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Portland OR

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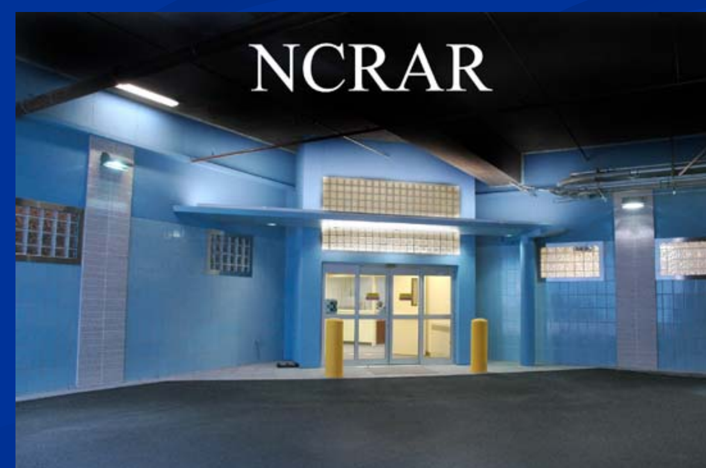
VA Rehabilitative Research & Development



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Mission

"to benefit veterans by alleviating the communicative, economic and social problems resulting from auditory system dysfunction"

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Investigators

Audiologists

Research Assistants

Engineers

Biostatisticians

Administrative

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NCRAR Staff

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Components

- Research
- Education & Outreach
- Mentoring
- Collaborate

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Components

RESEARCH

- Prevention of Hearing Loss, and Hearing Conservation
- Diagnosis and Assessment
- Rehabilitation Strategies, Devices and Techniques

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Anechoic Chamber

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Future Research Directions

- Rehabilitation of blast-related and noise-induced auditory injuries
- Rehabilitation strategies based on neural plasticity of the central auditory system
- Rehabilitation of dual-sensory impairment
- Telehealth and web-based audiological services and programs

All are translational hearing research initiatives

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NCRAR Collaborating Sites

VA Research Centers
COE for Aging Veterans with Vision Loss, MS COE West, HSR&D Polytrauma and Blast Injury QUERIs Palo Alto & Minneapolis, COE on Restoration of Function in Spinal Cord Injury & MS

VA Medical Centers
Bay Pines, FL, Biloxi, MS, San Diego, CA, Seattle-Tacoma, WA, Tampa, FL, Martinez, CA, Columbia, MO, Washington, DC, Nashville, TN

Portland VAMC
Audiology and Speech Pathology, Otolaryngology, Education, Neurology, Internal Medicine, Psychology, Oncology, HSR&D Division

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OHSU
OHRC, Dept. Med., Public Health & Preventative Medicine, SOSE, Behav. Neuroscience, Neurology, Advanced Imaging Research Center, School of Nursing, Oncology, Otolaryngology

Universities
Maryland, South Florida, Western Oregon, Pittsburg, Wisconsin, Emory, Indiana, Connecticut, Southern Illinois, Oregon, Washington,
Regensburg Germany

Institutes & Agencies
Walter Reed Army Medical Ctr., Boys Town Nat'l Rsh. Hosp., Naval Submarine Med Rsh. Lab., House Ear Inst, Cleveland Clinic, Smith-Kettlewell Eye Rsh. Inst. Starkey Hrg Rsch Ctr, Legacy Health System, DoD, VA Aud. & Spch.Path. Program Office

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Components

MENTORING

- **‘The next generation of auditory scientists’ (post-doctoral fellows, career development candidates, career scientists, visiting scientists)**
- **VA clinicians who have a desire to participate in conducting research**
- ***Au.D. students***

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Au.D. students

- 4th year externships: a research-based clinical experience
- NIH-sponsored summer research internship experiences: four students/year over the next 5 years

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Components

EDUCATION

- Professionals
- Students
- Veterans
- Community

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Education

- Professional seminar series
- Community Lecture Series
- Brochures for download
- Web-based Programs (tinnitus training for clinicians)
- Multimedia Hearing Loss Prevention Program
- Training Programs/workshops

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- **NCRAR Biennial Conferences:**

  Hearing Therapies for the Future

  September 27th & 28th 2007

- **Pre-conference workshop:**

  "Best practices in hearing loss prevention" **Theresa Schultz Ph.D., Kyle Dennis Ph.D. & David Chandler Ph.D.**

www.ncrar.research.va.gov/Education/Conf2007/Index.asp

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Some of My Research

- Performance-Perceptual Test as a Counseling Tool
- Localization and aging auditory system
- Hearing Loss Prevention program

Worked on these with Anna Forsline, Samantha Lewis and Susan Griest

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Hearing Aid Outcomes Measurement

Why measure hearing aid outcome?

- Justify costs to insurers and government
- Validate clinical decisions
- Demonstrate effectiveness of intervention to patients and their families.
- To help improve service we provide
- To create benchmarks against which to compare our clinical results.
- To establish a database for evidence-based practice and clinical practice guidelines

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Hearing Aid Outcome Measures

Two types are commonly used:

- Questionnaires to assess ‘subjective’ outcome
- Measures of speech understanding (in quiet and in noise) to assess performance-based outcome.

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What Are We Measuring?

FACT:

Questionnaire responses do not always reflect measured performance

i.e. there is often a disconnect between reported benefit and measured benefit

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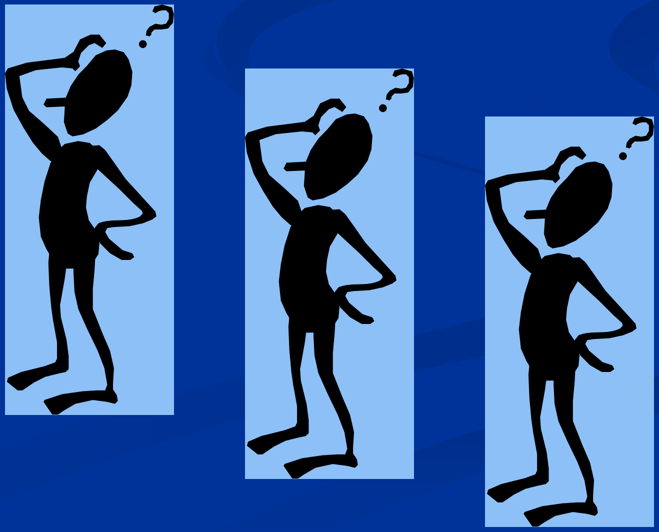
What Are We Measuring?

Some people report low satisfaction BUT testing shows considerable benefit

Others report high satisfaction BUT testing shows little or no benefit

WHY?



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At least 2 reasons:

1. Performance testing is conducted in the clinic, questionnaires reflect ‘real world’ listening.

Is it surprising then?

Which should we take notice of?

2. Different tools are used to measure each.

i.e. Questionnaires

vs.

Performance tests

Difficult to directly compare these two types of measure

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We came up with a test that enables a direct comparison of these.

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Performance-Perceptual Test (PPT)

Tests two conditions:

Performance = Actual ability to understand speech in noise (HINT)

Perceptual = Perceived ability to understand speech in noise

USING THE SAME TEST PROCEDURES

so results from the two are directly comparable

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Performance

Subjects repeat back HINT sentences presented in noise

Noise level is fixed

Speech level is altered depending upon response:

- Made quieter when sentence is repeated correctly (S/N more adverse)
- Made louder when repeated wrongly (S/N less adverse)

Perceptual

Subjects say whether they can understand sentences presented in noise

Noise level is fixed

Speech level is altered depending upon response:

- Made quieter when subjects say they can understand the sentence (S/N more adverse)
- Made louder when subjects say they cannot understand the sentence (S/N less adverse)

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The difference between these is a direct measure of the degree to which subjects (in)correctly assess their ability to hear:

= Performance Perceptual Discrepancy (PPDIS)

e.g.

5 dB S/N	minus	5 dB S/N	= 0 dB
Performance SRTN		Perceptual SRTN	PPDIS

→ Subject accurately estimates hearing ability

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Negative PPDIS

5 dB S/N	minus	10 dB S/N	= -5 dB
Performance SRTN		Perceptual SRTN	PPDIS

→ Subject underestimates hearing ability

Positive PPDIS

5 dB S/N	minus	0 dB S/N	= +5 dB
Performance SRTN		Perceptual SRTN	PPDIS

→ Subject overestimates hearing ability

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Test-retest Reliability

Data from a number of studies

Performance SRTN range: r = 0.924 to 0.988

Perceptual SRTN range: r = 0.934 to 0.989

PPDIS range: r = 0.810 to 0.880

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Some studies

PPT & OAD

Used the PPT to examine individuals with 'Obscure Auditory Dysfunction (OAD)'

Individuals who complain of difficulties hearing speech in noise and yet have 'clinically normal' hearing

PPT & OAD

Purpose: What is the underlying basis of OAD?

- Tested 50 subjects with OAD & 50 controls, (pairs matched on age, thresholds, noise exposure history)
- Large test battery including PPT, frequency resolution, personality questionnaires, dichotic listening test, gap detection

PPT & OAD

Used stepwise logistic regression to determine which combination of variables best differentiated OADs from matched controls.

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PPT & OAD

Independent variable	[illegible]	[illegible]–value	P<
PPDIS	33.1	-0.59	0.006
Performance SRTN	27.0	0.41	0.007
Dichotic listening test	[illegible]	[illegible].29	0.003
2kHz masked threshold	9.5	-0.38	0.010
Total	82.3		

OADs underestimated hearing ability

OADs performed less well

PPT & OAD

Next obtained a classification matrix via discriminant function analysis (DFA) to determine whether individuals were correctly or incorrectly identified using this equation.

PPT & OAD

Results

More false negatives than false positives i.e. under-predicted OAD status

	Predicted group	
Actual group	OAD	Control
OAD	80%	20%
Control	10%	90%

Saunders & Haggard (1992); Saunders, Field & Haggard (1992)

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Conclusion

The PPT, in particular the PPDIS variable, provides information over and above that provided by performance measures and questionnaire measures – at least for the OAD population

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PPT and Unaided Handicap

Subjects

- 33 normal hearing, 74 symmetrical SNHL
- 24 binaurally aided

Tests (subset)

- PPT unaided
- HHIE or HHIA

PPT and Unaided Handicap

Results

- Performance & Perceptual SRTNs are significantly correlated with thresholds (r=0.89 for both)
- PPDIS is not (r=0.04)
- No PPT variable is correlated with age when thresholds are accounted for.

