

RECIPE FOR SUCCESSFUL WORD RECOGNITION IN QUIET AND NOISE



MAIN INGREDIENT?



1. MAIN INGREDIENT – Recorded Material



RECIPE FOR WORD RECOGNITION (WR) TESTING

Ingredients (What?)

1. Recorded Material
2. Correct terminology
3. Materials available
4. 2000 Hz SL presentation level
5. Number of points on PI curve
6. Interpretation of findings
7. Testing in “noise”



Our journey 2013

Dr. Gus Mueller: “If you cannot do it right, don’t do it at all.....”



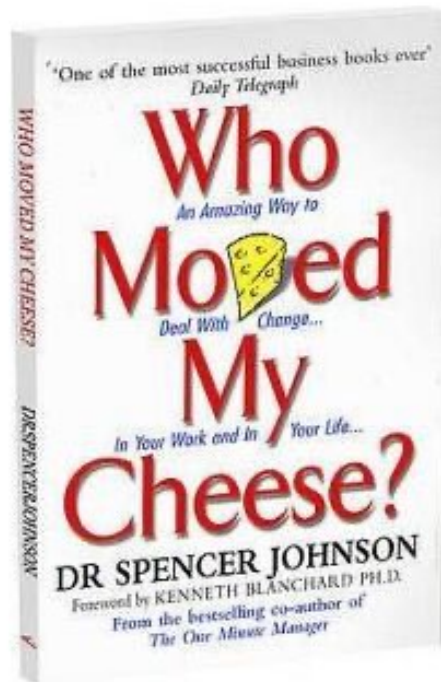
What we do!!



Adam sê dis Eva en Eva sê dis die slang.....



Dr Gus moved my cheese.....



CHANGE the how & why of doing WR

READY for change

WANT to change

ADAPT to change

ENJOY the change



Started to read, ask, read & read.....

AUDIOLOGYonline

20Q: Word Recognition Testing – Let's Just Agree to do it Right!

ROSS J. ROESER, PhD
JACKIE L. CLARK, PhD

Clinical
Report

Live Voice Speech Recognition Audiometry—Stop the Madness!

Word-recognition testing: Why not do it well?

By Brad A. Stach

I I could do word-recognition testing in my sleep. You present some words, calculate the percentage correct, and then you're done. Why would you possibly write an article about this?

I know, it seems so simple. And yet, over the years as I have listened to audiologists and graduate students present cases at staff meetings, I have been amazed at how many times they do not know the answer to the simple question, "Is that score abnormal?"



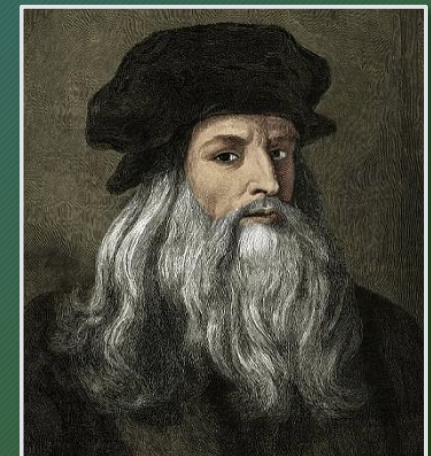
HPCSA (Dec. 2012)

