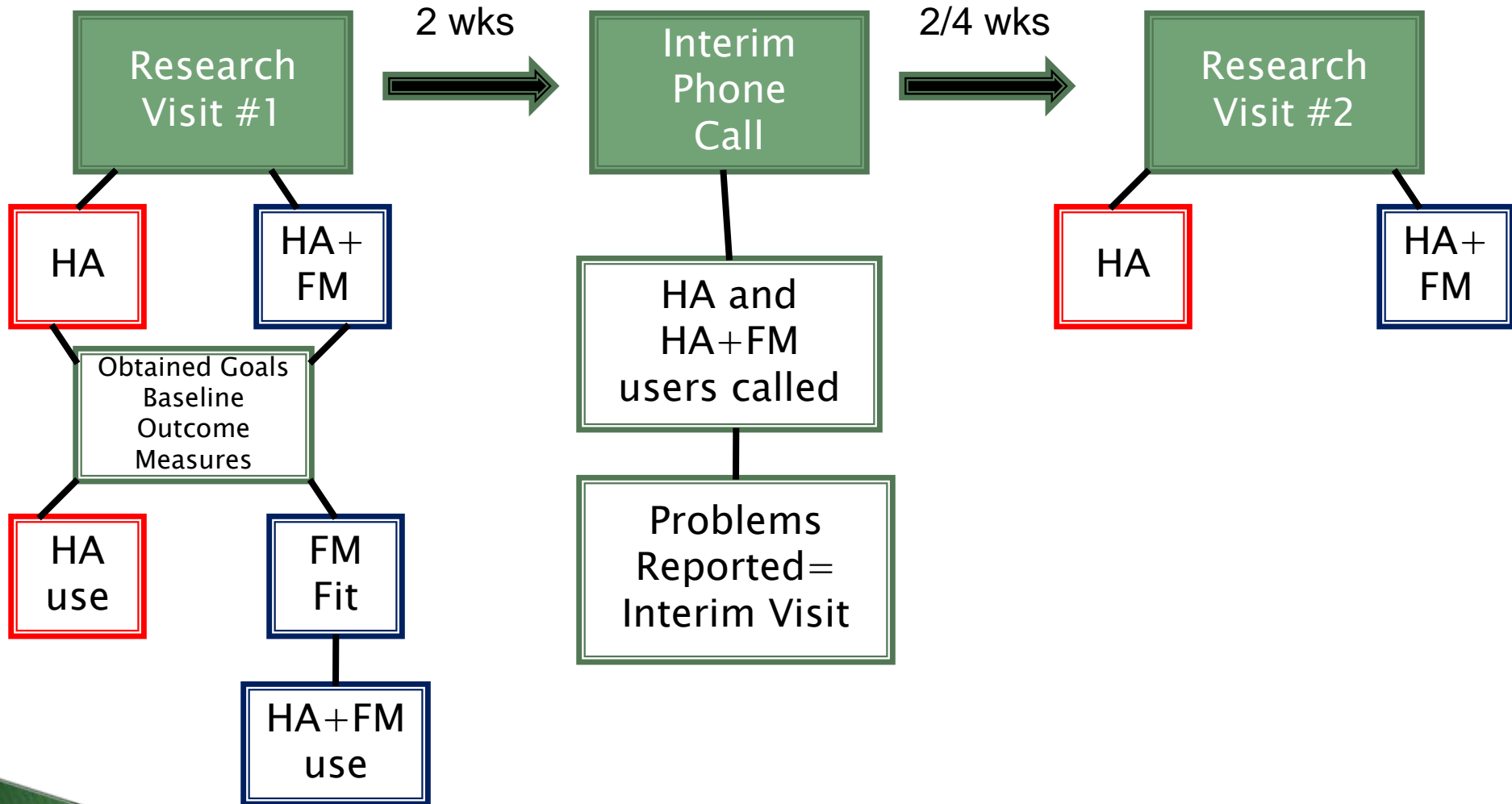
# Procedure (2 visits)



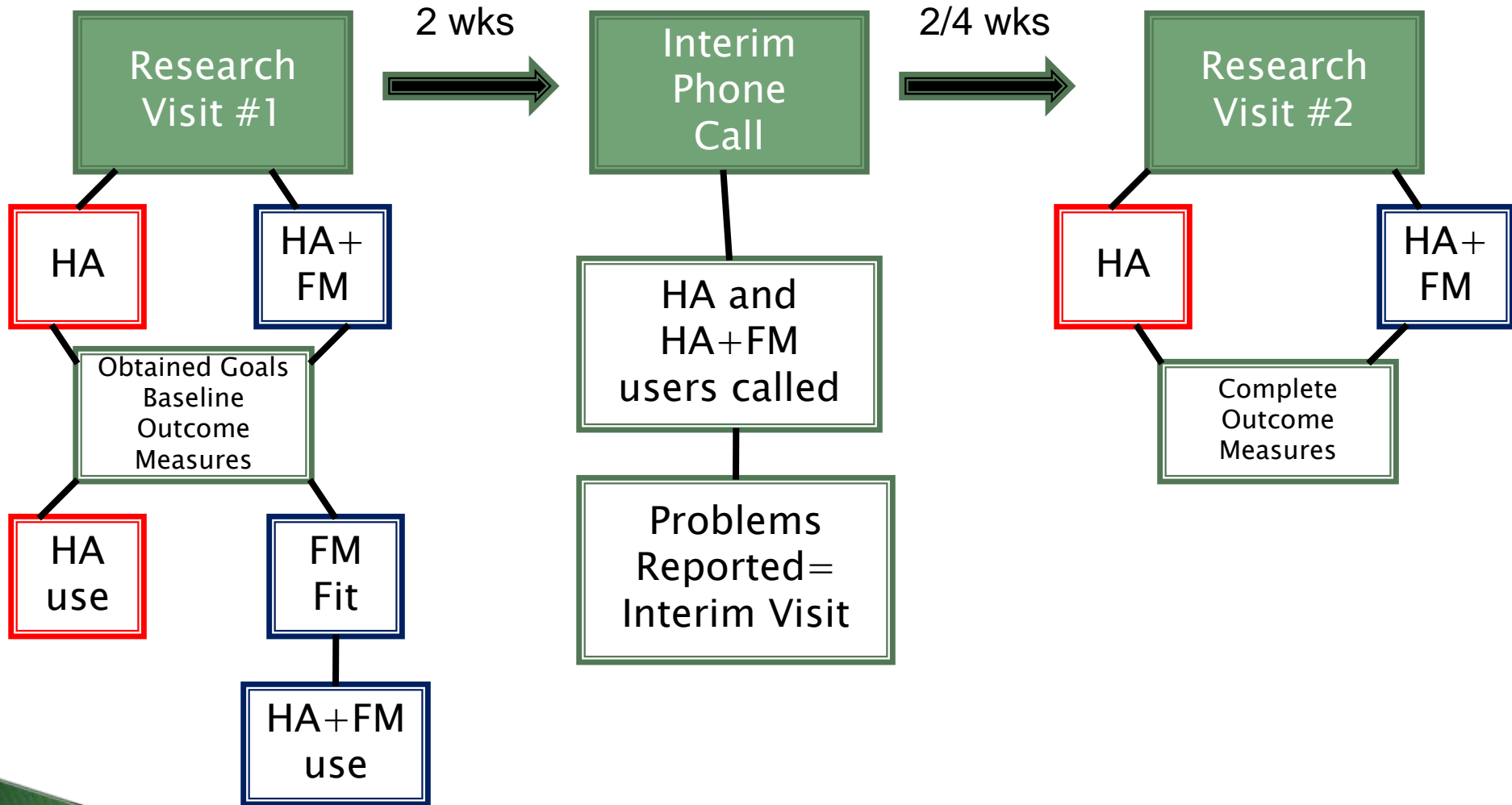
# Procedure (2 visits)



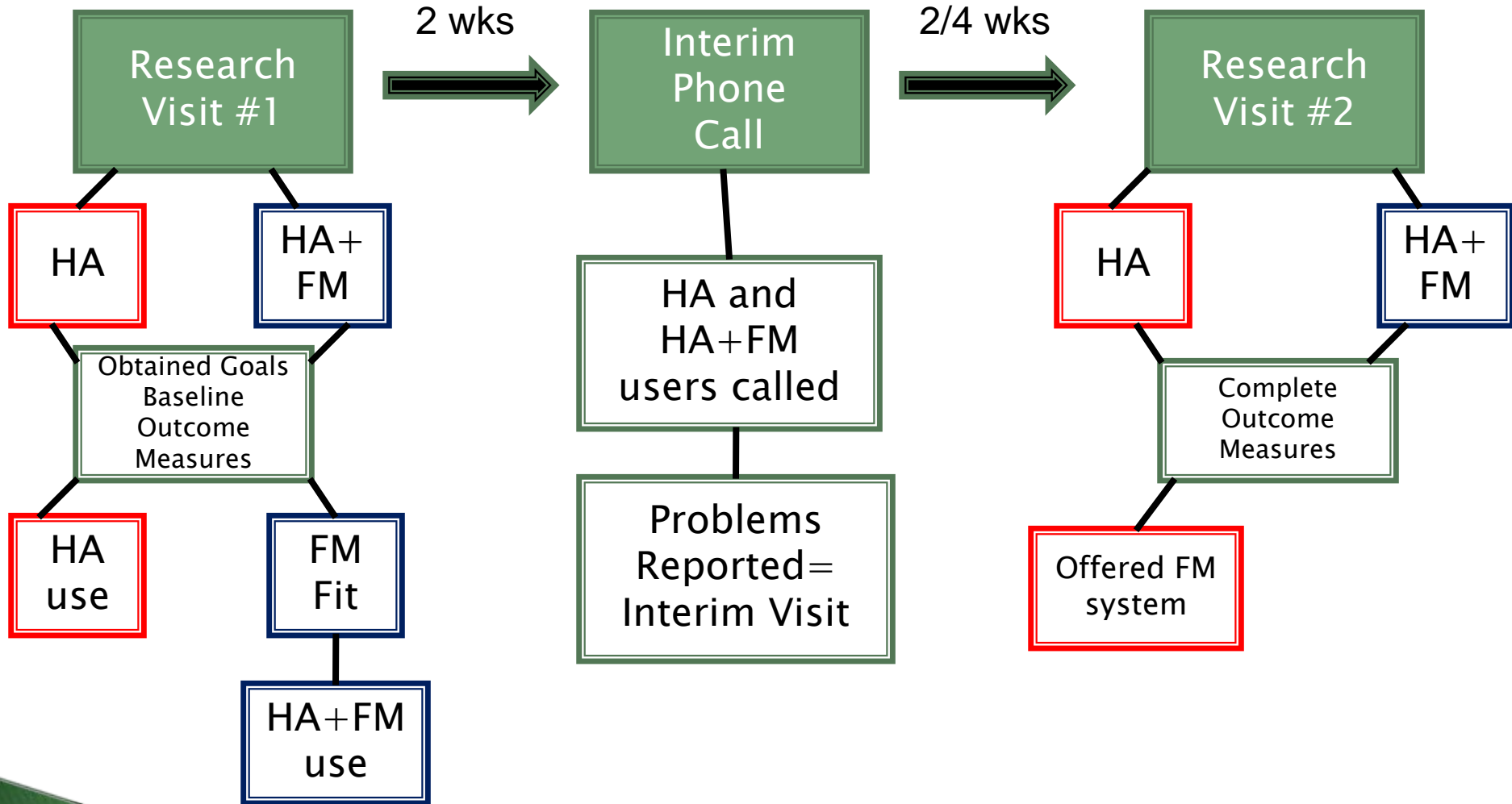
# Procedure (2 visits)