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PPT and Unaided Handicap

Multiple regression analysis used to predict HHIE/A scores from age, 4F-PTA, Performance SRTN and PPDIS

PPT and Unaided Handicap

[illegible]	[illegible]	β-value	% variance explained	β-value
PPDIS	12.8	-0.370	[illegible]	[illegible]
[illegible]	[illegible]	0.755	13.8	0.715
Age	8.3	-0.347	10.8	-0.372
Total	41.2		39.3	

More handicap = underestimation

More handicap = poorer SRTN

More handicap = being younger

All subjects

HI subjects only

PPT and Unaided Handicap

- Handicap greater for underestimation of hearing (-ve β-value)
- Handicap greater for poorer performance (+ve β-value)
- Handicap greater for younger aged individuals (-ve β-value)
- Mis-perception explains almost as much variance as actual performance for HI subjects

Saunders et al, 2004

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PPT and Aided Listening

- 94 subjects with symmetrical SNHL
- Binaural HA users

- Tests: PPT, HHIE

PPT and Aided Listening

Multiple regression analysis to predict HHIE/A scores showed the same as for unaided listening:

Greater handicap is associated with:

- Underestimation of hearing ability
- Poorer performance
- Being younger

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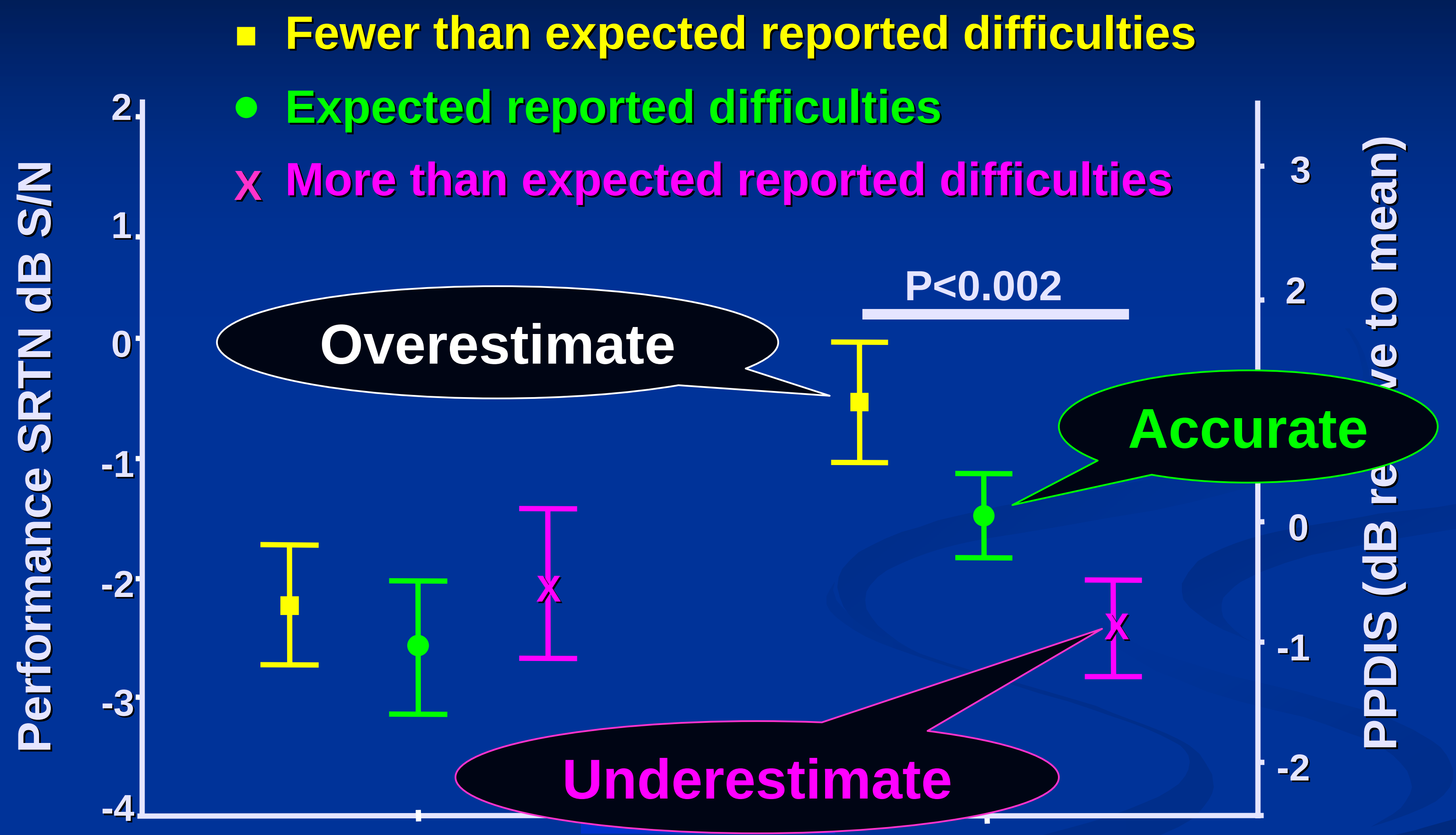
HHIE/A



Saunders & Forsline 2006

PPDIS – what determines it?

Not really investigated this but most likely is a ‘trait’ rather than a ‘state’

Evidence

Comparison of unaided and aided PPDIS values shows no difference ($t=0.3$, $p=0.75$)

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PPT as a Counseling Tool

PPDIS counseling has proven useful with OAD subjects:

- 37/50 subjects responded to a survey regarding their visits. Of these 33% found their visit useful or very useful.
- None received any ‘treatment’ but counseling
- Counseling is now part of a packet used in the UK

PPT as a Counseling Tool

Study in progress evaluating the PPT as a hearing aid counseling tool.

- Two groups of 40 dissatisfied HA users
- PPT, HHIE/A, APHAB, IOI-HA
- Group 1 receive PPT-based counseling
- Group 2 receive non-PPT counseling
- Outcome is compared

All subjects in Experimental Group 1:
PPT-based counseling

Subjects that underestimated their hearing ability

Subjects that Accurately assessed their hearing ability

Subjects that overestimated their hearing ability

Counseling Content A

Counseling Content B

Counseling Content C

- **Underestimation:**

  PPDIS < 33rd percentile of normative data

- **Accurate:**

  PPDIS between 33rd & 66th percentile of normative data

- **Overestimation:**

  PPDIS > 66th percentile of normative data

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PPT counseling consists of:

- Provision of information
- Suggested Explanations
- Subject Exposition
- Discussion
- Suggested Solutions

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Provision of information

Underestimate (Content A)	Accurate (Content B)	Overestimate (Content C)
This test shows you hear better than you think you do.	You accurately assess your hearing ability.	This test shows you overestimate how well you can hear

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Suggested Explanation

Underestimate (Content A)	Accurate (Content B)	Overestimate (Content C)
High expectations, cautious, reluctant to take risks, lack of confidence, not want to fail		Denial to self and others, slow onset of HL, over confident

Subject Exposition

Underestimate (Content A)	Accurate (Content B)	Overestimate (Content C)
Response to above, other explanations?	Response to above, comments?	Response to above, other explanations?

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Discussion/Implications

Underestimate (Content A)	Accurate (Content B)	Overestimate (Content C)
Fearful of social interaction, withdrawal, dependency.	Accepting of hearing loss and of the limitations it imposes.	Frustrate others, appear unintelligent or arrogant, misunderstandings or wrong information

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Solutions

Underestimate (Content A)	Accurate (Content B)	Overestimate (Content C)
Try guessing, take risks assume you heard correctly, rephrase to clarify to boost confidence, communication strategies	NA. Discuss communication strategies	Ask for clarification, admit to difficulties to self, communication strategies

All subjects in Experimental Group 2

Explanation of audiometric data

Discussion of the relationship between the audiogram and speech understanding ability

Rationale for measuring the Performance SRTN

Concept of S/N

Description of HINT normative data

Comparison of subject's Performance SRTN with HINT normative data

Discussion of communication strategies

Follow-up at 2 weeks and 10 weeks post-counseling to determine:

Has PPDIS changed?

and more importantly whether

Have reported handicap, disability and HA satisfaction changed?

Results

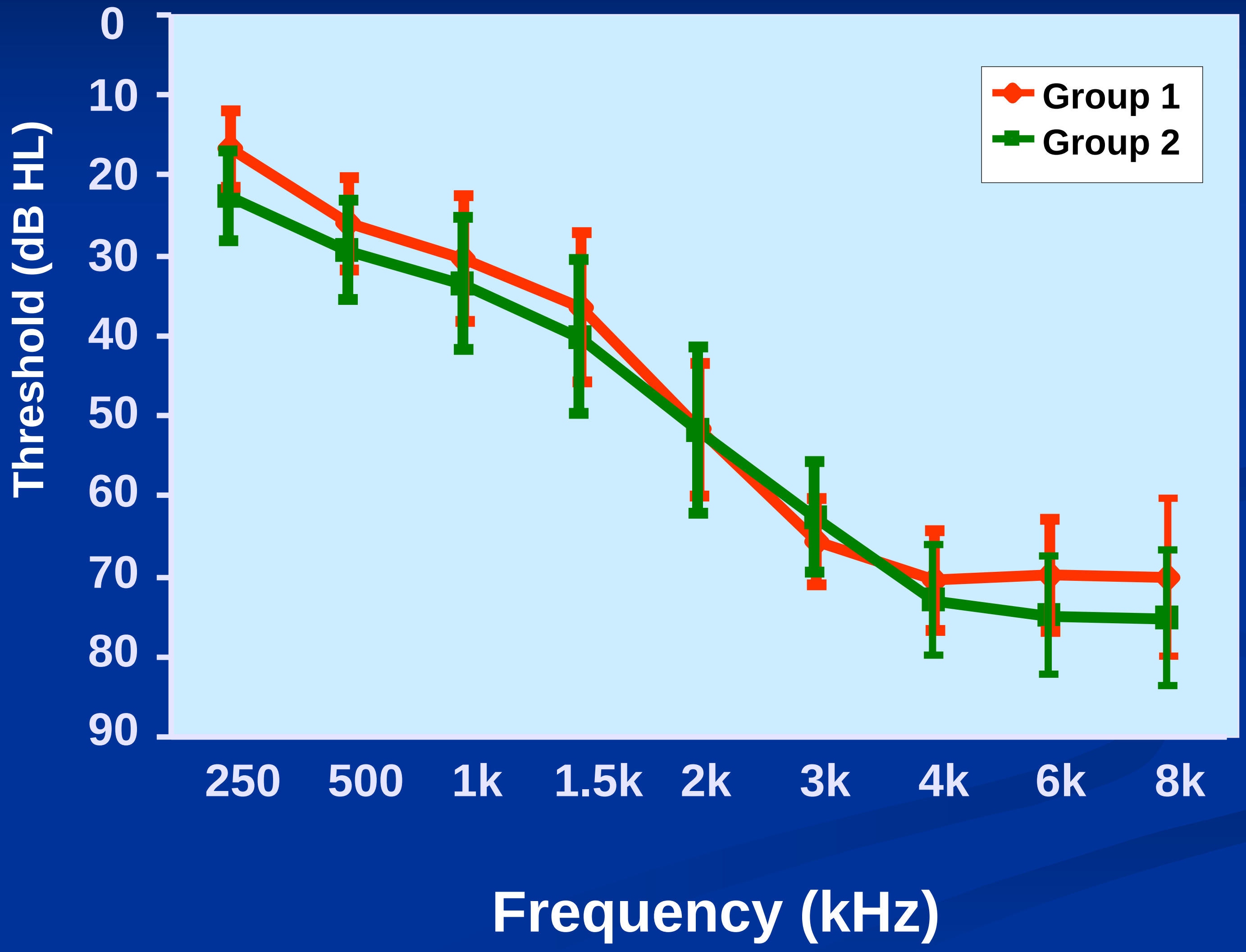
- Data from 44 subjects:

    23 in Group 1,

    21 In Group 2

Mean age 65.4, range 48-75 years

Mean group audiogram.
Left & right ears combined



Interesting that:

- 10 accurate
- 2 overestimators
- 32 underestimators

All dissatisfied HA users – something to do with underestimation perhaps?