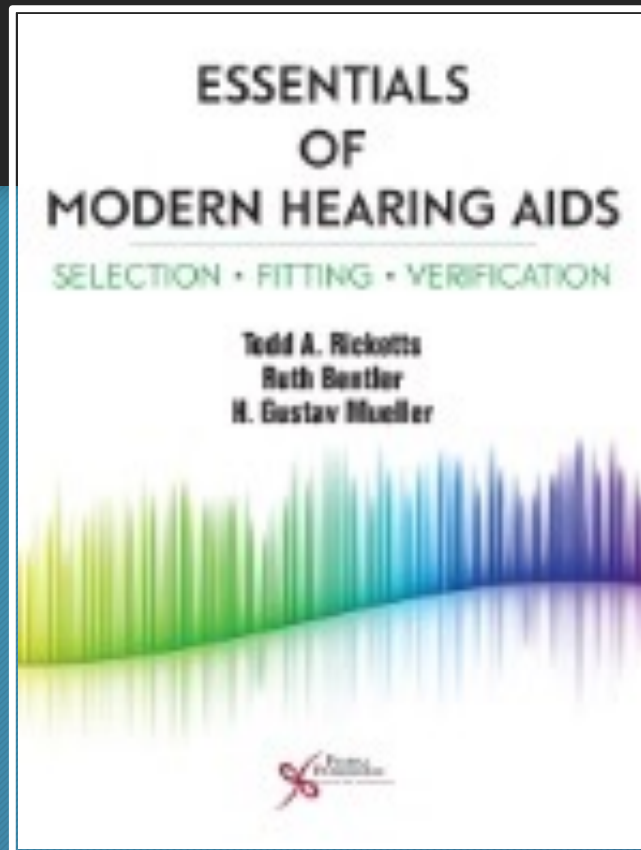
Standards of Practice in Audiology p.3
(Test material): The use of live voice for speech audiometry does not provide accurate test results. Hearing health care professionals should use tape or CD *recorded test materials*. Reduced word lists do not provide accurate test results.



Best Practice is Research Based Practice (James Hall, 2017)

Leonardo Da Vince (1452 – 1519): “Those who fall in love with practice without science are like a sailor who steers a ship without a rudder or compass, and who can never be certain whither he is going.”



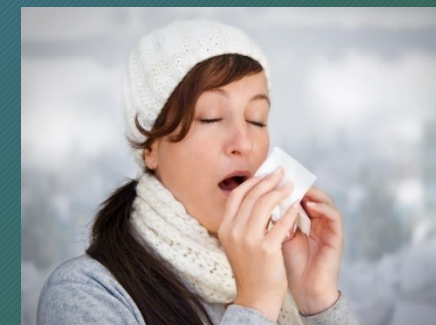


Gus Mueller (2017): “The words are not the test..... the recorded version of the words are the test”



Why not live voice testing?

TOO MANY VARIABLES TO CONTROL/EXCLUDE !!