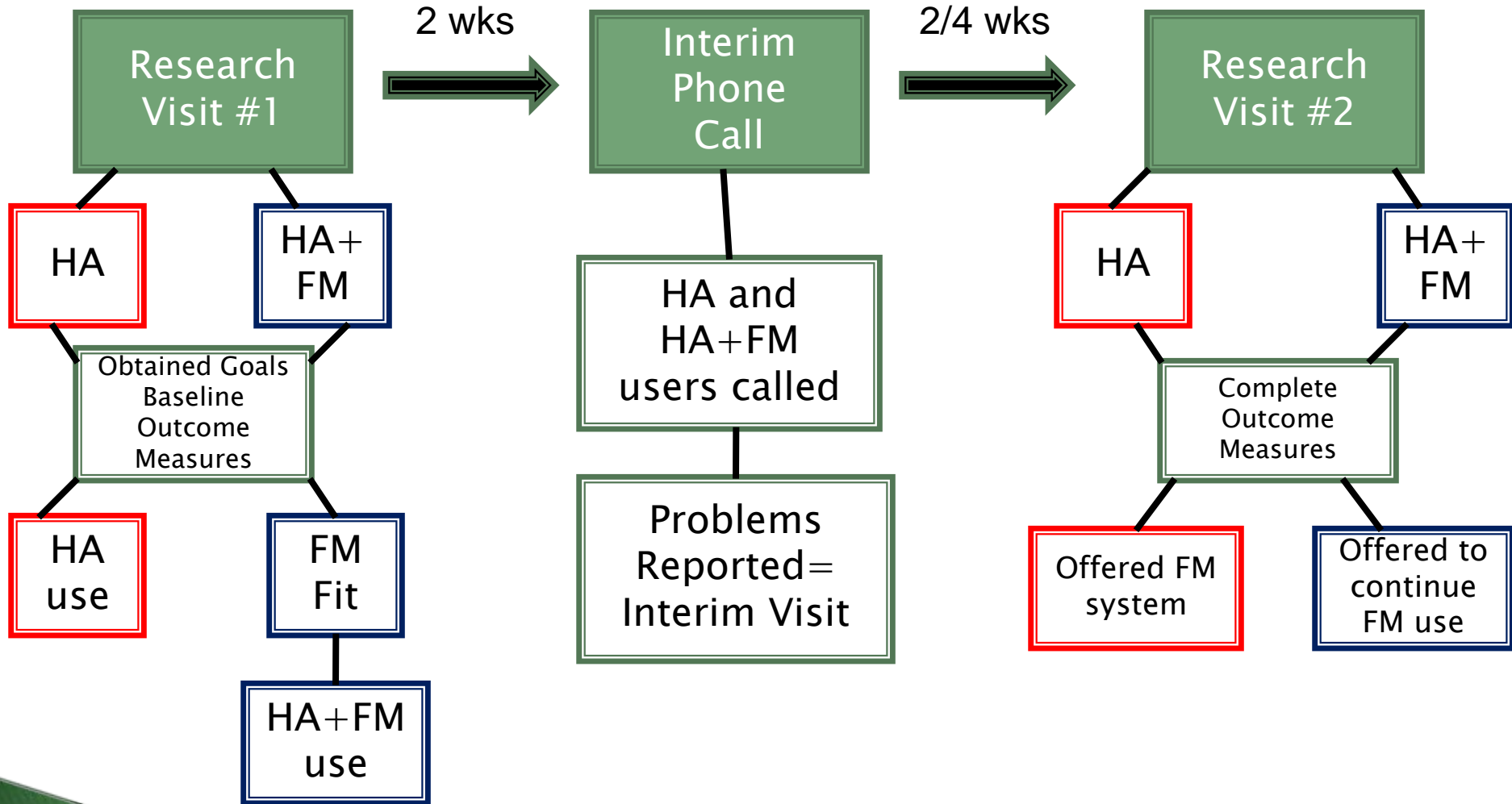
# Procedure (2 visits)



# Procedure (2 visits)



# Procedure (2 visits)





# Results



# Ability to Meet Individualized Goals

Hearing Aid Use Alone (HA)

Hearing Aid + FM System (HA+FM)





# Client Oriented Scale Of Improvement

Name : \_\_\_\_\_  
 Audiologist : \_\_\_\_\_  
 Date : 1. Needs Established \_\_\_\_\_  
 2. Outcome Assessed \_\_\_\_\_

Degree of Change

Final Ability  
 Person can hear  
 10% 25% 50% 75% 95%

## SPECIFIC NEEDS

Category New \_\_\_\_\_  
 Return \_\_\_\_\_

Able to hear and understand the wife while at a restaurant

Understand T.V. at a level that is comfortable for wife

Able to understand wife when she is driving the car.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

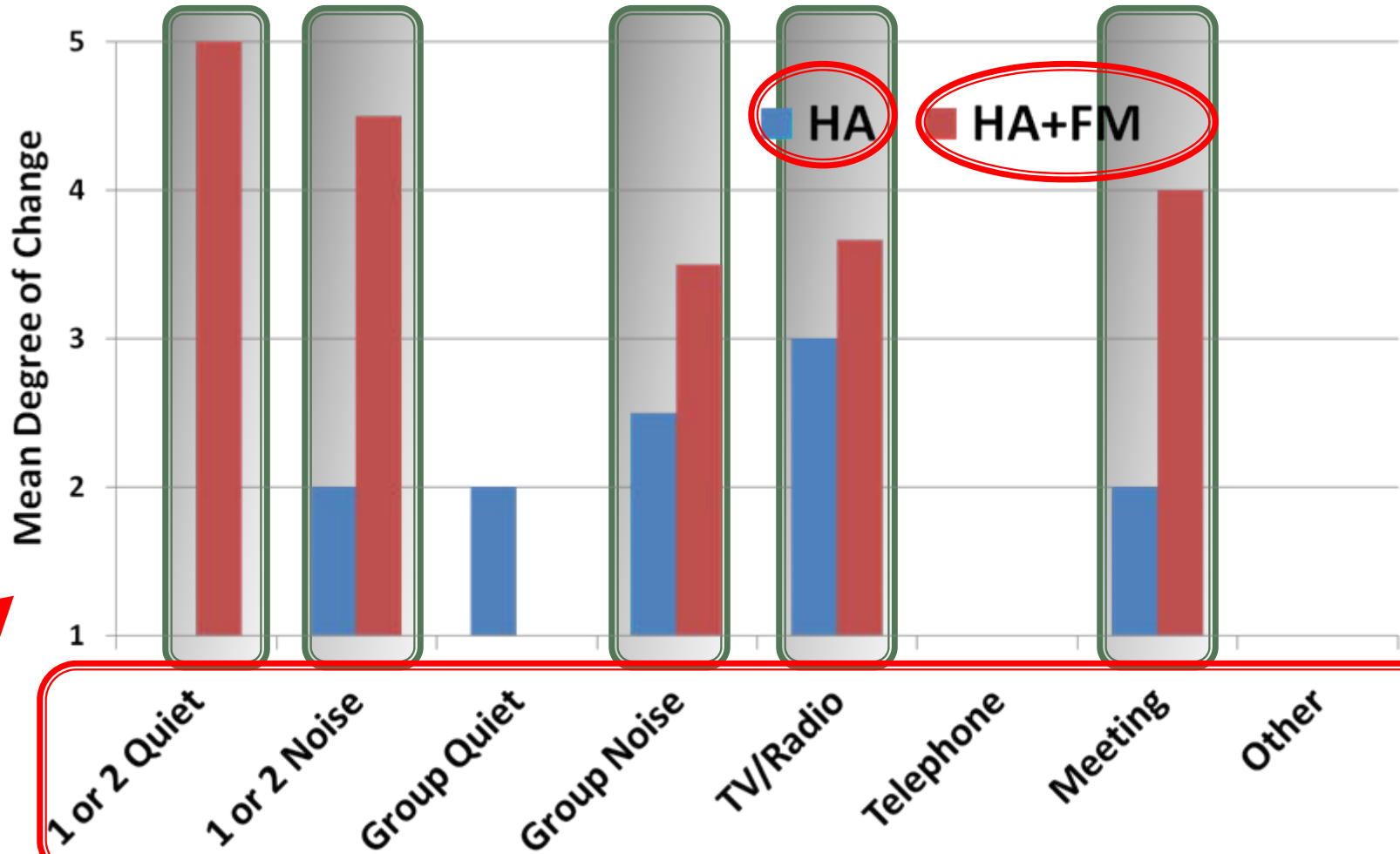
	Worse	No Difference	Slightly Better	Better	Much Better	CATEGORY	Hardly Ever	Occasionally	Half the Time	Most of the Time	Almost Always
	1										
			3								
					5						