Group mean PPT values from Visit 1

Variable	Group 1	Group 2	F-value P-value
Unaided Performance SR[illegible]	[illegible]	[illegible]	[illegible]0.46 [illegible]1
A[illegible] Performance S[illegible]	[illegible]	[illegible]	[illegible]
Unaided PPD[illegible]	[illegible]	[illegible]	[illegible]70 [illegible]=0.330
Aided PPDIS	-3.2 (2.5)	-3.4 (2.5)	F=0.025 P=0.876
Aided benefit	2.7 (2.3)	1.8 (2.5)	F=1.43 P=0.239

No group differences at baseline on PPT variables

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Repeated measures ANOVAs comparing Visits 1 & 2 Performance SRTNs

Significant finding:

- main effect of aiding

Non-significant findings:

main effect:

- retest

interactions:

- Group x aiding
- Group x retest
- Group x aiding x retest

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Repeated measures ANOVAs comparing Visits 1 & 2 PPDIS

Significant finding:

main effect of aiding

Non-significant findings:

main effect:

- retest

interactions:

- Group x aiding,
- Group x retest
- Group x aiding x retest

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Conclusion so far:

- Counseling does not change PPDIS value ‘significantly’ when examined in the manner

Next analysis:

- Examined subjects in terms of whether they changed PPDIS status i.e. whether they over-, accurately or under-estimated their hearing ability

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	Classification at Visit 2			
	Visit 1	Under-estimator	Accurate	Over-estimator
Group 1	Underestimator	7	8	0
	Accurate	3	3	0
	Overestimator	0	2	0
Group 2	Underestimator	9	3	1
	Accurate	1	4	1
	Overestimator	0	0	1

- ✓ Underestimator to accurate
- ✓ Overestimator to accurate

- x Accurate to overestimator
- x Accurate to underestimator

- Accurate to accurate
- Underestimator to overestimator
- Overestimator to underestimator

	Desirable change	Undesirable Change	Neutral/ No Change
Group 1	10	3	10
Group 2	3	2	15

The groups do not differ significantly but almost chi-square = 0.091

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Questionnaire data

- To date, the questionnaire responses show no group differences
- Data from a final interview are more interesting

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Final Interview

Has your ability to hear with your hearing aids changed?

	Better	Same	Worse
Group 1	8	14	1
Group 2	6	15	0

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Have you had your hearing aids reprogrammed since beginning the study?

	Yes	No
Group 1	7	16
Group 2	6	15

As a result of being in this study do you feel differently about your hearing?

	Yes	No
Group 1	11	12
Group 2	11	10

Group 1

I realize I ‘fake’ a lot

Am more willing to rely on HAs

Questionnaires made me think about my hearing

Your +ve feedback was helpful

Now I realise I need HAs

I am willing to try/wear my HAs

I can explain the difficulties I have better to my family

I am more aware of what I miss

I feel vindicated to know I do have a problem

Group 2

I am more aware of my difficulties

I accept and understand my HL better

I know there is hope

I pay more attention to what is said

I have more confidence now

I ask for help from people

I understand I have a hearing loss and now have lower expectations

Do you feel differently about your hearing aids as a result of being in this study?

	Yes	No
Group 1	13	10
Group 2	10	11

Group 1

Before study I thought HAs didn't help, now I know they do

I have more respect for my HAs

I realize they help me a lot

I now realize I'll never hear normally again

I wear them more

I'm pleased to have them now

Intellectually I realize their value

I am more aware of what they do for me

Group 2

I have an FM system now and so I wear them more

Now I leave them in after work, this helps at home

I feel friendlier towards them

I am more relaxed with them in

I know they help

I am more accepting of the HAs

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Have you been wearing your hearing aids more since starting this study?

	Yes	Same	Wore fulltime
Group 1	9	3	11
Group 2	11	4	6

Seventy-three percent of patients who didn't already wear their hearing aids all waking hours reported increased use on Visit 2

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Summary

- Almost 3 times as many individuals in Group 1 as Group 2 had a desirable change in PPDIS
- Counseling for Group 2 was also helpful
- Both groups of dissatisfied users benefited

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From the final interview many people liked the counseling – even those in group 2. So if nothing else it would seem that education of patients is very helpful.

Summary

- PPT is quick and efficient (10 minutes)
- It provides information additional to that currently measured by audiometric and performance tests
- Potentially has applications as a counseling tool

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Applications of the PPT

- ✓ to help ‘deniers’ (people who overestimate their hearing ability?) become aware that they do have hearing loss
- ✓ to give confidence to individuals that underestimate their hearing ability
- ✓ to improve HA satisfaction

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Acknowledgements

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Thank you to Anna Forsline my invaluable research audiologist

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Sound Localization and the aging auditory system

Background

Horizonatal sound localization and the auditory system

Interaural time differences (ITD): signals <1.5 kHz

Interaural level differences (ILD): signals > 2 kHz

Spectro-temporal pinna cues: > 6.0 kHz & back-front discrimination

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Background

Localization in horizontal plane is better for:

- Wide-band signals than narrow-band signals (both ILDs and ITDs are available)
- Low and high frequencies over mid-frequencies

- *Re: low vs. high: data are mixed*

Background

Impact of hearing loss

- Asymmetric hearing loss is a huge problem
- SNHL has (surprisingly little) impact of localization if the signal is audible
- Localization performance is not easily predicted based on audiogram
- SNHL seems to affect LF localization more than HF localization – audibility provides access to ILD cues not ITD cues?

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Background

Impact of Age

Few studies, those that exist show:

- Independent effects of age and HL on sound localization

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Study

What are the effects of aging and hearing loss on localization of sound in horizontal plane for signals of different frequency and bandwidth?

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Methods

Subjects

- Three groups

  10 young normal hearing listeners (YNH)

  10 Older normal hearing listeners (ONH)

  10 older hearing impaired listeners (OHI)

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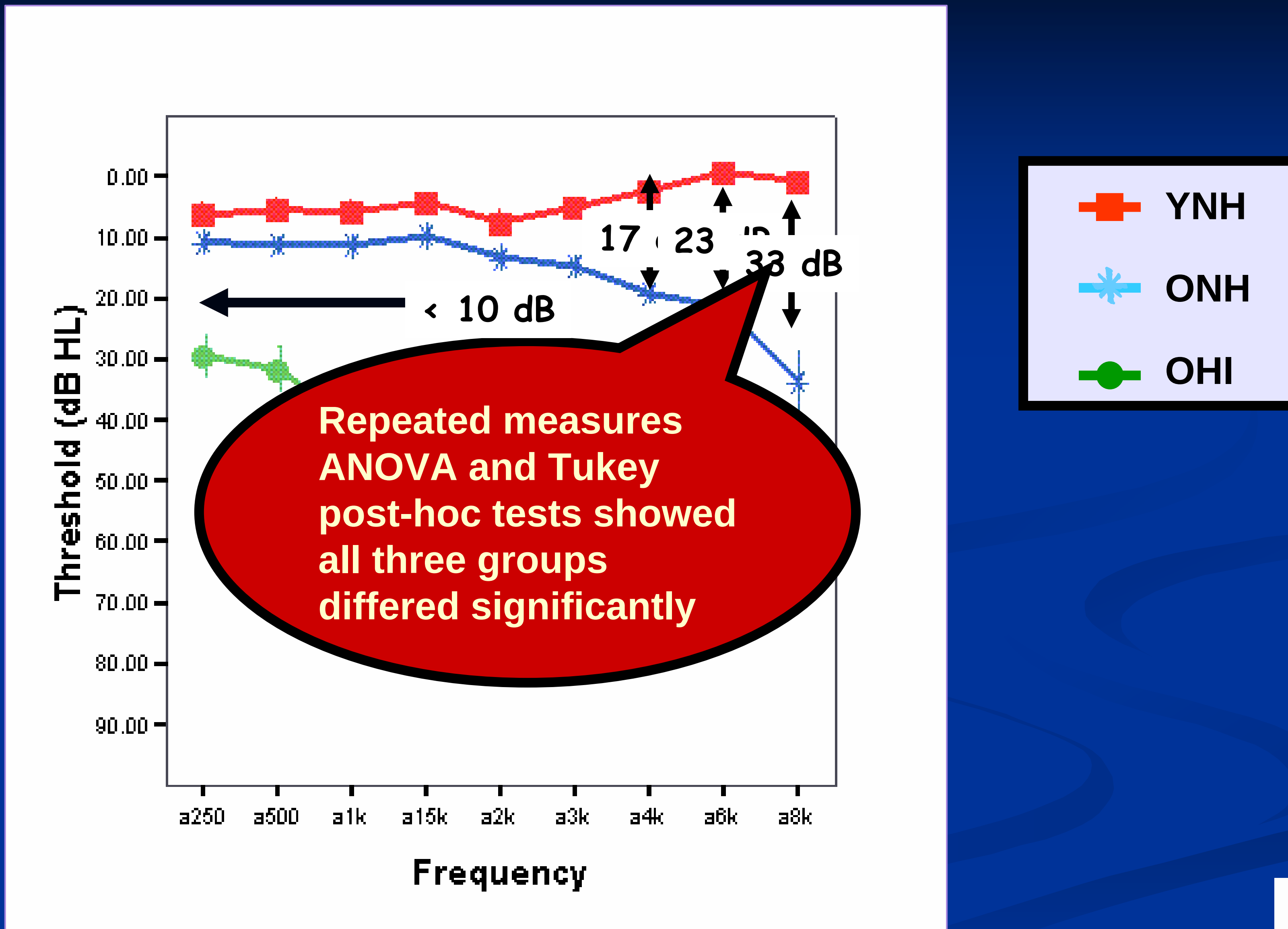
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
Threshold (dB HL)
a250
a500
a1k
a15k
a2k
a3k
a4k
a6k
a8k
Frequency
< 10 dB
17
23
33 dB
Repeated measures ANOVA and Tukey post-hoc tests showed all three groups differed significantly
YNH
ONH
OHI

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Participant ages by group.

Group	Mean Age	SD	Range
YNH	26.8	4.3	20-35
ONH	66.3	4.8	60-74
OHI	69.0	7.2	59-78

Analyses show YNH differs from ONH & OHI but ONH and OHI do not differ

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Test Measures

Audiometric evaluation:

- pure tone thresholds
- Word recognition at 40 dB HL CID W-22 list
- Speech reception threshold CID W-1 list

Speech Perception in Noise

- HINT

Sound Localization measurement

Speech test results, along with ANOVAs for between-group comparisons.

Group	SRT [illegible]	WRS (%)	HINT (S/N)
[illegible]	[illegible]	[illegible]	-78 (1.7)
[illegible]	[illegible]	[illegible]	-5.7 (2.5)
OHI	[illegible]	[illegible]	-1.3 (2.0)
ANOVA	F(2,27) 77.1 p<0.001	F(2,27) 36.2 p<0.001	F(2,27) 24.7 p<0.001