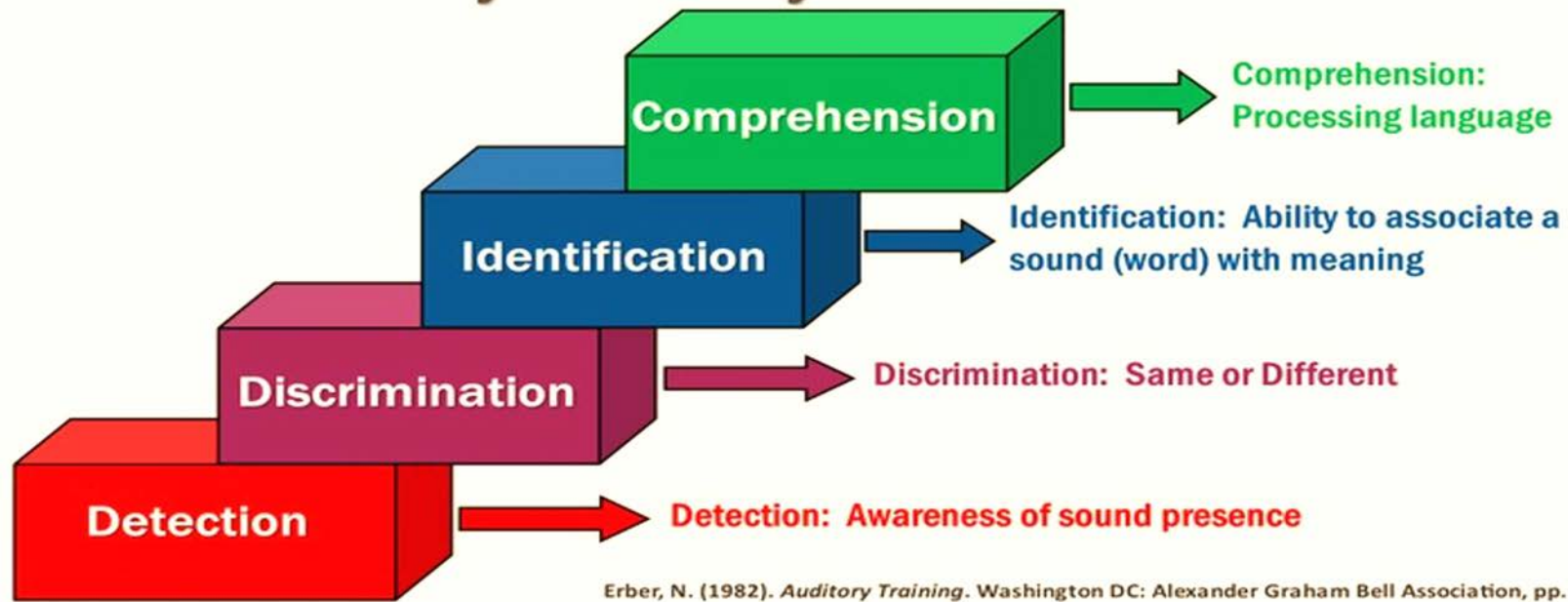


Testing is not controlled and thus is scores not valid & reliable



2. CORRECT TERMINOLOGY

Erber's Auditory Hierarchy



Erber, N. (1982). *Auditory Training*. Washington DC: Alexander Graham Bell Association, pp. 92-94.



2. Correct terminology

Discrimination



James Hall –
speech discrimination =
“incorrectly used term”
(Audiologyonline, 2017)



Until 80's used “discrimination”

Textbooks of 90's using recognition

vs

Recognition



Apply correct Term:

- ✓ PI-PB graph – rename “word recognition”
- ✓ Reports -recognition
- ✓ Conversation with colleagues



3. RECORDED SPEECH MATERIAL FOR SOUTH-AFRICA

Foneties Verteenwoordigende Eenlettergrepige Woordlyste in Afrikaans (FVEWA)

- Phonetically Balanced
- 6 lists of 25 words each
- Whole word scoring
- Standardized for RSA
- 6 years ↑



vrug
merk

gril
feit

nier





- Calibration tone at 1000 Hz
- Instruction track
- 6 lists in quiet
- Tracks multi-talker babble noise (+5 & +10 dB signal to ratios) (SNR)



3. Recorded Speech Material for South Africa

Northwestern University (NU 6 II) – Ordered by difficulty (Hurley & Sells, 2003)

- 4 lists of 50 words list – could present only 10 words
- 12 years ↑
- Whole word scoring: 9/10 → $\geq 96\%$