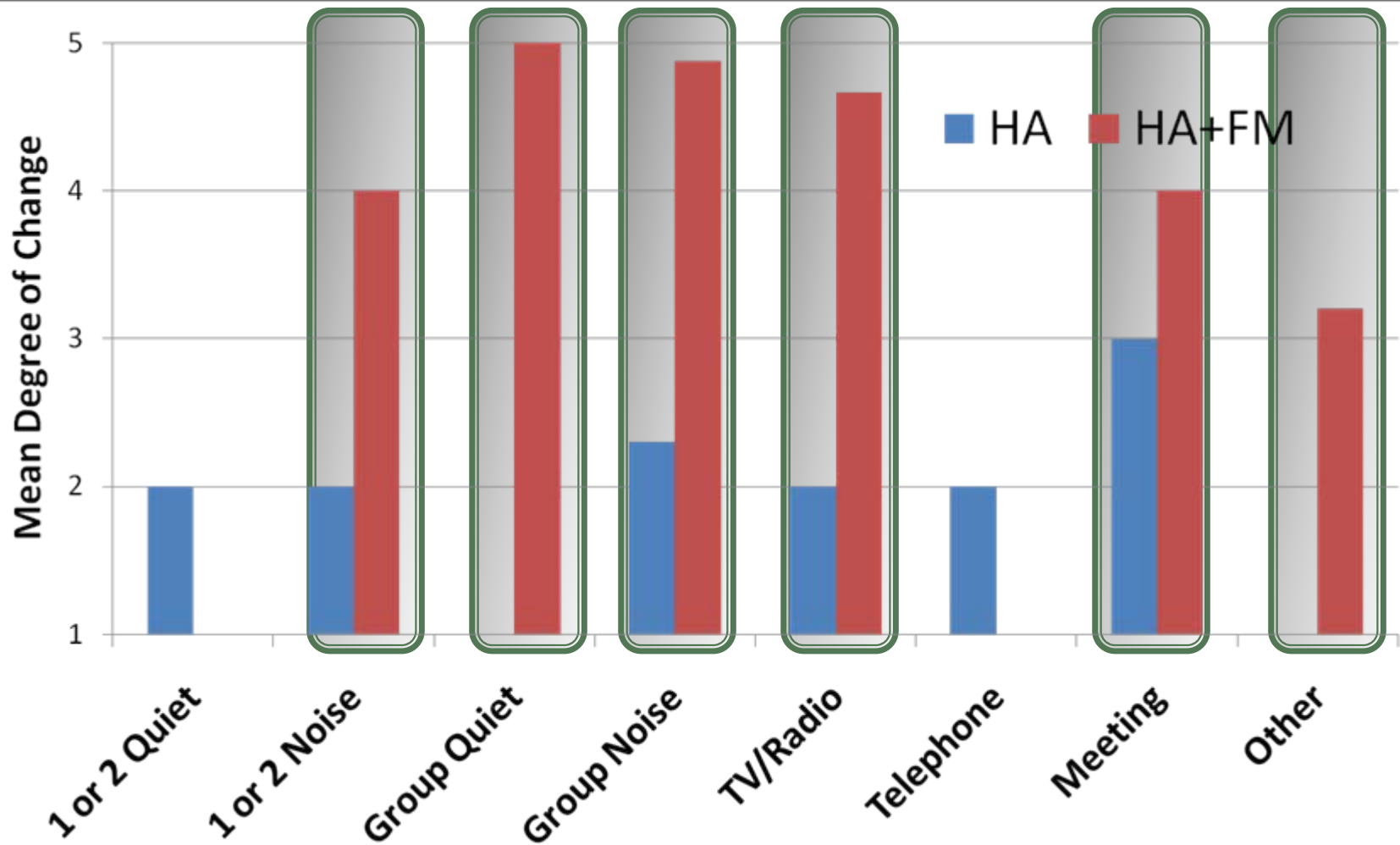
H. Dillon (NAL) et al

- Categories
- 1. Conversation with 1 or 2 in quiet
  - 2. Conversation with 1 or 2 in noise
  - 3. Conversation with group in quiet
  - 4. Conversation with group in noise
  - 5. Television/Radio @ normal volume
  - 6. Familiar speaker in phone
  - 7. Unfamiliar speaker on phone
  - 8. Hearing phone ring from another room
  - 9. Hear front door bell or knock
  - 10. Hear traffic
  - 11. Increased social contact
  - 12. Feel Embarrassed or stupid
  - 13. Feeling left out
  - 14. Feeling upset or angry
  - 15. Church or meeting
  - 16. Other