OHI scores were significantly poorer than YNH and ONH

YNH & ONH did not differ

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Sound localization

Signals

NBN: 0.25-0.5 kHz, 1-2kHz, 3-6kHz

WBN: Speech-shaped

500ms duration with 10ms rise-fall times

70 dB SPL

Test configuration

24 speakers, separated by 15º

3 repetitions per speaker

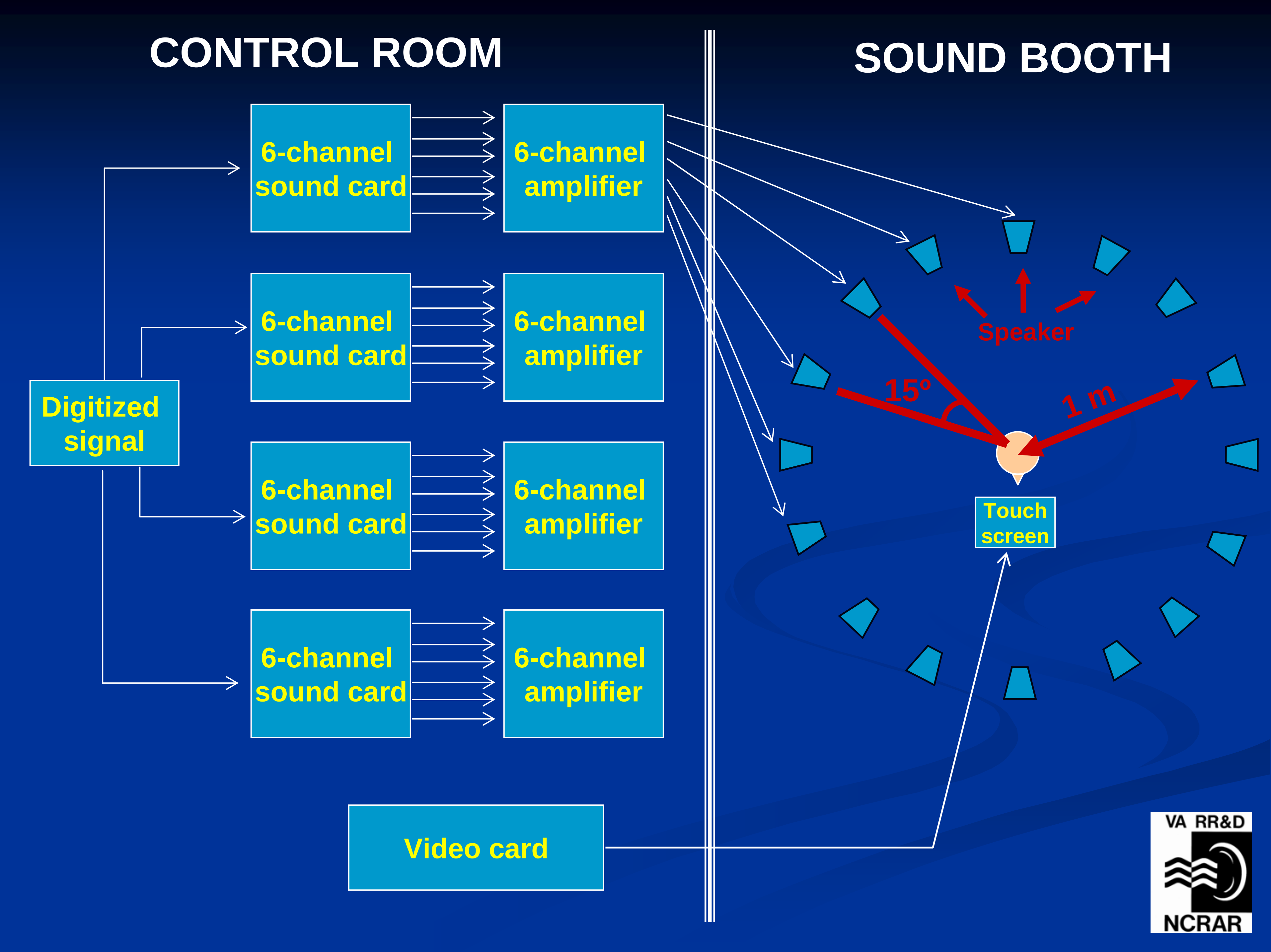
Calibration

Automated process.

Tolerance of +/- 0.25dB SPL

Practice run

White noise


CONTROL ROOM
SOUND BOOTH
Digitized signal
6-channel sound card
6-channel amplifier
6-channel sound card
6-channel amplifier
6-channel sound card
6-channel amplifier
6-channel sound card
6-channel amplifier
Video card
Speaker
15°
1 m
Touch screen
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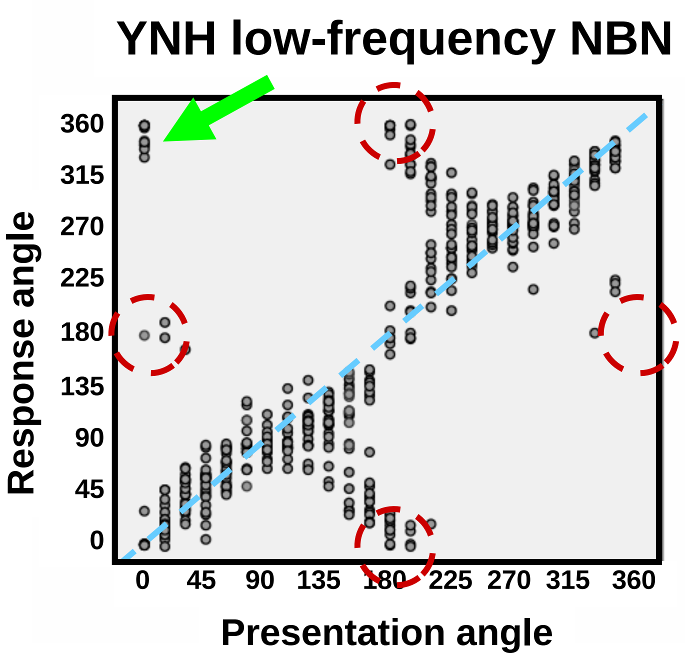
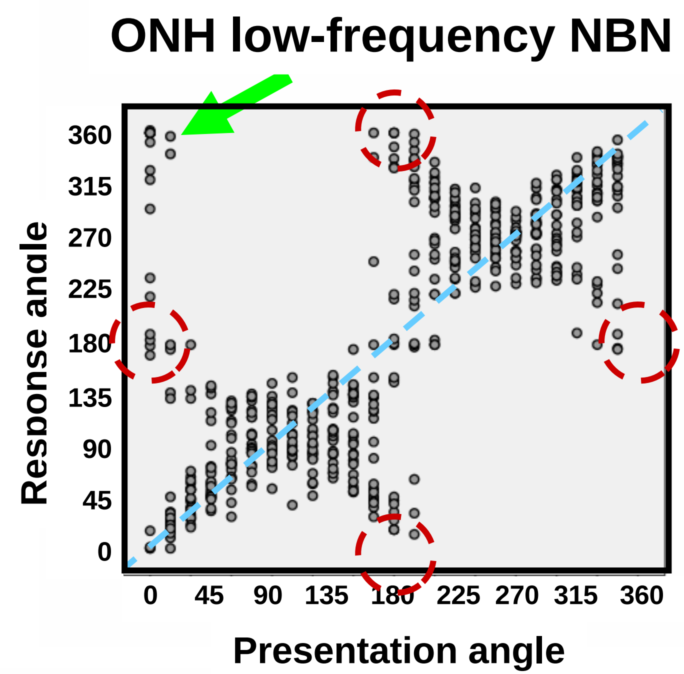
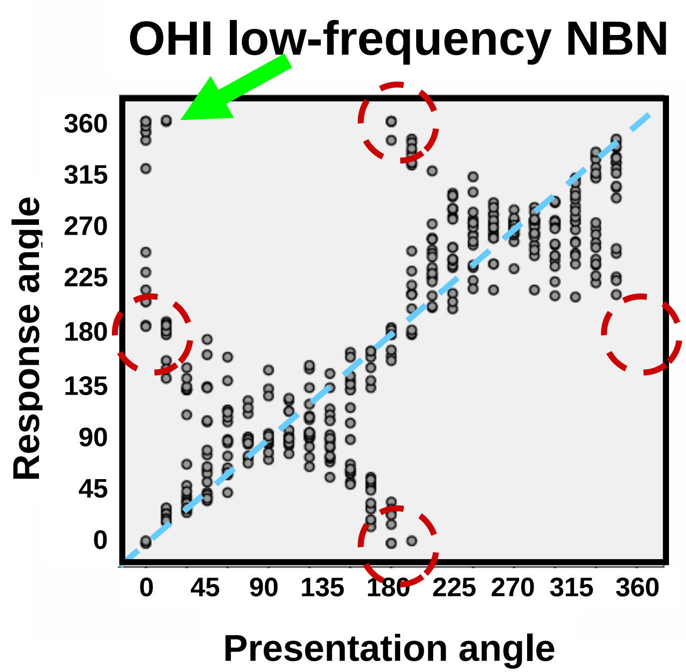
Touch screen

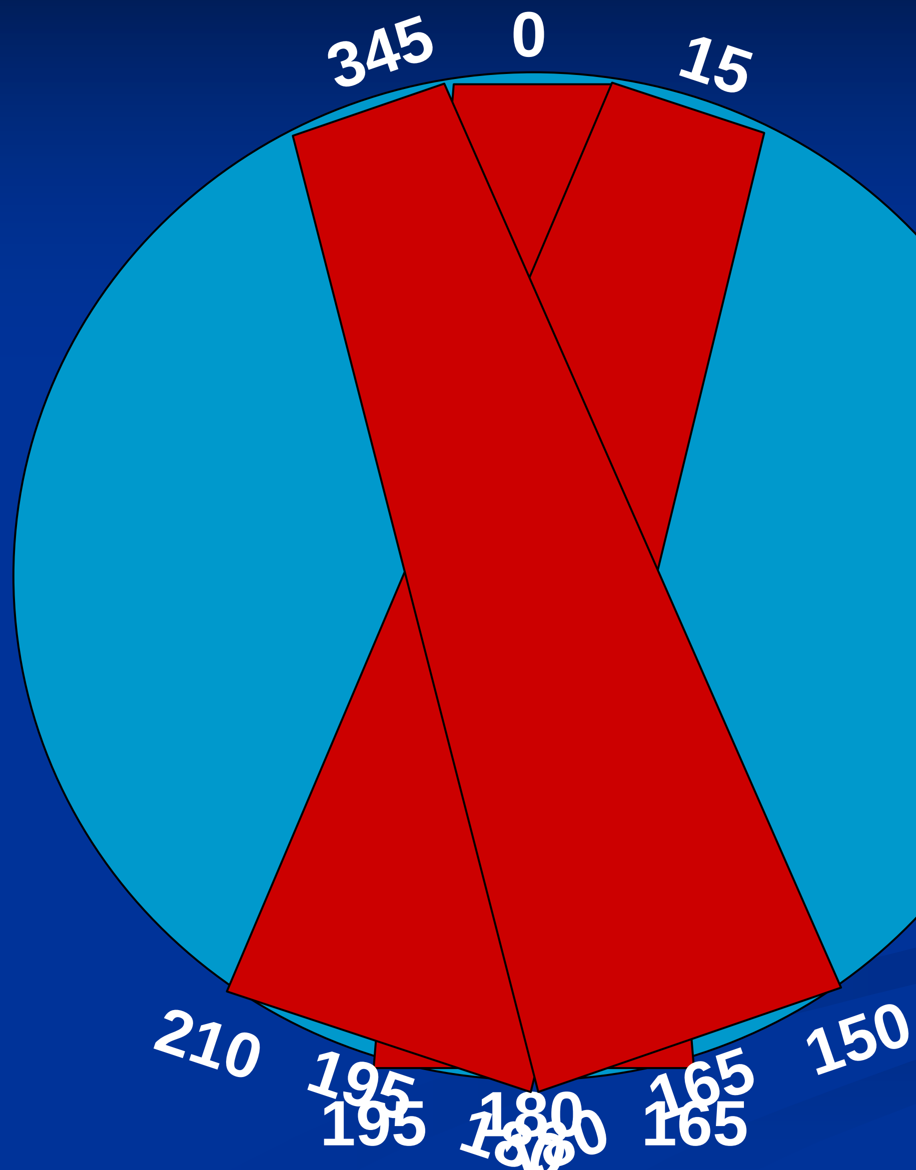
Photo of booth


YNH low-frequency NBN
Response angle
Presentation angle
0
45
90
135
180
225
270
315
360