3. Recorded Speech Material for South Africa



**ARTHUR
BOOTHROYD**
WORD LISTS

Arthur Boothroyd Wordlist

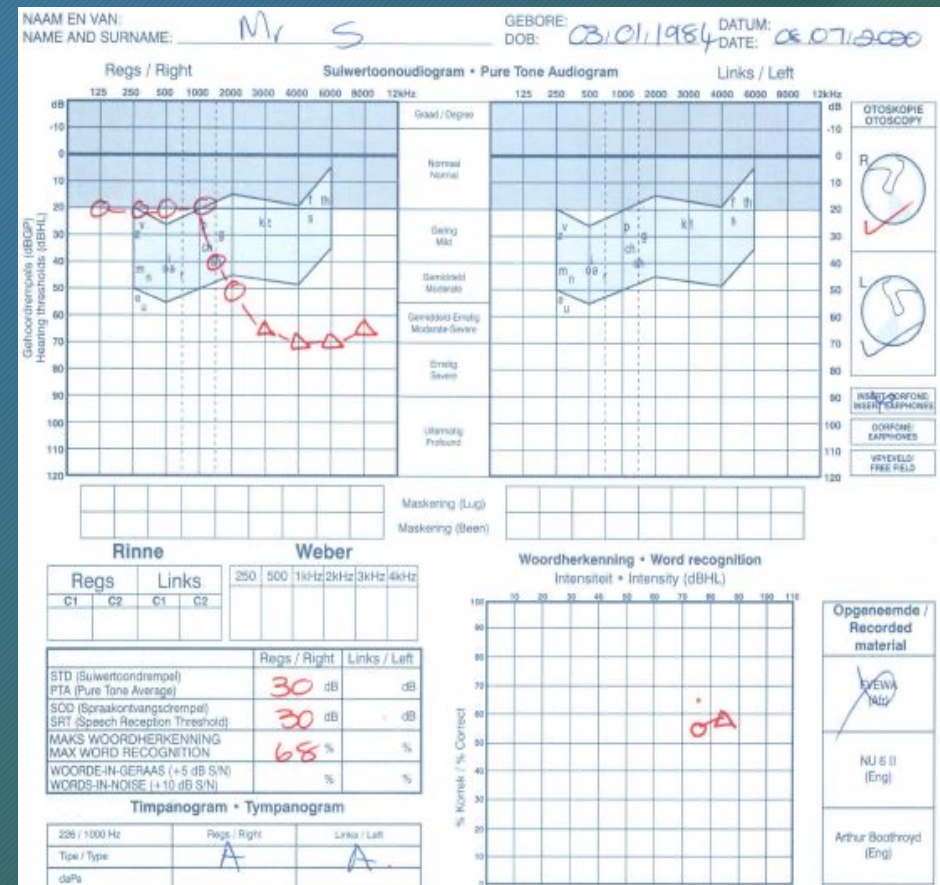
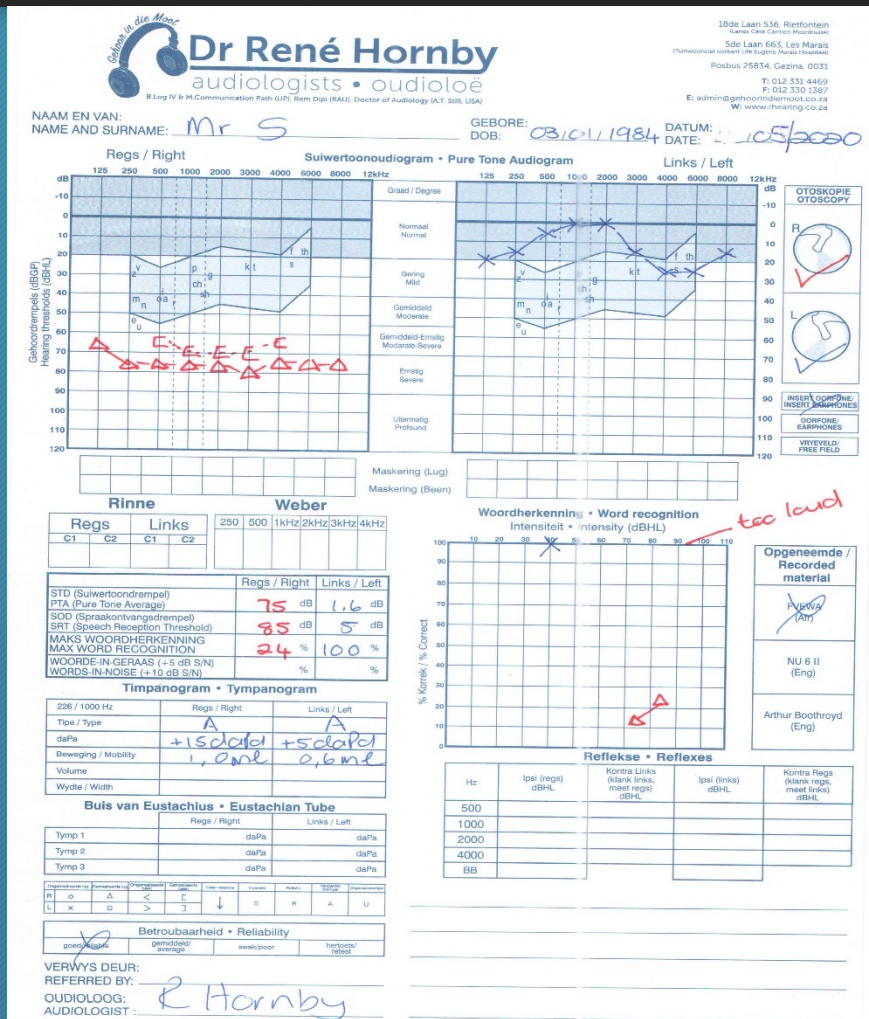
- Isophonemic wordlist
- 20 lists of 10 words each
- Phoneme scoring (score /30)
- 5 years ↑ & English 2nd