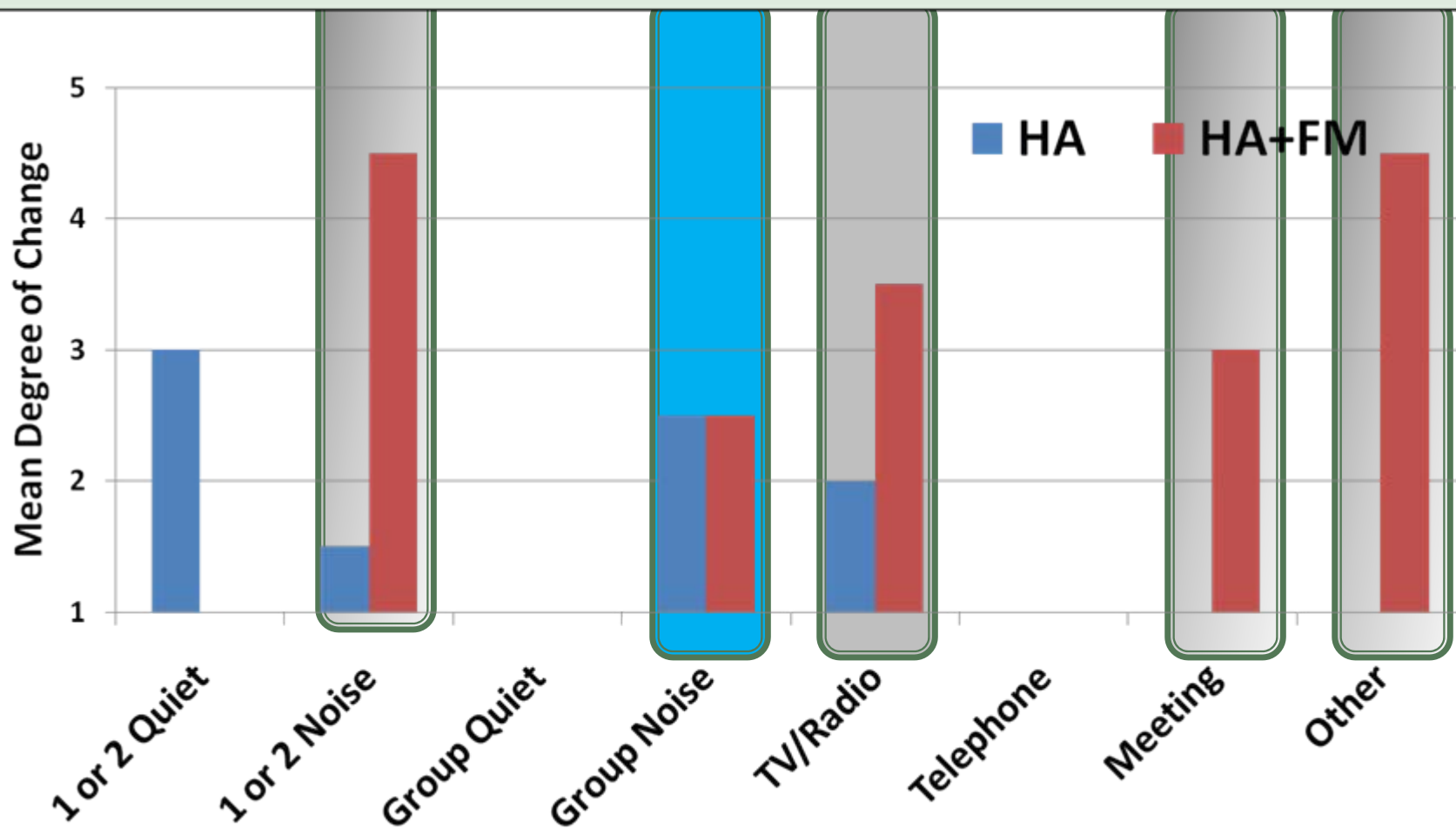
# COSI Degree of Change < 70 years old



# COSI Degree of Change 70-79 years old

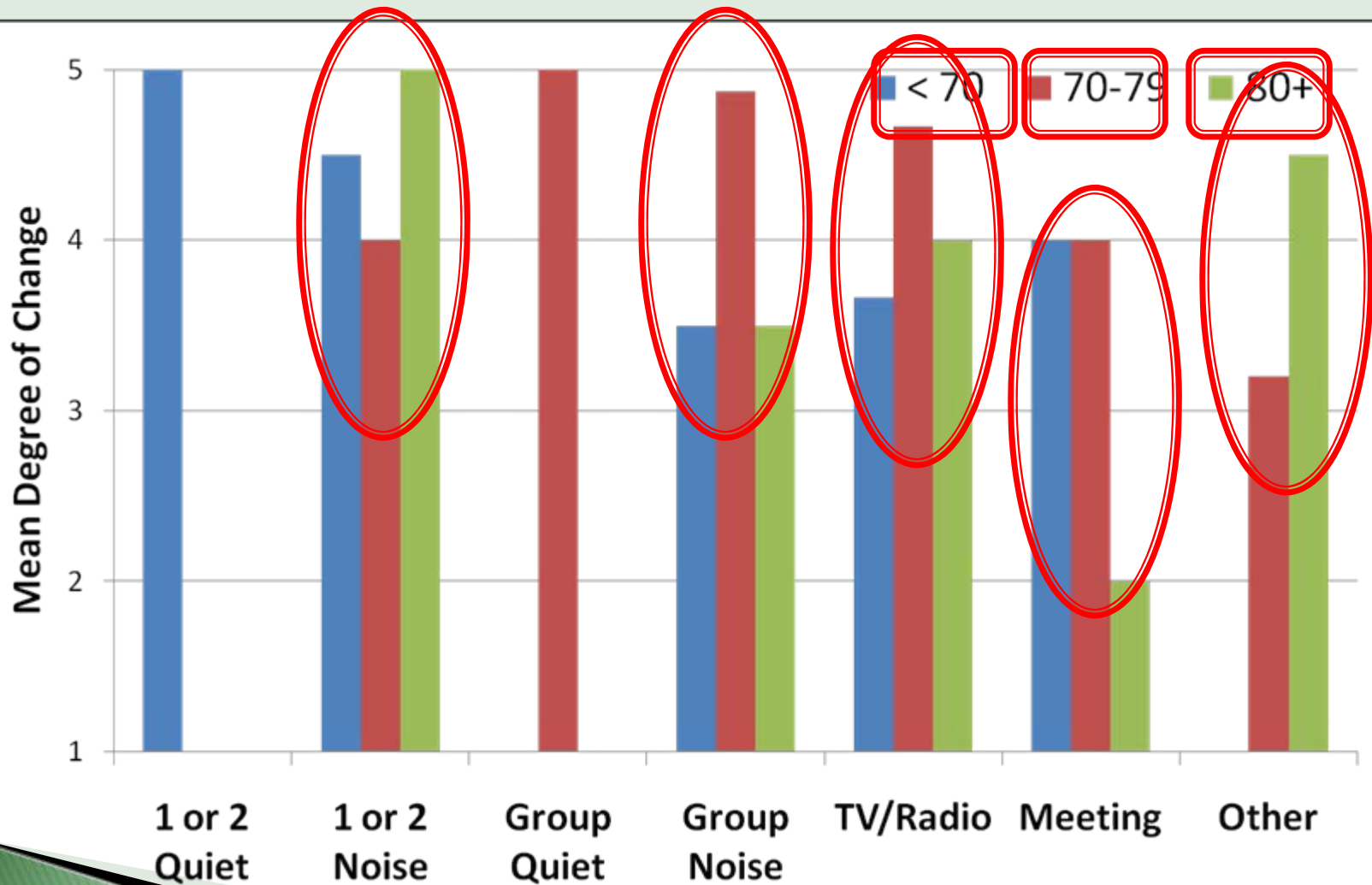


# COSI Degree of Change 80+ years old



# COSI Degree of Change HA+FM All Age Groups

# COSI Degree of Change HA+FM All Age Groups





# Client Oriented Scale Of Improvement



Name : \_\_\_\_\_  
 Audiologist : \_\_\_\_\_  
 Date : 1. Needs Established \_\_\_\_\_  
 2. Outcome Assessed \_\_\_\_\_

## Degree of Change

## Final Ability Person can hear

10% 25% 50% 75% 90%

### SPECIFIC NEEDS

Category New \_\_\_\_\_  
 Return \_\_\_\_\_

Able to hear and understand the speaker at monthly men's club meetings at church.

Understand T.V. at a level that is comfortable for wife

Able to understand wife when she is driving the car.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

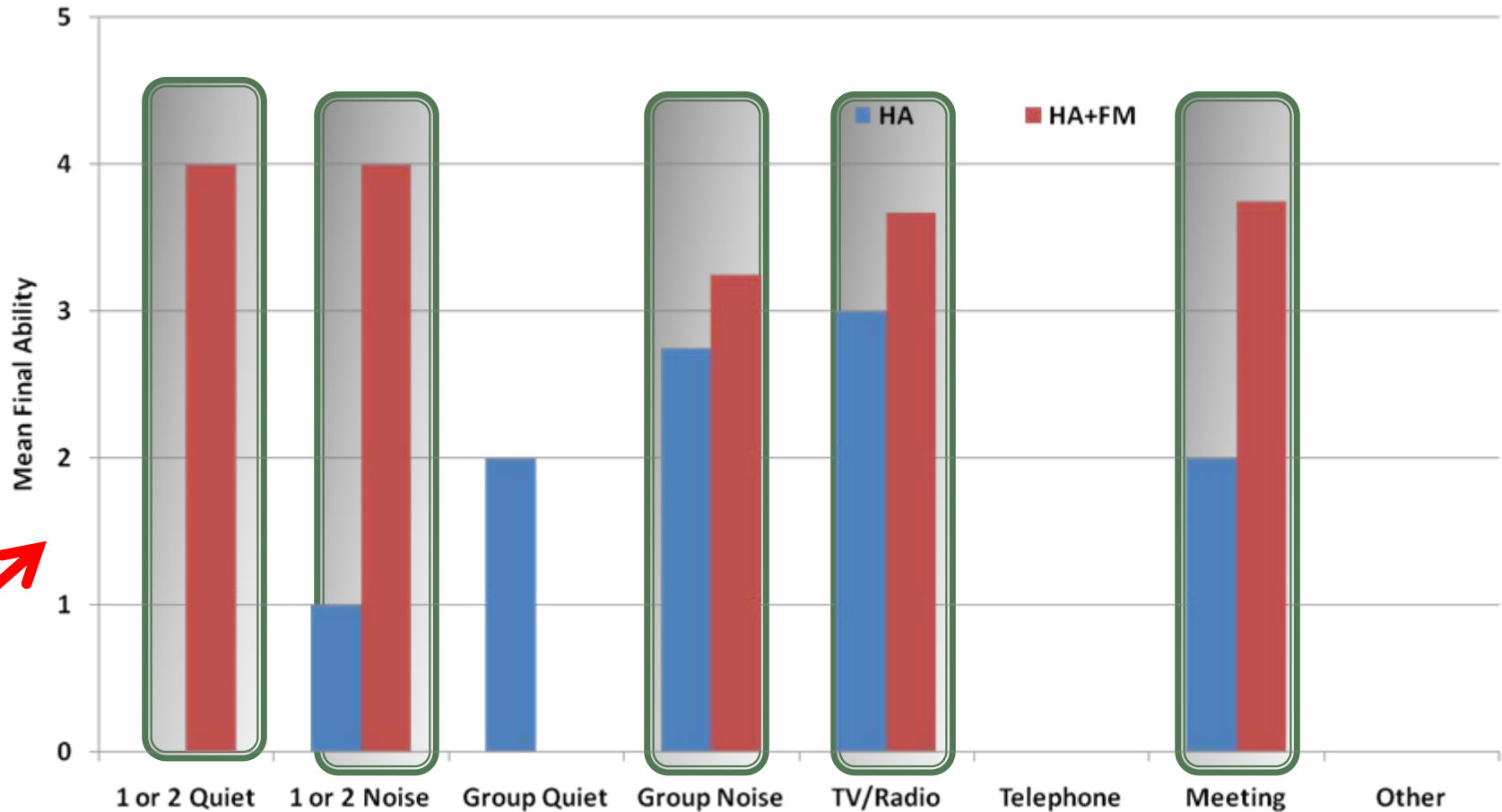
\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Worse	No Difference	Slightly Better	Better	Much Better	CATEGORY	Final Ability				
						Hardly Ever	Occasionally	Half the Time	Most of the Time	Almost Always
						1				
								3		
										5

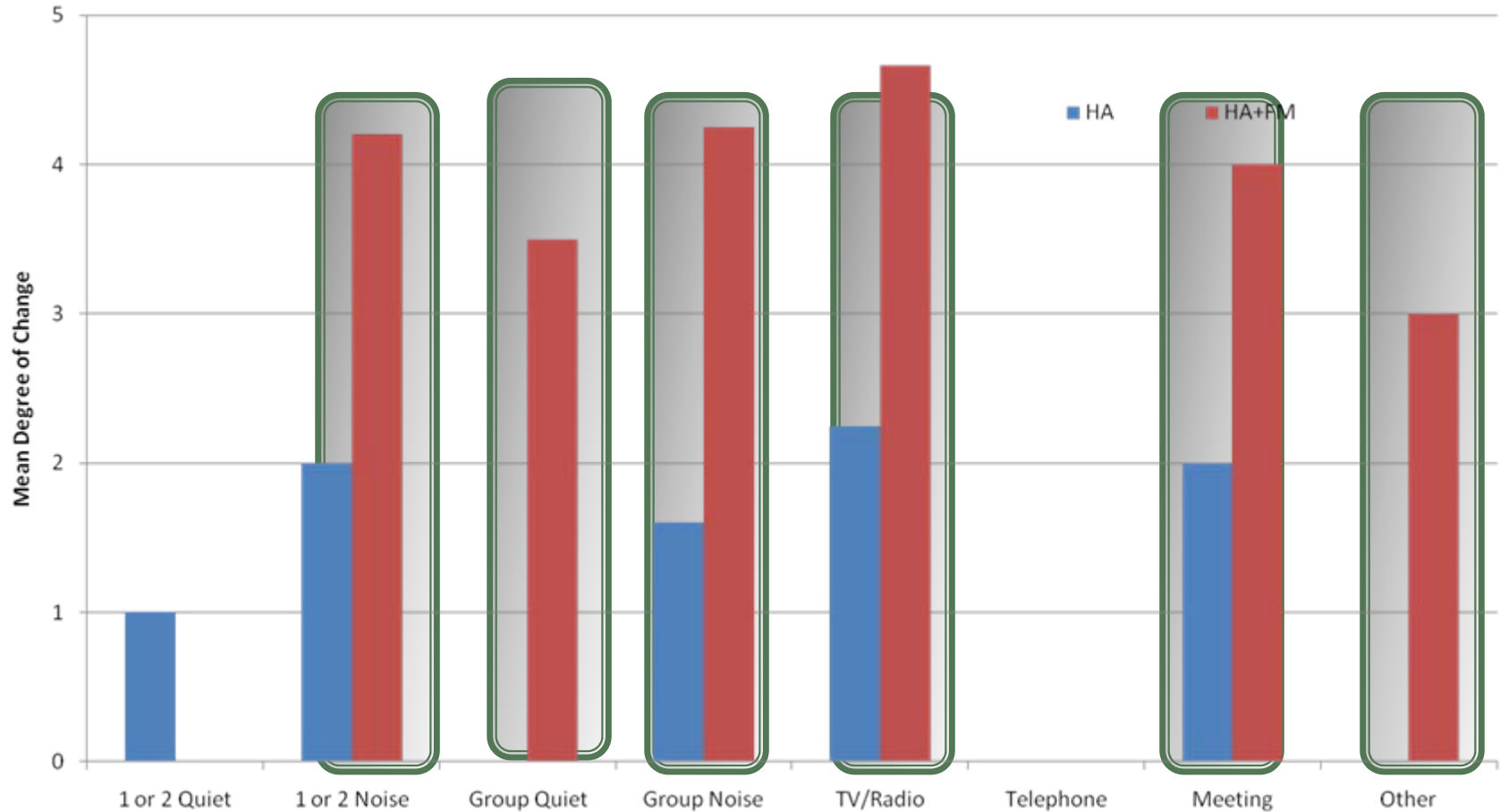


- Categories
- |   |                                  |
|---|----------------------------------|
| 1. Conversation with 1 or 2 in quiet    | 9. Hear front door bell or knock |
| 2. Conversation with 1 or 2 in noise    | 10. Hear traffic                 |
| 3. Conversation with group in quiet     | 11. Increased social contact     |
| 4. Conversation with group in noise     | 12. Feel Embarrassed or stupid   |
| 5. Television/Radio @ normal volume     | 13. Feeling left out             |
| 6. Familiar speaker in phone            | 14. Feeling upset or angry       |
| 7. Unfamiliar speaker on phone          | 15. Church or meeting            |
| 8. Hearing phone ring from another room | 16. Other                        |