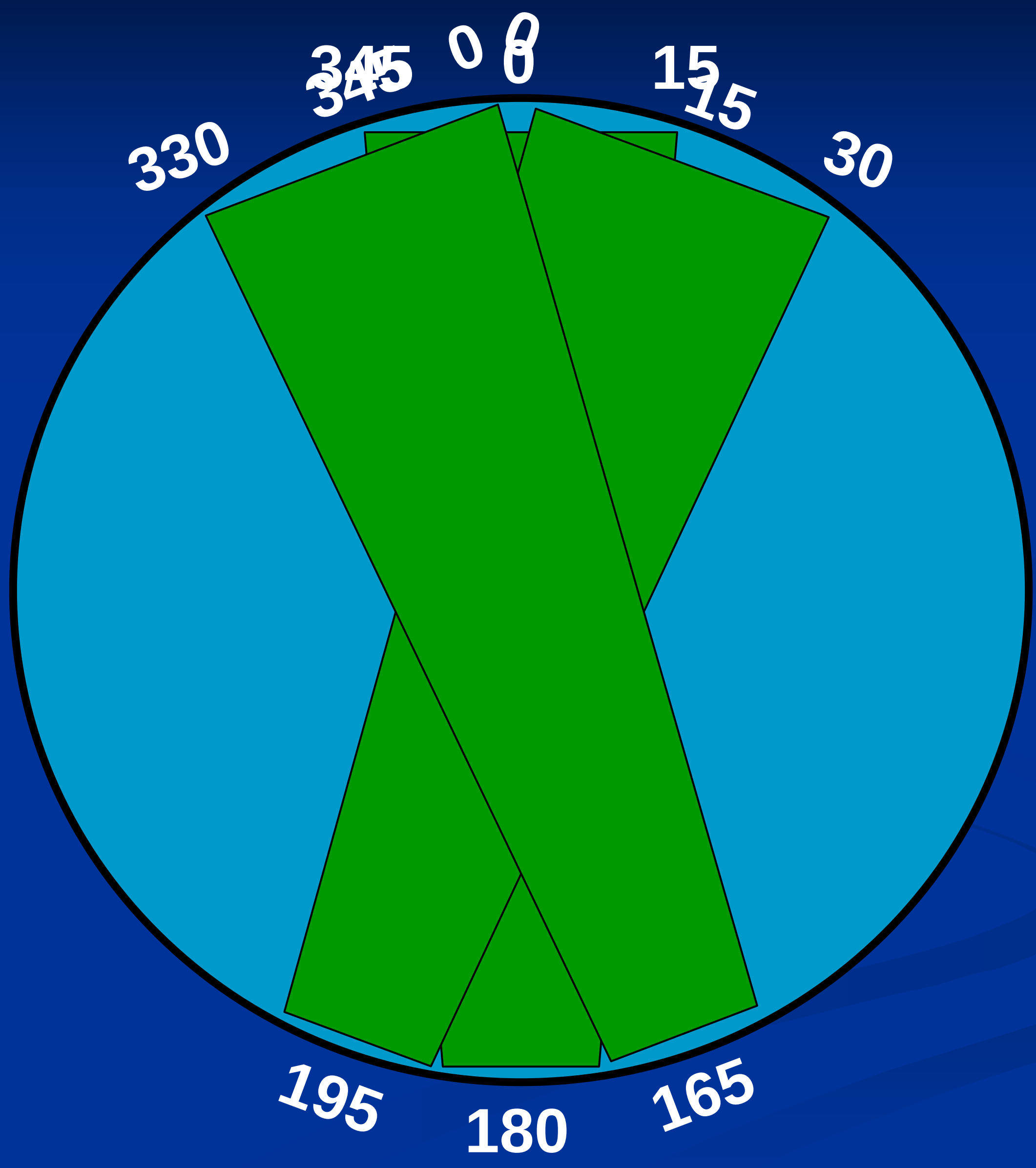

ONH low-frequency NBN
Response angle
Presentation angle
0
45
90
135
180
225
270
315
360

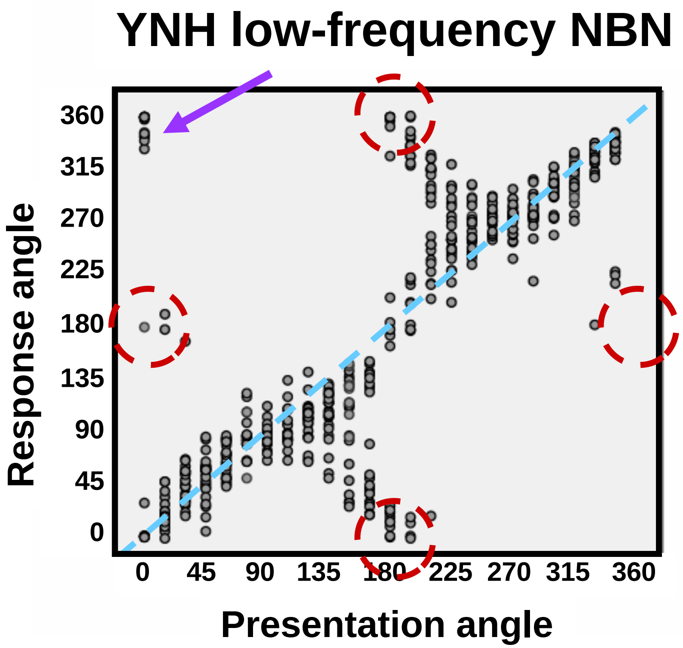

OHI low-frequency NBN
Response angle
Presentation angle
0
45
90
135
180
225
270
315
360

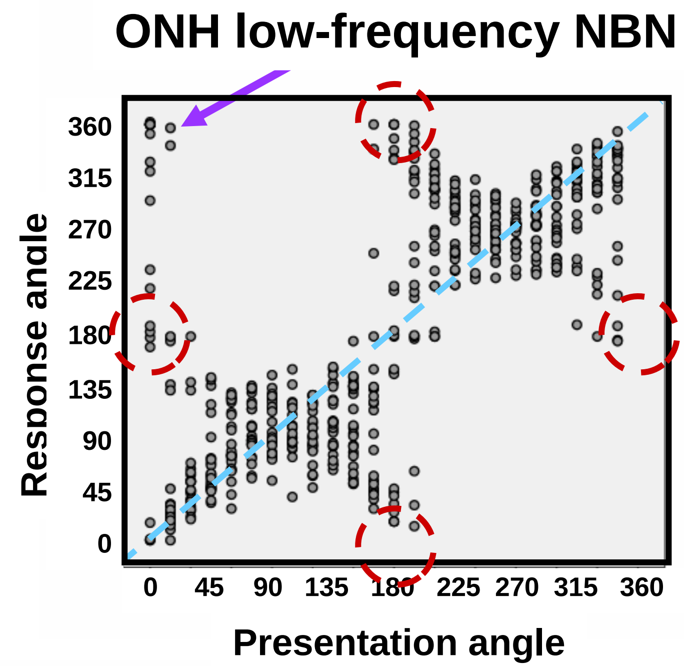
Front-Back reversals

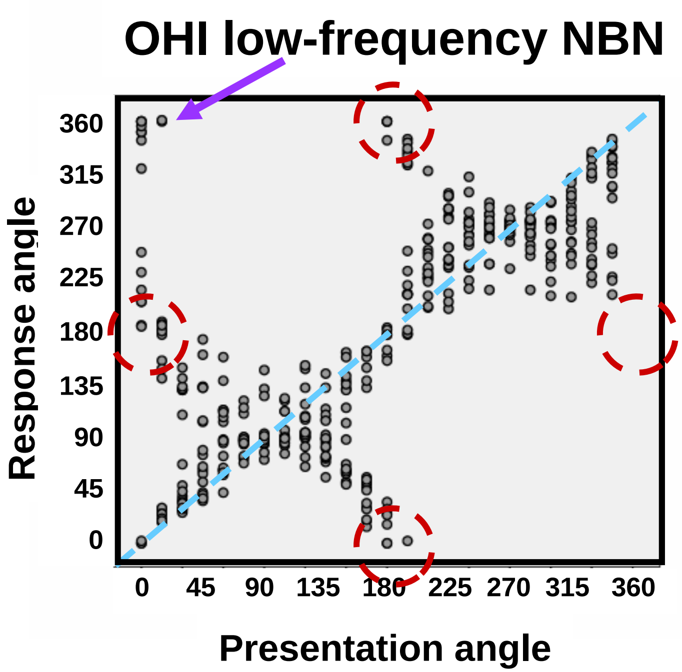


Back-Front reversals

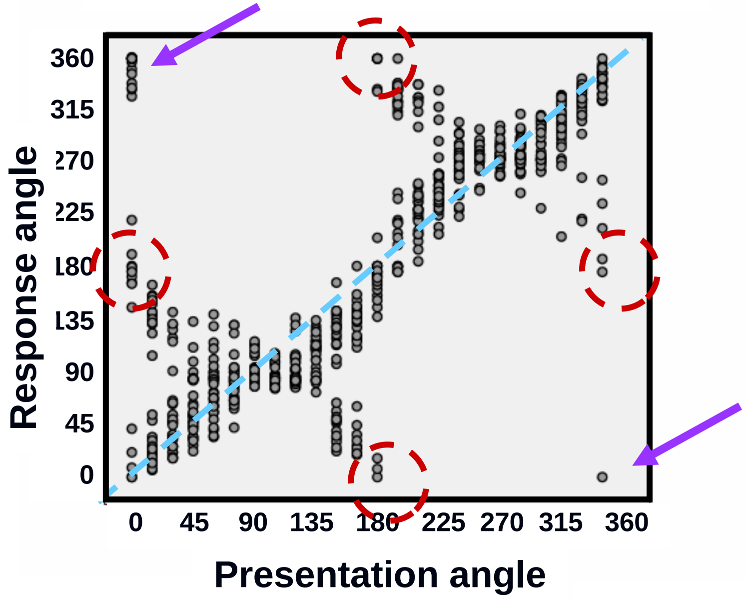



YNH low-frequency NBN
Response angle
360
315
270
225
180
135
90
45
0
0 45 90 135 180 225 270 315 360
Presentation angle

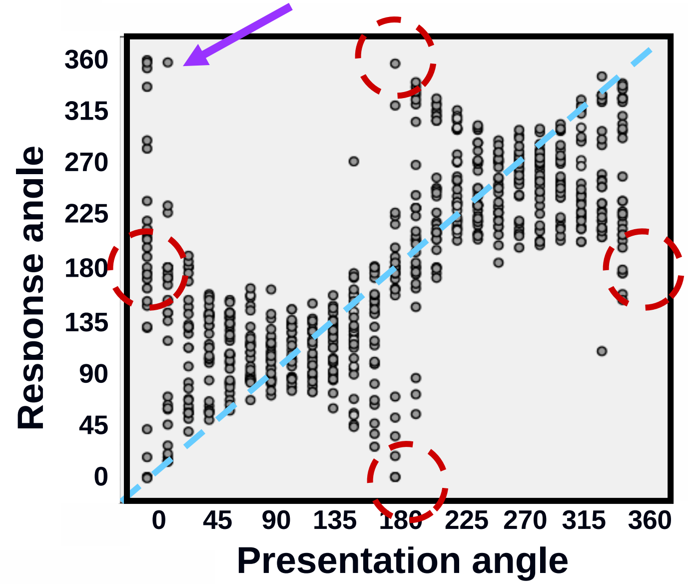

ONH low-frequency NBN
Response angle
360
315
270
225
180
135
90
45
0
0 45 90 135 180 225 270 315 360
Presentation angle


OHI low-frequency NBN
Response angle
360
315
270
225
180
135
90
45
0
0 45 90 135 180 225 270 315 360
Presentation angle