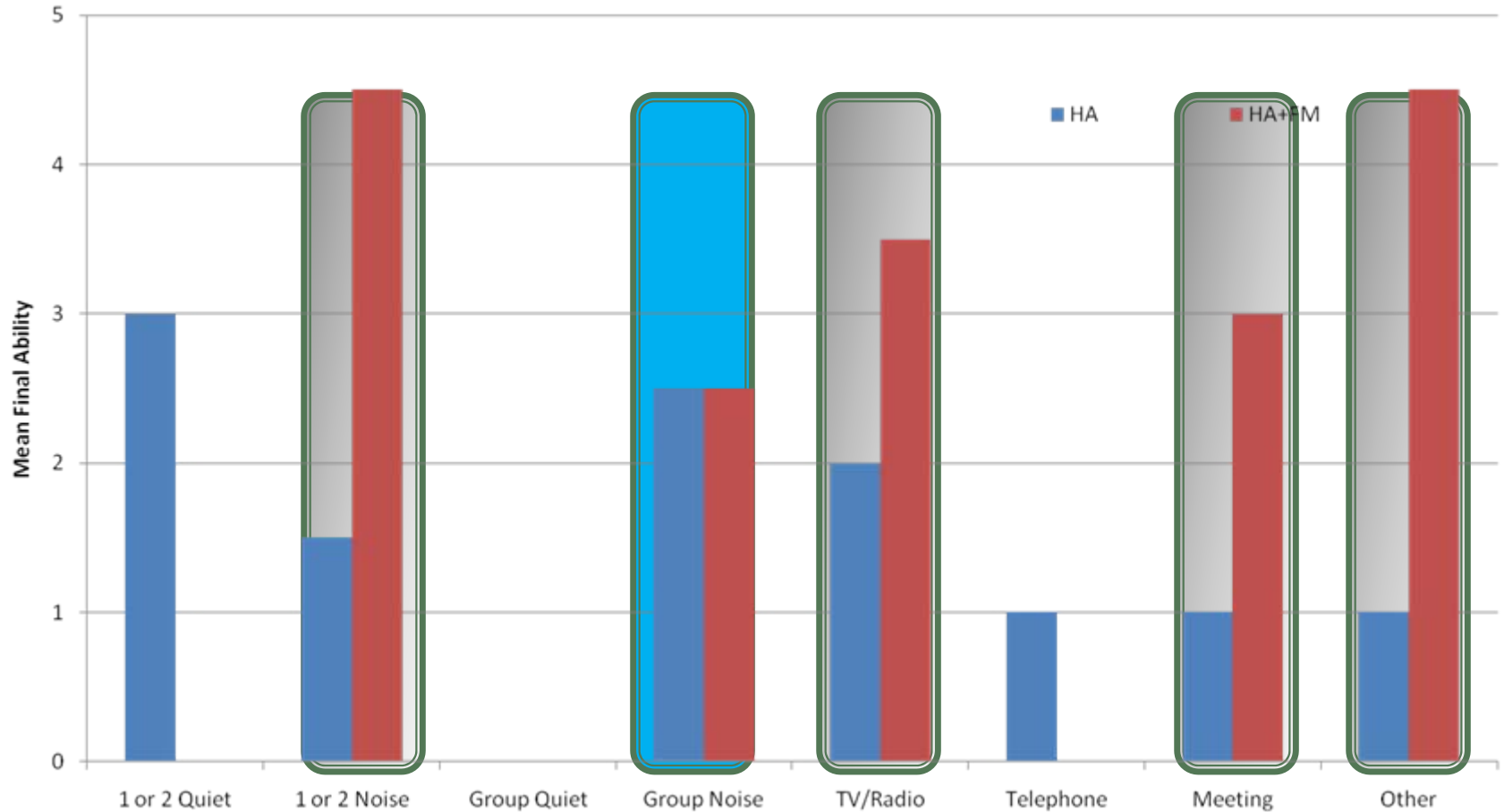
# COSI Final Ability < 70 years old



# COSI Final Ability 70-79 years old



# COSI Final Ability 80+ years old

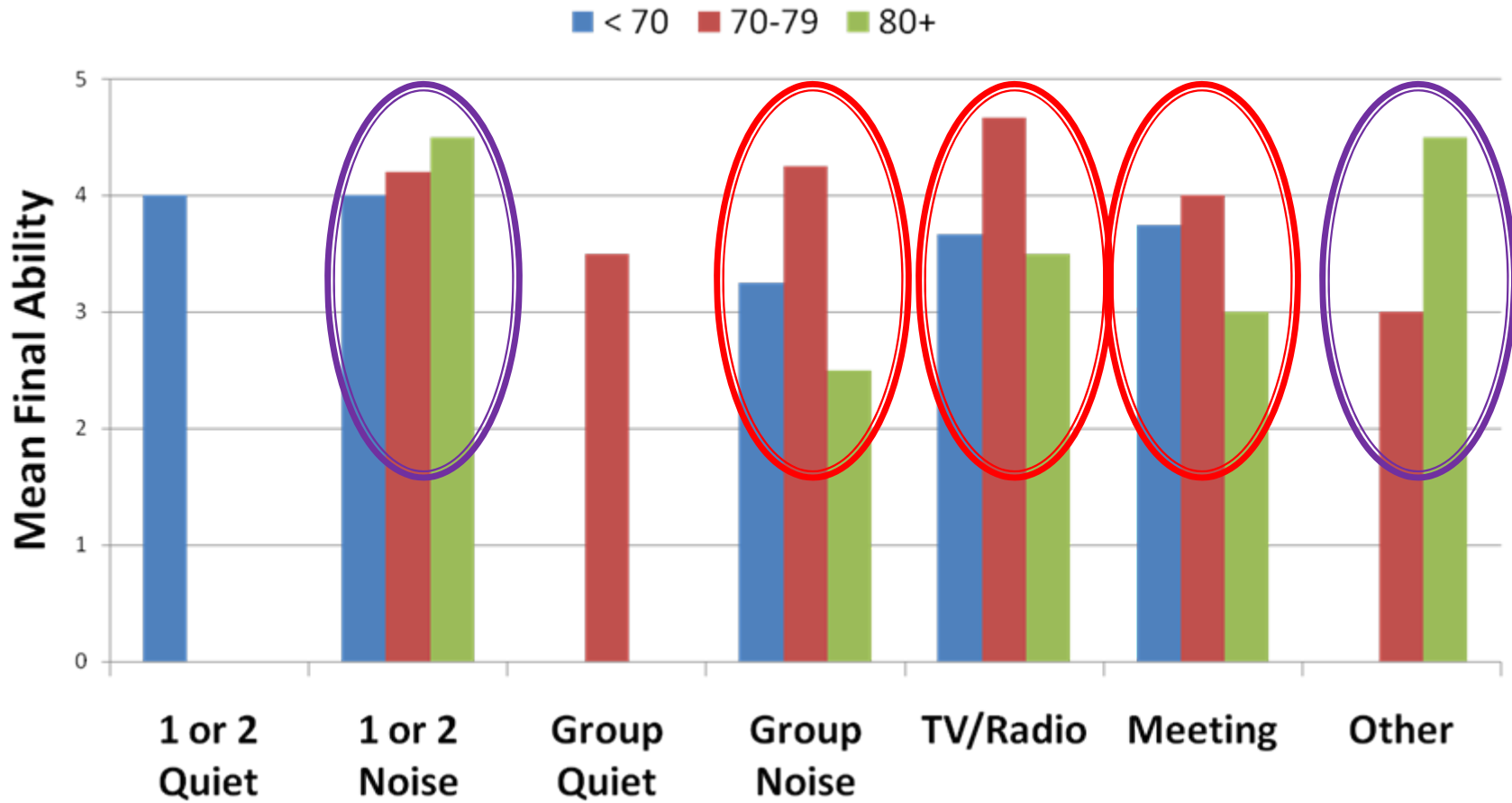


# COSI Final Ability

## HA+FM All Age Groups

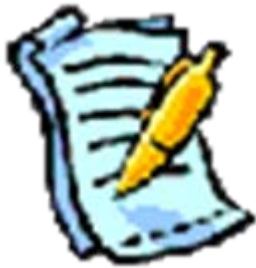
# COSI Final Ability

## HA+FM All Age Groups



# Satisfaction

Selected items from MarkeTrak  
Survey [Kochkin, 1990]



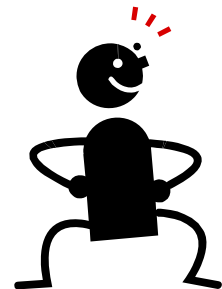
# MarkeTrak Satisfaction Survey

- **Device Features**

- e.g., visibility, reliability, natural sounding, etc
- 16 items

- **Various Listening Situations**

- e.g., watching TV, riding in a car, etc
- 14 items





# Rating Scale

Very  
Unsatisfied

Very  
Satisfied

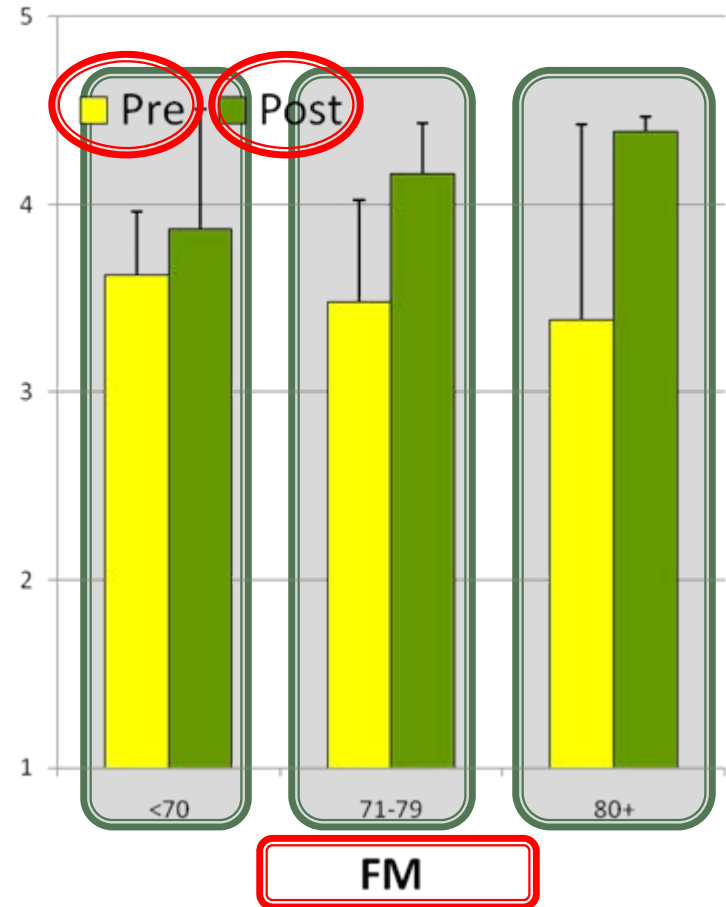
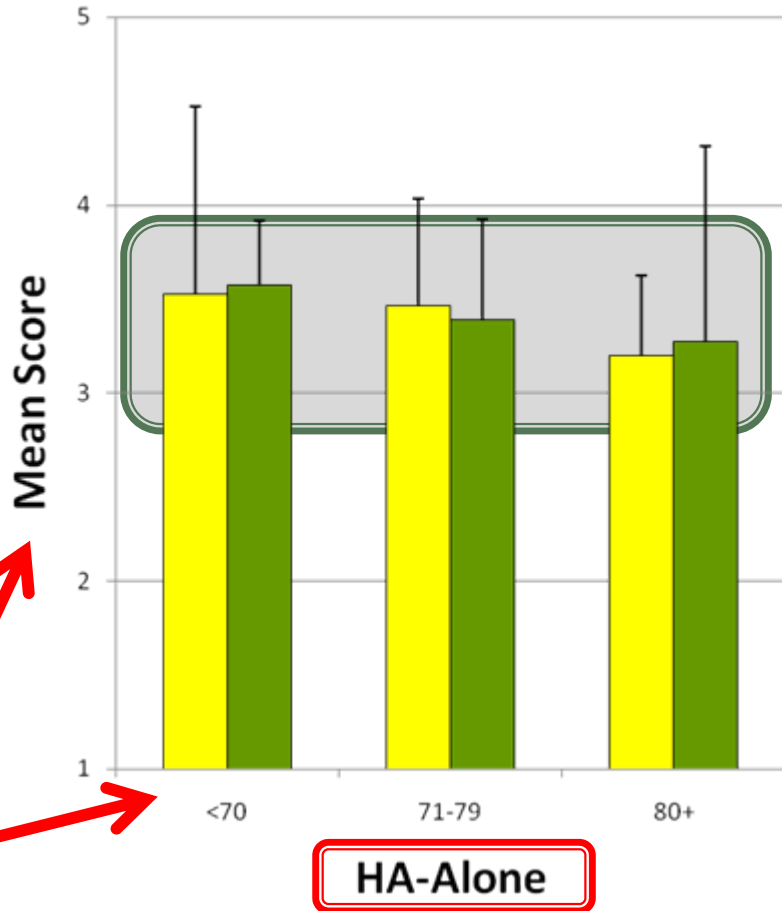
**1**

**3**

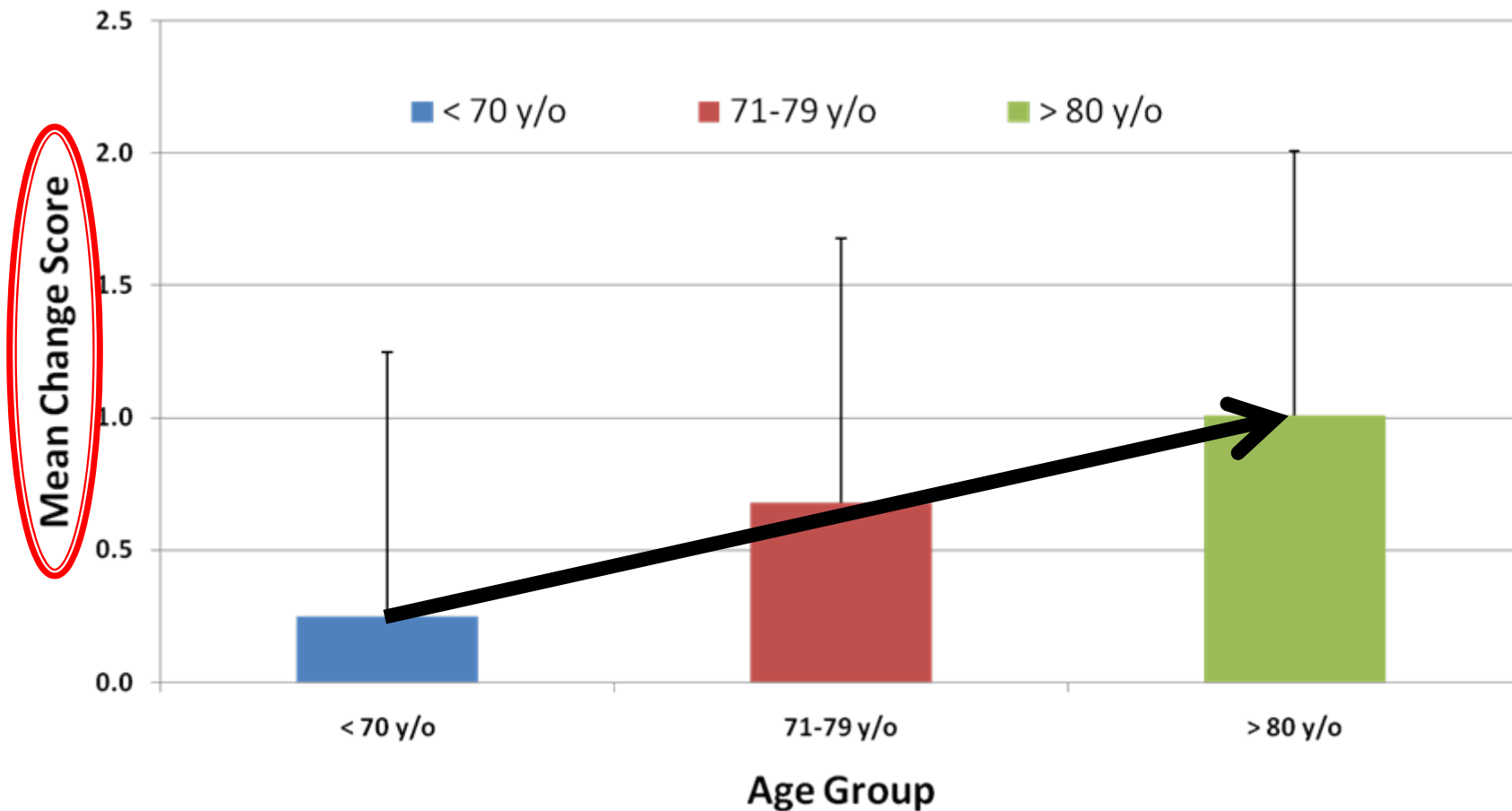
**5**



# Results: MarkeTrak Satisfaction Survey



# Results: MarkeTrak Satisfaction Survey



# Benefit:

Self-perception of reductions in restrictions of auditory ability in performing everyday listening activities

# The Speech, Spatial and Qualities of Hearing Scale (SSQ; Gatehouse & Noble, 2004)

- ▶ 50-item questionnaire (Version 3.1)
  - Speech: 14 items
  - Spatial: 17 items
  - Other “Qualities”: 19 items

## Appendix 1. A sample item from the SSQ Questionnaire

1. You are talking with one other person and there is a TV on in the same room. Without turning the TV down, can you follow what the person you're talking to says?	Not at all	Perfectly	tick if not applicable
	0	10	<input type="checkbox"/> <input type="checkbox"/>
	Min	Max	or wouldn't hear it

# SSQ Results

- ▶ Individual item scores
- ▶ Average Speech, Spatial & Qualities Scale Scores
- ▶ 10 Pragmatic Scale Scores

# Pragmatic Scales

## ▶ 4 Pragmatic Speech Scales

- Speech in Quiet
- Speech in Noise
- Speech in Speech Contexts
- Multiple Speech–Stream Processing and Switching