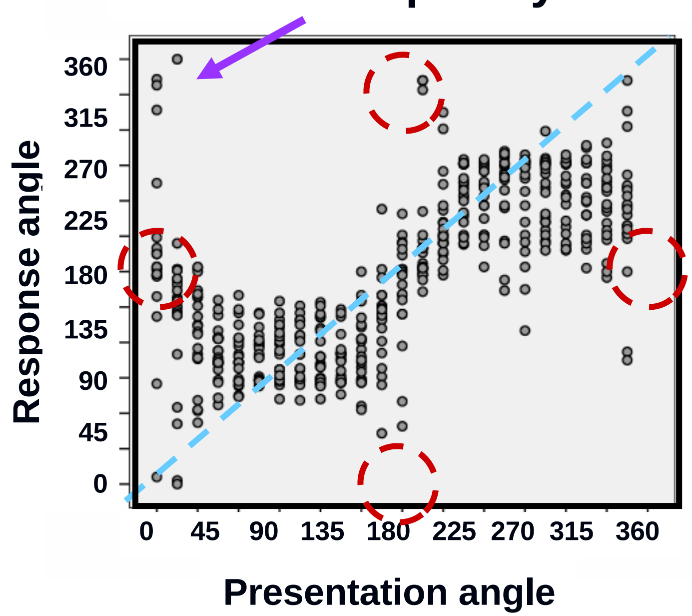
YNH mid-frequency noise

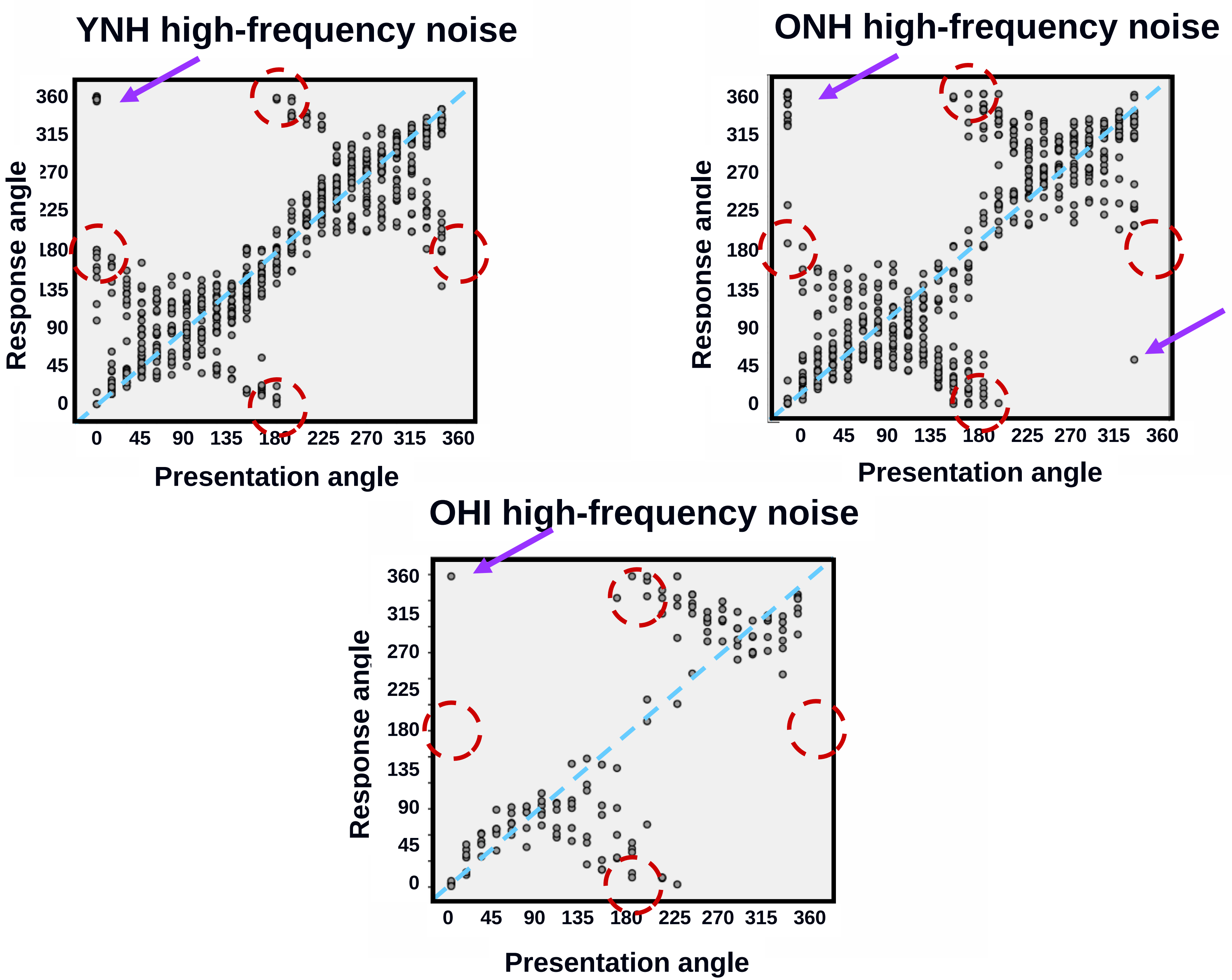


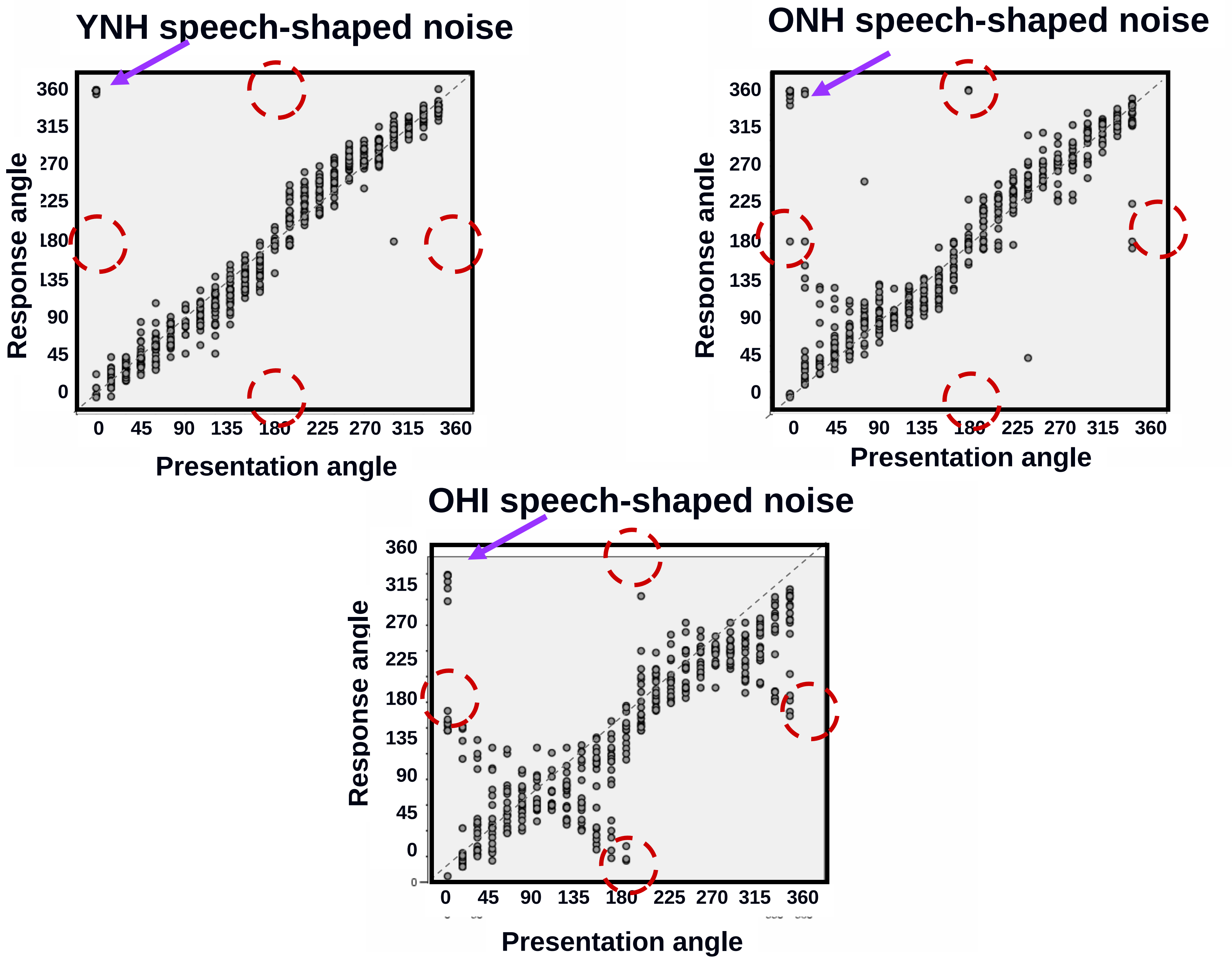
ONH mid-frequency noise



OHI mid-frequency noise




YNH high-frequency noise
ONH high-frequency noise
OHI high-frequency noise
Response angle
Presentation angle
0
45
90
135
180
225
270
315
360



YNH speech-shaped noise
Response angle
360
315
270
225
180
135
90
45
0
0 45 90 135 180 225 270 315 360
Presentation angle
ONH speech-shaped noise
Response angle
360
315
270
225
180
135
90
45
0
0 45 90 135 180 225 270 315 360
Presentation angle
OHI speech-shaped noise
Response angle
360
315
270
225
180
135
90
45
0
0 45 90 135 180 225 270 315 360
Presentation angle

Percentage of F-B and B-F reversals by participant group and test stimulus.