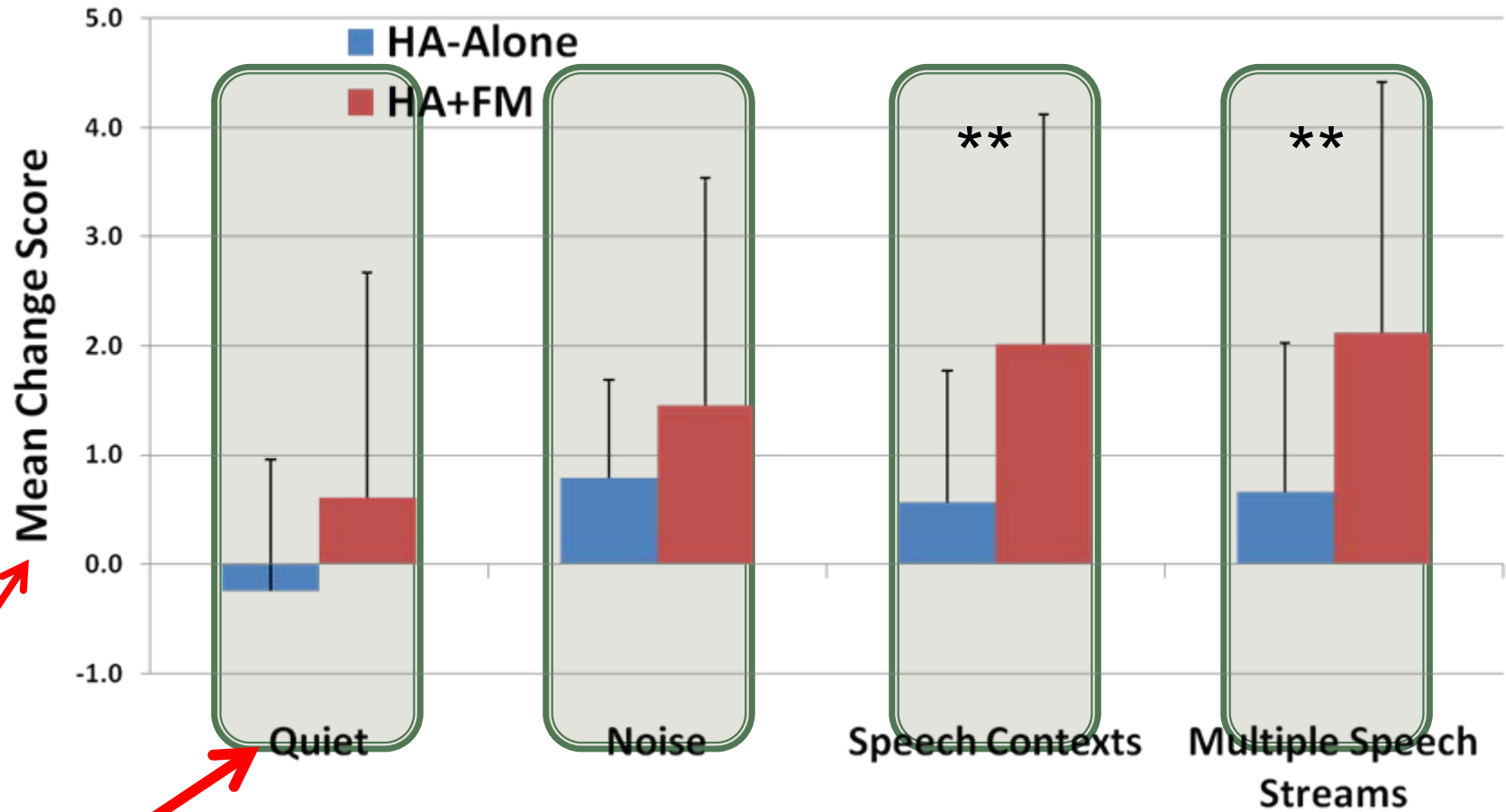
## ▶ 2 Pragmatic Spatial Scales

- Localization
- Distance and Movement

## ▶ 4 Pragmatic Other Qualities Scales

- Sound Quality and Naturalness
- Identification of Sound and Objects
- Segregation of Sounds
- Listening Effort

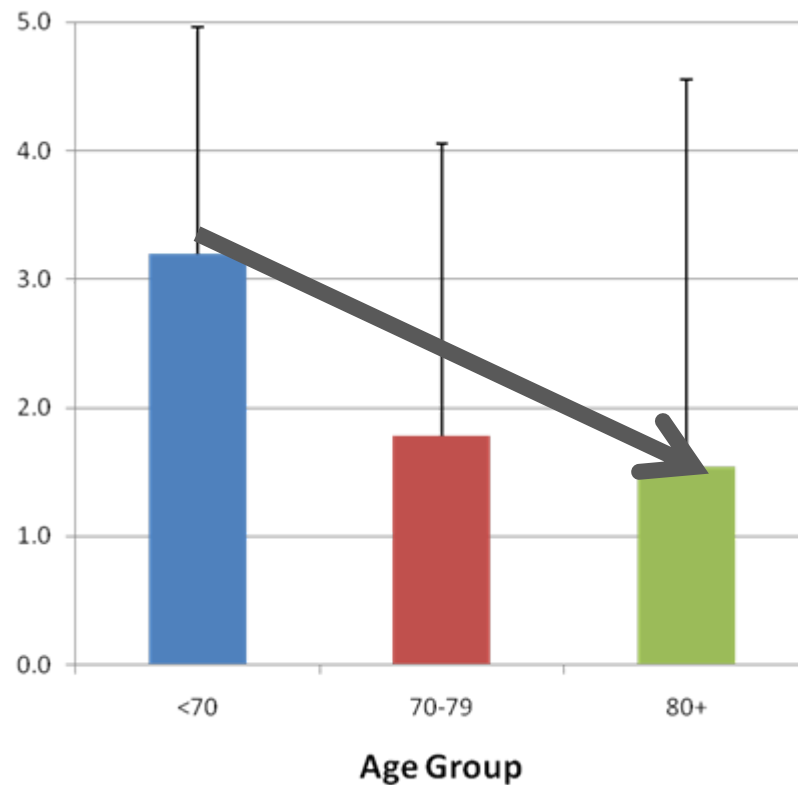
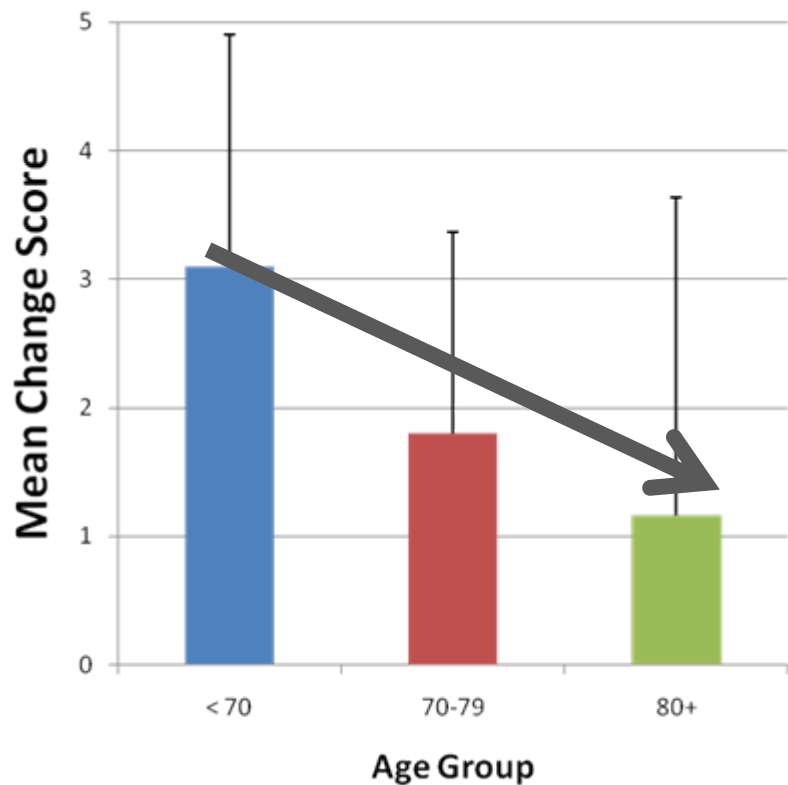
# SSQ Pragmatic Speech Scales





# FM Benefit for SSQ

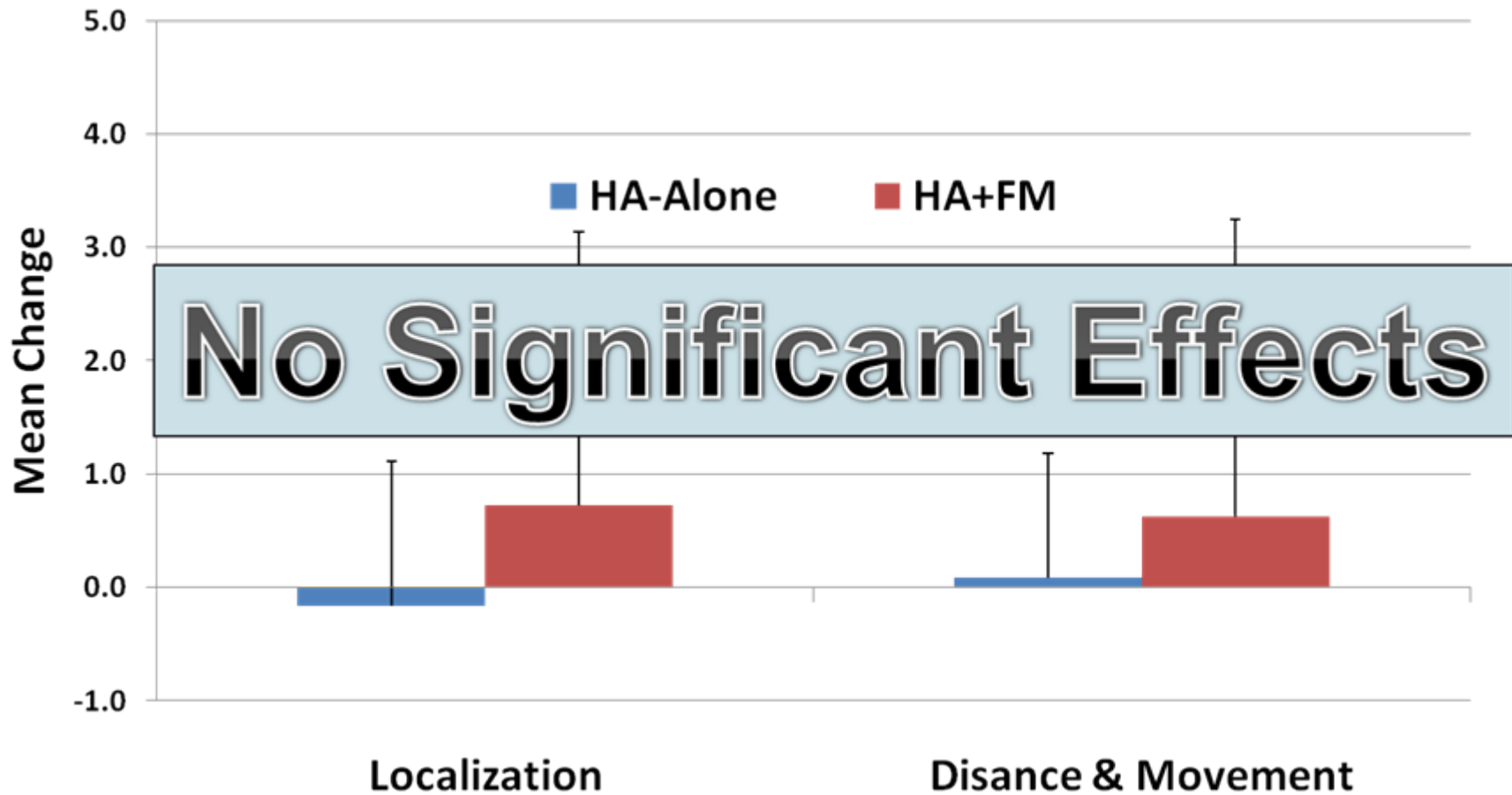
## Speech Scales as Function of Age



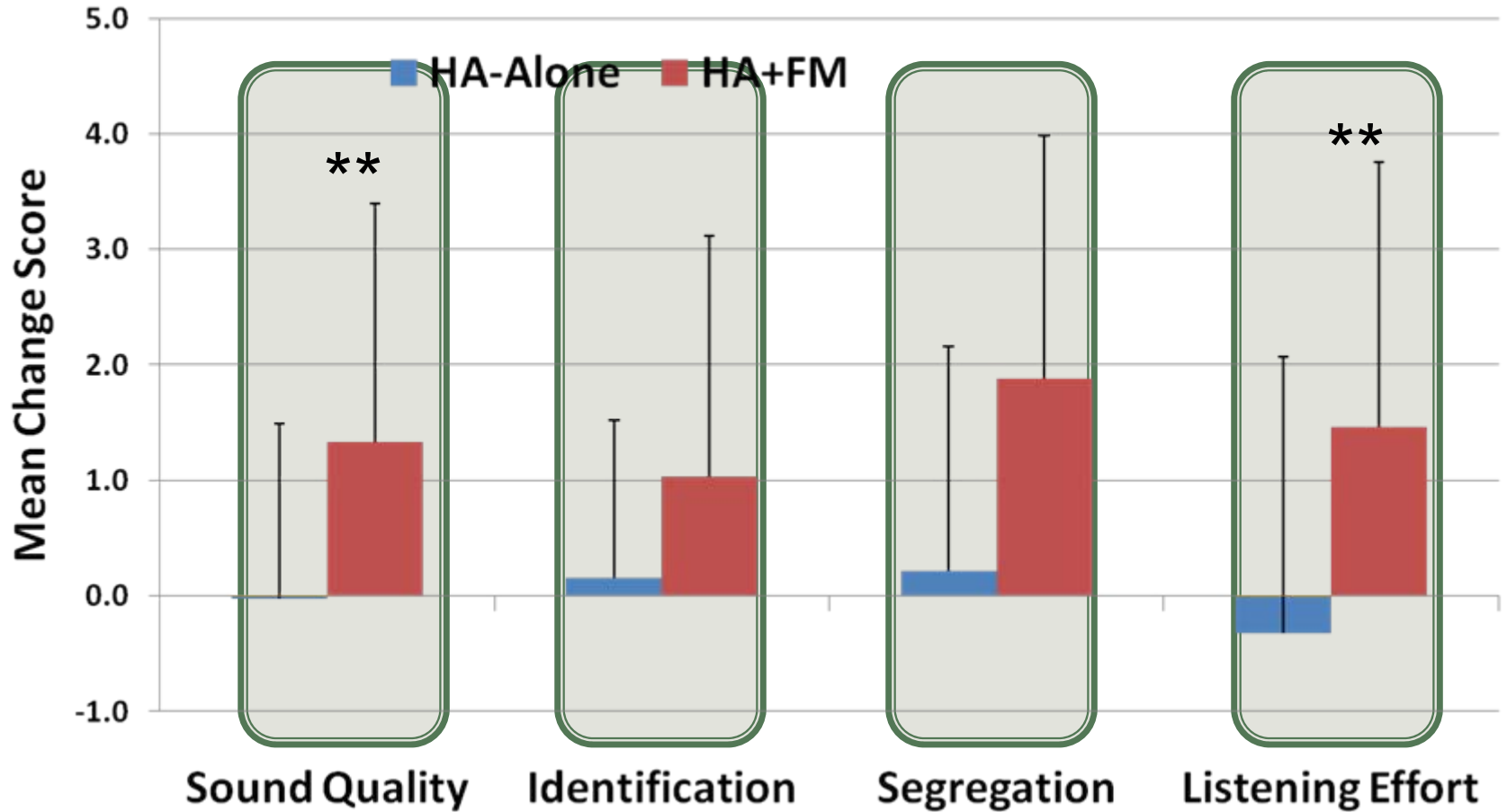
Speech Context

Multiple Speech Streams

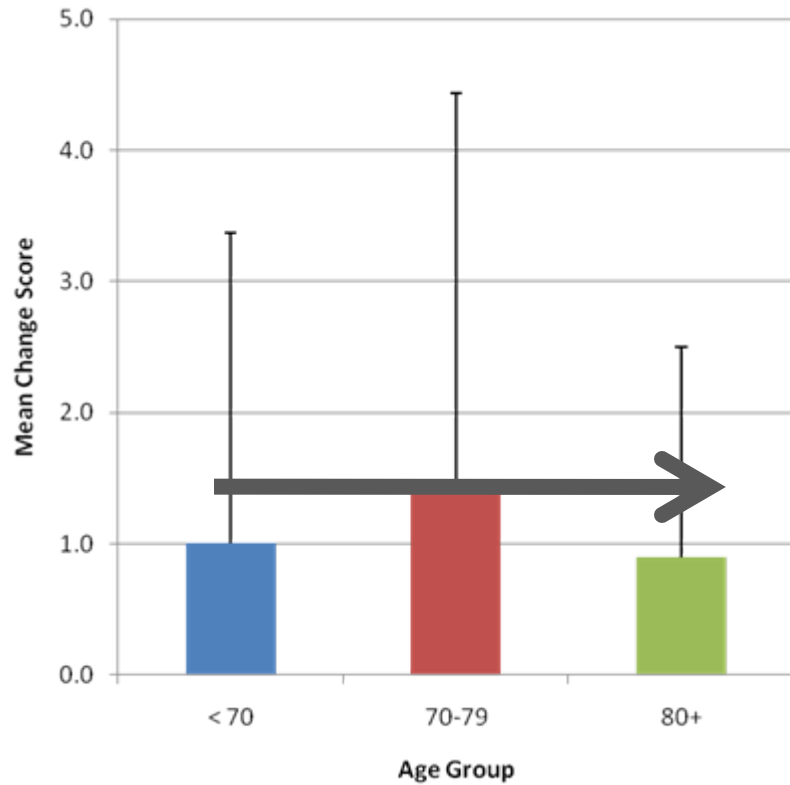
# SSQ Pragmatic Spatial Scales



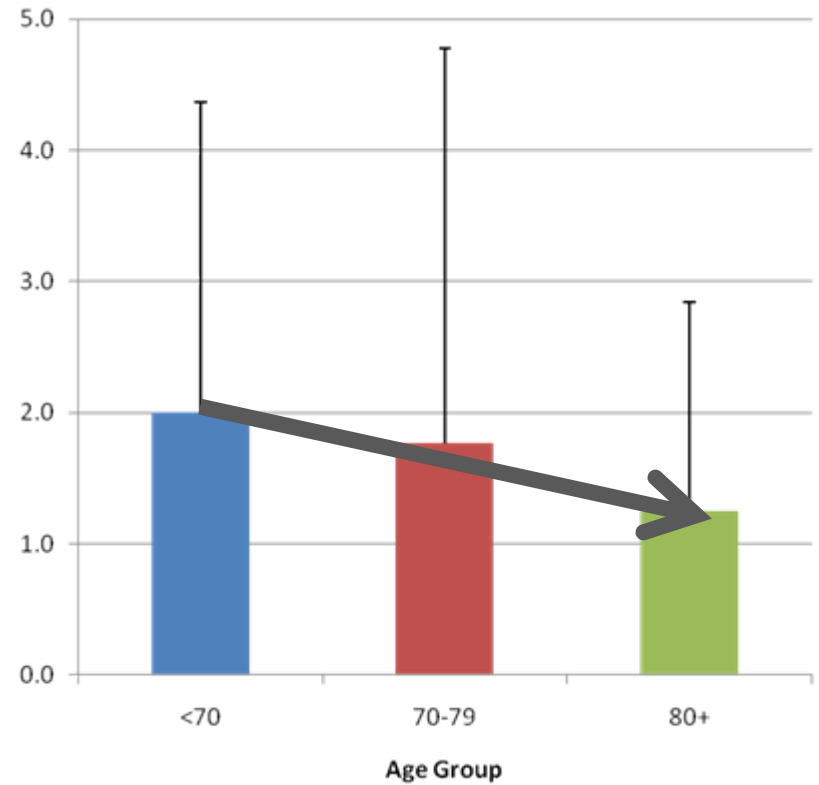
# SSQ Pragmatic Quality Scales



# FM Benefit for Pragmatic Qualities Scales as Function of Age



Sound Quality &  
Naturalness



Listening Effort

# Gold Standard Outcome

- ▶ Decision to keep FM devices beyond trial period
- ▶ **16** of **18** elected to continue use of FM systems at trial end!
- ▶ 1 in 80+ y/o group
- ▶ 1 in < 70 y/o group



# Summary

- ▶ Are outcomes of FM use better than outcomes for hearing aid alone use in older adults?
- ▶ Does age influence outcomes of FM use?

# Summary

- ▶ Are outcomes of FM use better than outcomes for hearing aid alone use in older adults?
  - **YES**
    - Individualized Goals (except groups in noise)
    - Satisfaction
    - Benefit
      - Cognitively challenging speech understanding conditions and Listening Effort

# Summary

- ▶ Does age influence outcomes of FM use?
  - **No**, for meeting Individualized Goals
  - **Yes**, Satisfaction increasing as mean age increased



# Summary

- ▶ Does age influence outcomes of FM use?
  - **Yes**, with **Benefit** decreasing as mean age increased for:
    - Speech in Speech Contexts
    - Multiple Speech Stream Processing and Switching
    - Listening Effort

# Summary

- ▶ Does age influence outcomes of FM use?
  - **Benefit decreasing as mean age increased**
    - Not surprising finding
    - SNR-50 increased as mean age increased
    - Role of cognitive functioning

# Conclusion

- ▶ Older adults can benefit from FM use
- ▶ Optimize outcomes:
  - Counseling, coaching, instruction
  - Additional intervention approaches:
    - Auditory–visual perceptual training
    - Conversational fluency training

# Audiological Intervention Toolbox



# References

- ▶ Dillon, H., James, A., & Ginis, J. (1997). Client Oriented Scale of Improvement (COSI) and its relationship to several others measures of benefit and satisfaction provided by hearing aids. *Journal of the American Academy of Audiology* . 8, 27–43.
- ▶ Gatehouse, S., Noble, W. (2004). The Speech, Spatial and Qualities of Hearing Scale (SSQ). *International Journal of Audiology*, 43, 85–99.
- ▶ Kochkin, S. (1990). Introducing MarkeTrak: a consumer tracking survey for the hearing instrument market. *Hearing Journal*, 43, 17.27.
- ▶ Pichora–Fuller, M.K., & Singh, G. (2006). Effects of age on auditory and cognitive processing: Implications for hearing aid fitting and audiological rehabilitation. *Trends in Amplification*, 10, 29–59.
- ▶ Ross, M. (2004). Listening with a “Third” Ear: FM Systems. Downloaded from: [http://www.audiologyonline.com/articles/pf\\_article\\_detail.asp?article\\_id=561](http://www.audiologyonline.com/articles/pf_article_detail.asp?article_id=561).