	Front-Back			
Participant Group				Speech
YNH				
ONH				
OHI				

Main effect of stimulus

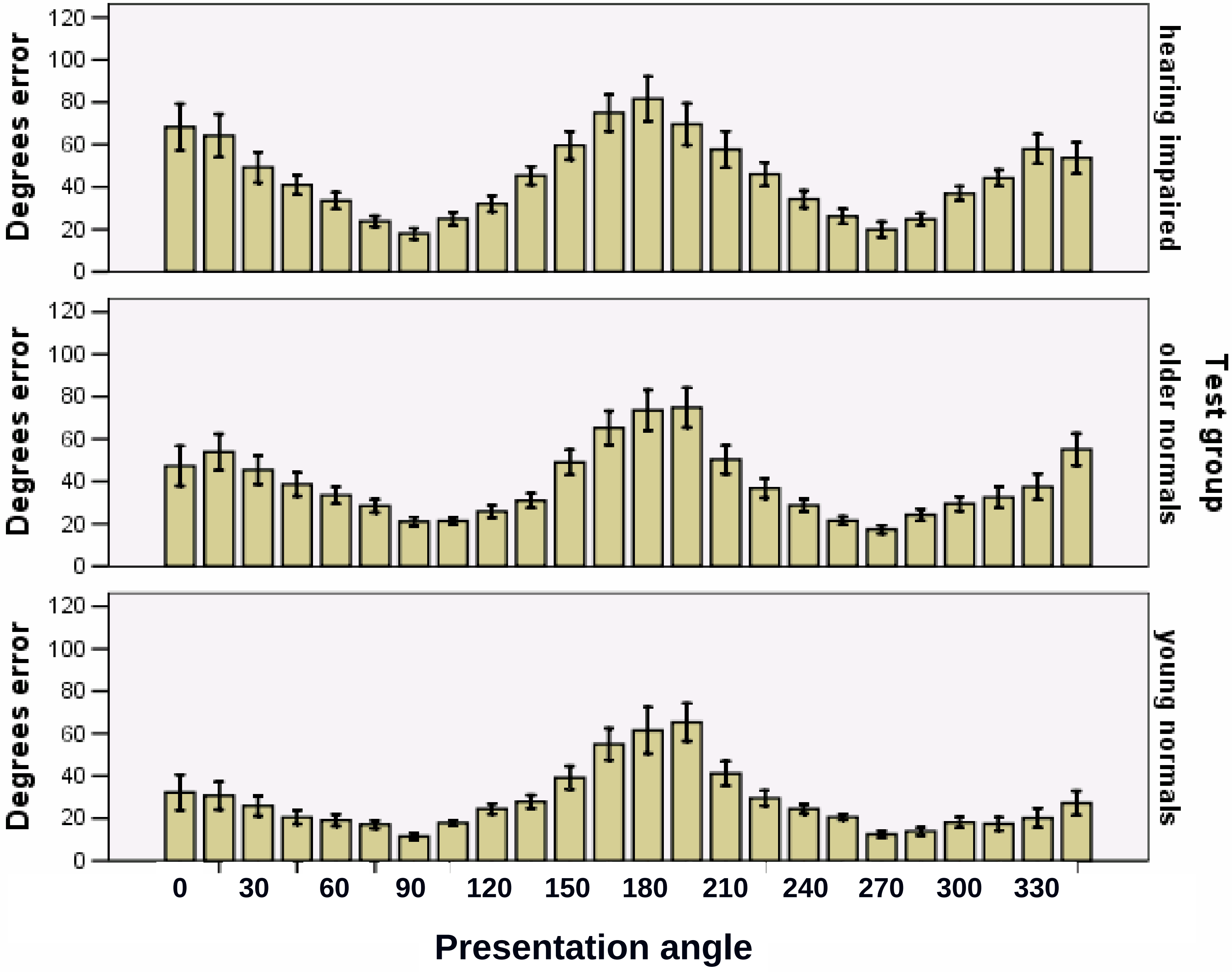
F-B errors: more for mid than others

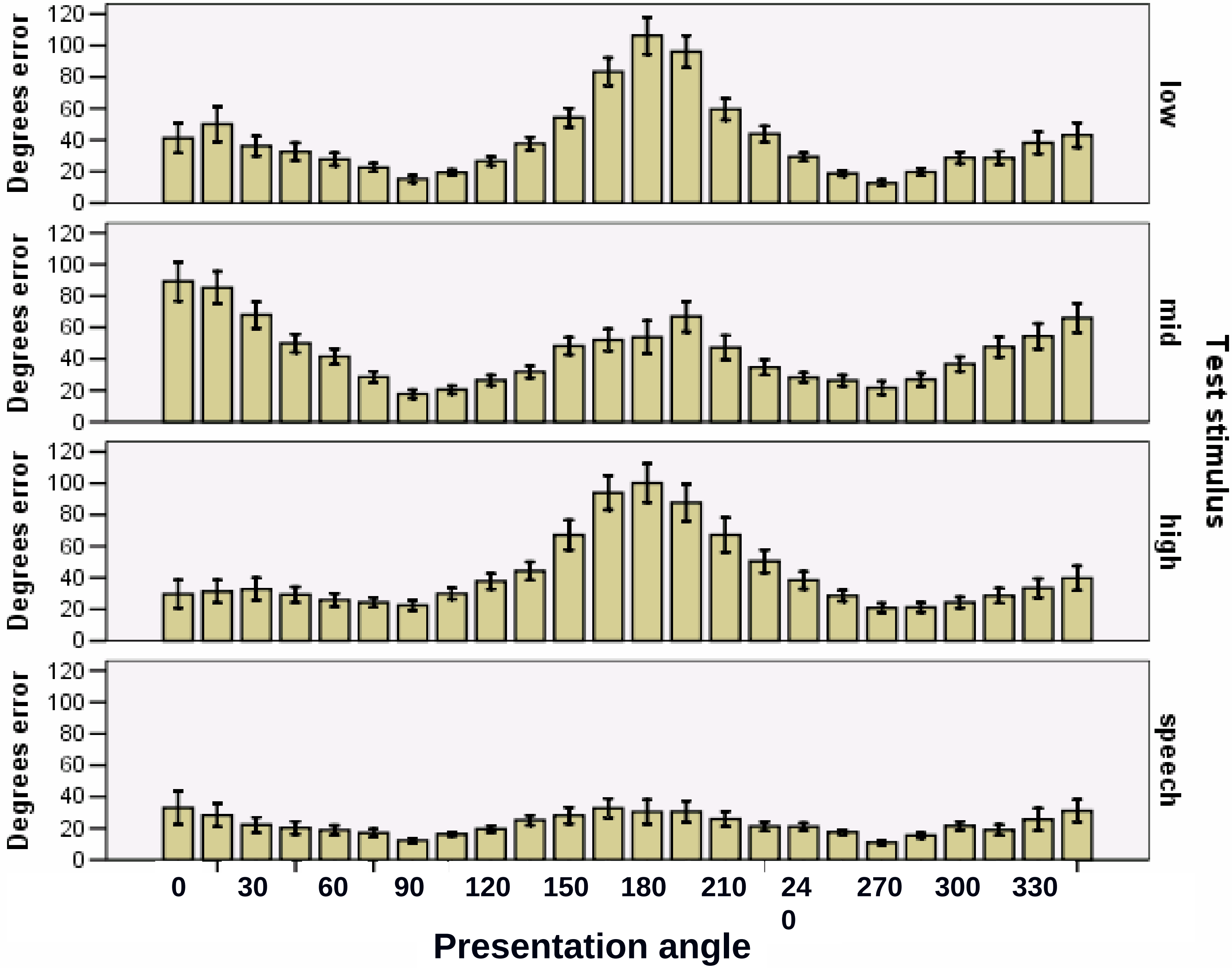
B-F: more for LF & HF than mid and speech

No significant effects for comparisons involving group

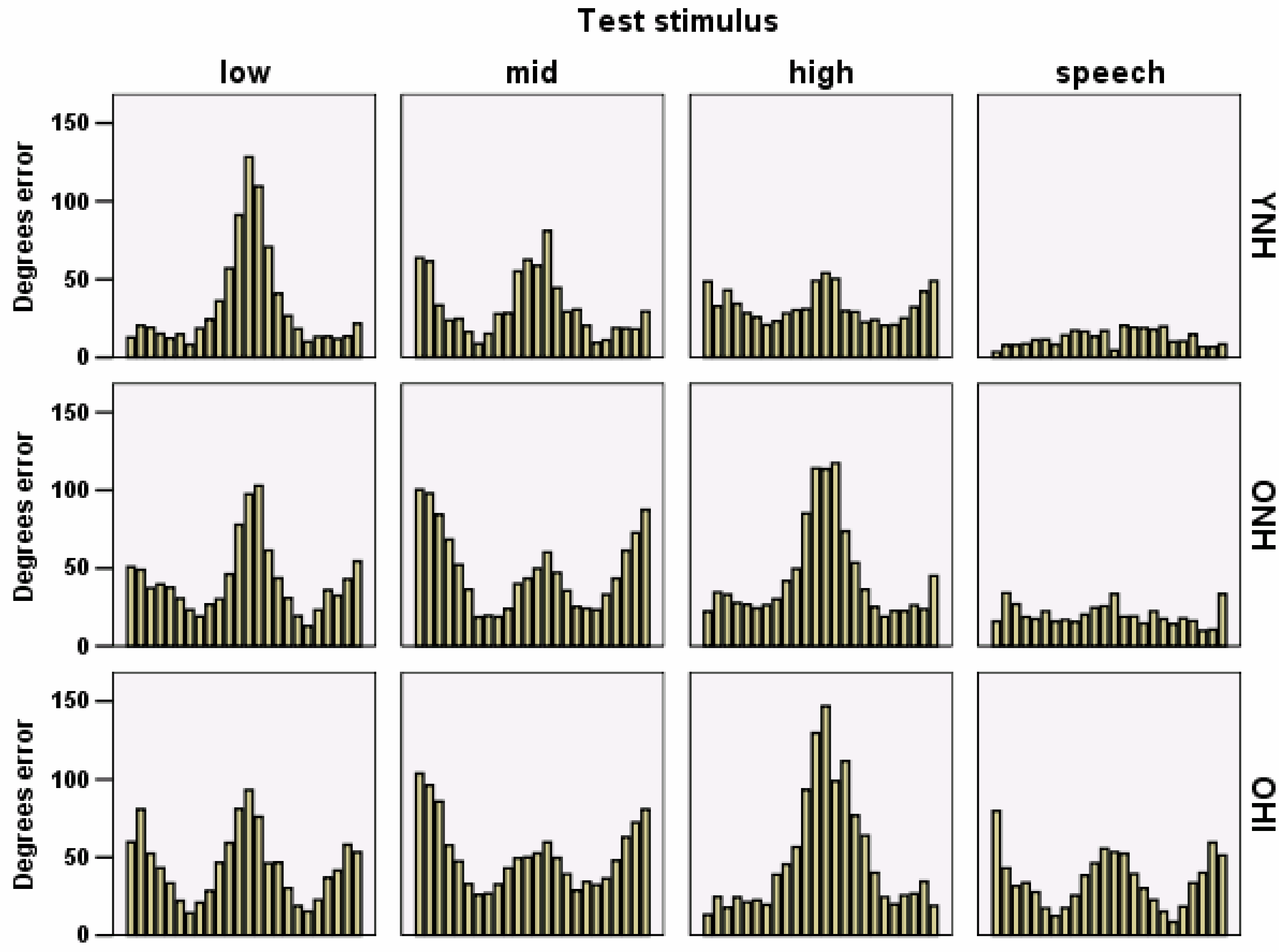
	Low	Mid	High	Speech
YNH	**21.4**	**6.7**	**7.8**	**0**
ONH	**7.8**	**3.3**	**20.7**	**2.3**
OHI	**13.6**	**1.2**	**12.7**	**3.4**

VA RR&D NCRAR


Degrees error
120
100
80
60
40
20
0
hearing impaired
older normals
Test group
young normals
0
30
60
90
120
150
180
210
240
270
300
330
Presentation angle



Degrees error
120
100
80
60
40
20
0
low
mid
high
speech
Test stimulus
0
30
60
90
120
150
180
210
24
0
270
300
330
Presentation angle



Test stimulus
low
mid
high
speech
Degrees error
150
100
50
0
YNH
ONH
OHI

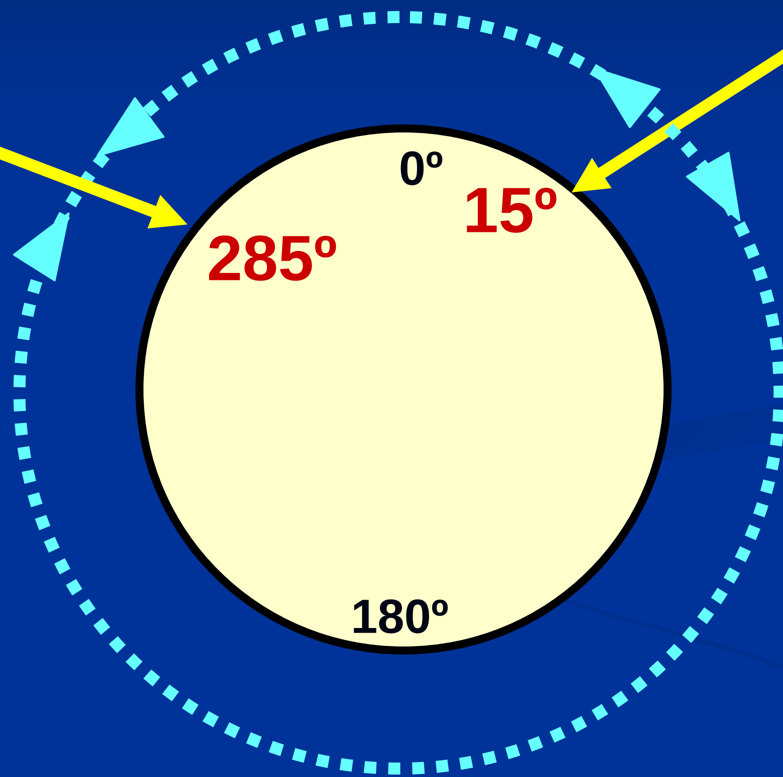
VA RR&D NCRAR

|P-R| =
360º - (285º – 15º) = 90

Presentation angle

Response angle

|P-R| =
285º - 15º =
270º



VA RR&D NCRAR

Mean RMS errors

Participant group	RMS error			
	Low	Mid	High	Speech
YNH	55.1 (10.2)	50.8 (15.2)	49.0 (20.8)	16.4 (2.9)
ONH	61.0 (6.5)	66.6 (8.4)	[illegible]	31.3 (9.1)
OHI	[illegible]	[illegible]	[illegible]	[illegible]
F=([illegible] P- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	Speech
YNH	[illegible]	[illegible]	44.7 (17.8)	16.4 (2.9)
ONH	55.6 (6.8)	60.9 (7.9)	56.9 (11.3)	27.7 (9.2)
OHI	55.9 (6.3)	62.4 (10.4)	60.5 (13.0)	45.2 (14.7)
F=(2,29) P-value	4.9 0.016	8.7 0.001	3.2 0.056	20.5 <0.001

<u>RMS erro</u>

Main effect of

Main effect of

Interaction stimulus

<u>RMS error without F-B and B-F</u>

Main effect of stimulus only

YNH listeners performed better than ONH and OHI

- For LF & MF signals ONH and OHI did not differ, both performed more poorly than YNH
- For speech-shaped noise all groups differed with YNH best and OHI poorest
- For HF signal there were no group differences

VA RR&D NCRAR

Why?

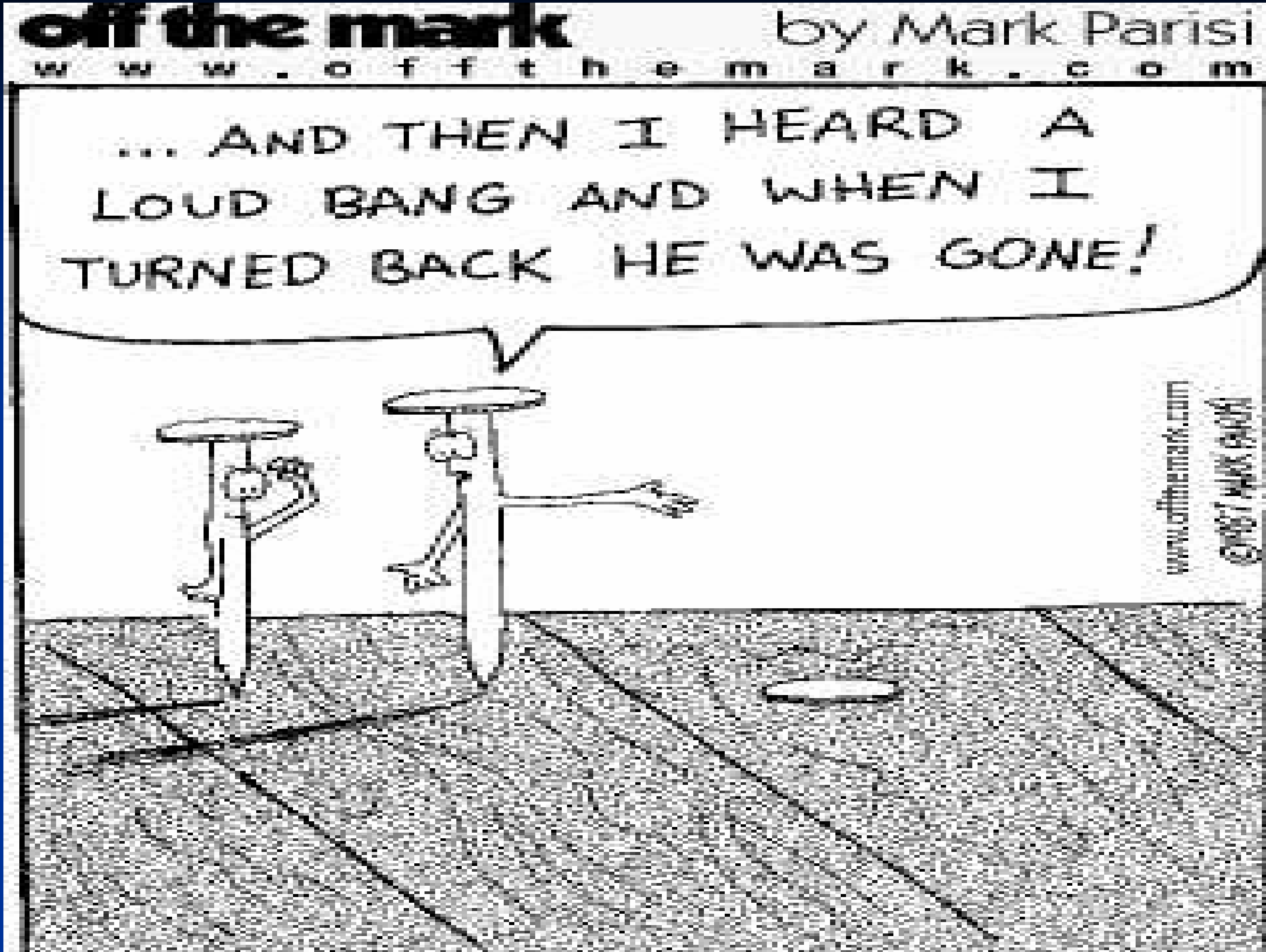
Not likely due to peripheral HL

- Since thresholds differ in HF but localization in HF does not
- Past studies show mild SNHL has little impact on localization

Why?

Central auditory processing capacity

- Studies have shown older individuals had reduced ability to use ITD cues or needed longer time delays to hear a difference than younger individuals – thus the poorer performance with LF and MF signals



off the mark
by Mark Parisi
www.offthemark.com
...AND THEN I HEARD A LOUD BANG AND WHEN I TURNED BACK HE WAS GONE!
www.offthemark.com

What to do?

- HA manufacturers may address: filter to mimic ‘average’ pinna cues
- Use a questionnaire such as the Speech, Spatial and Qualities Scale (SSQ) to monitor changes

VA RR&D NCRAR

VA RR&D

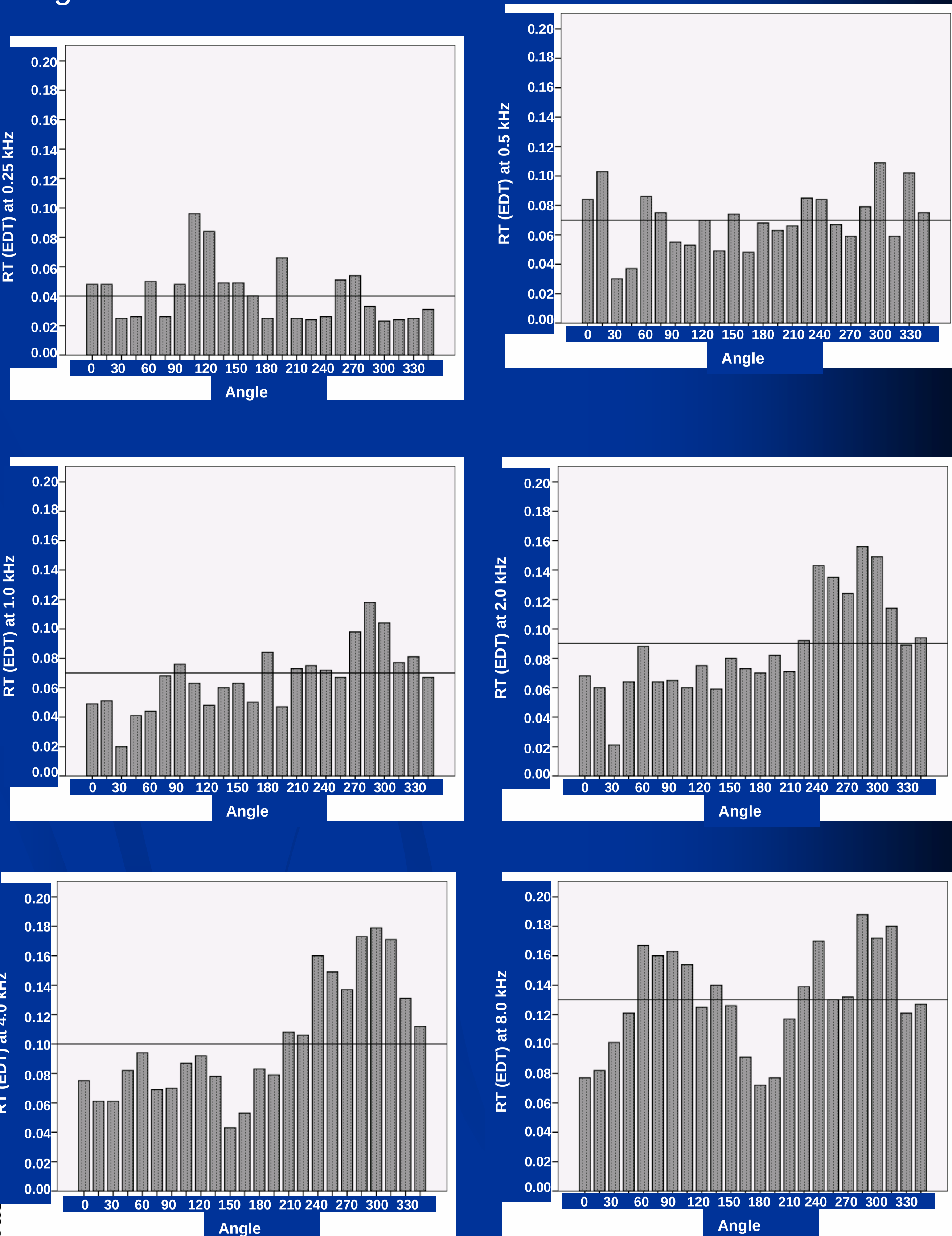
NCRAR

NCRAR

Table 5. Pearson correlation r-values for relationships between RMS error value raw correlations and correlations controlling for days between test and retest a

Signal		Raw correlation	Partial correlation	Fisher z-value
Low	Total RMS error	0.694	0.697	0.017
	Total RMS error B	0.757	0.756	0.007
Mid	Total RMS error	0.841	0.851	0.103
	Total RMS error B	0.786	0.802	0.126
High	Total RMS error	0.849	0.853	0.042
	Total RMS error B	0.819	0.816	0.026
Speech	Total RMS error	0.602	0.576	0.116
	Total RMS error B	0.692	0.674	0.115

Figure 3


RT (EDT) at 0.25 kHz
RT (EDT) at 0.5 kHz
RT (EDT) at 1.0 kHz
RT (EDT) at 2.0 kHz
RT (EDT) at 4.0 kHz
RT (EDT) at 8.0 kHz
Angle
0 30 60 90 120 150 180 210 240 270 300 330
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20

PPT and Aided Listening

- 48 individuals with SNHL
- Wore binaurally HAs for 18 months for study.
- Ran PPT once every three months (averaged data used here)
- Completed 4-item HA satisfaction questionnaire

VA RR&D NCRAR

PPT and Aided Listening

HA satisfaction questionnaire

- How satisfied are you overall with the performance of your HAs?
- To what extent do your HAs fulfill your specific needs?
- Do you think you get as much benefit as others?
- For talking in a group I find my HAs:

  (very useful to not at all useful)

VA RR&D NCRAR

PPT and Aided List

Poor SRTN = S/N higher than mean + 2SE

Data were then used to class

Underestimation = mean PPDIS - 2SE

- Good vs. poor Perfor
- Underestimation versus not underestimating hearin (PPDIS)

HA Satisfaction score in top 75% vs. bottom 25%

- ‘Content’ and ‘Discontent’ users

VA RR&D NCRAR

PPT and Aided Listening

DFA used to examine how well the combination of the PPDIS and the Performance SRTN correctly classified subjects into content and discontent users

i.e. can you use PPT to predict hearing aid satisfaction?

VA RR&D NCRAR

PPT and Aided Listening

Results

More false negatives than false positives i.e. over-predicted contentedness

	Predicted group	
Actual group	Discontent	Content
Discontent	73%	27%
Content	24%	77%

Saunders & Cienkowski, 2002

VA RR&D

NCRAR

Group mean PPT values from Visit 2

Variable	Group 1	Group 2	F-value P-value
Unaided Performance SRTN	-0.46 (2.9)	0.40 (5.3)	F-0.19 P=0.667
Aided Performance SRTN	-3.1 (2.9)	-1.4 (3.7)	F=3.68 P=0.062
Unaided PPDIS	-3.7 (2.8)	-4.6 (3.1)	F=0.046 P=0.832
Aided PPDIS	-3.2 (2.5)	-3.4 (2.5)	F=1.75 P=0.194
Aided benefit	2.7 (2.3)	1.8 (2.5)	F=3.10 P=0.086

VA RR&D NCRAR