LIST 1				LIST 2			
ship	sh	i	p	fish	f	i	sh
rug	r	u	g	duck	d	u	ck
fan	f	a	n	path	p	a	th
cheek	ch	ee	k	cheese	ch	ee	s
maze	h	ei	z	face	r	ei	s
dice	d	ai	s	hive	h	ai	v
boon	b	ou	th	bone	b	ou	n
well	w	e	l	wedge	w	e	dg
jot	j	o	t	log	l	o	g
move	m	oe	v	tomb	t	oe	mb
TOTAL				TOTAL			



Case study Mr S - 36 y



FREQUENCY SPECIFIC WORDLIST (2019)

Why?

- Validation of hearing aid fitting
- Configuration of loss → affects which speech sounds (eg “s, t, f, tch, sh,ch)

	LOW	LOW-MID	MID-HIGH	HIGH
	Blue	Pump	Hit	Cheese
	Broom	Ball	Tail	Sight
Quiet Score				
SNR 0dB				
SNR +5dB				





Recorded Material for children (open-set)



- Developed by Rozelle Roets (2019)
- Normal developmental for consonant production (Sander, 1972)
- Age 3-6 y
- CVC words e.g. food, nose, doll / vis, rak, dier
- Isophonemic vowels,
- 10 lists of 10 words each
- Scoring phonemic, score /30
- 6 Ling sound test
- Vowel imitation, Vokaal verwarring, Konsonant verwarring





Recorded Material for children (closed-set)



Ouditiewe Diskriminasie Prent Identifikasie Toets

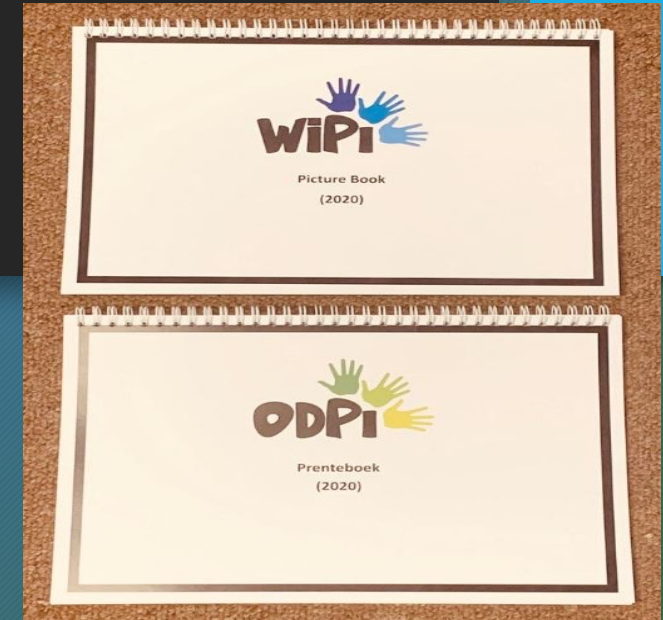
- Developed by Lida Müller in 1979
- “Wys vir my die..... / Waar is die.....?”

Word Intelligibility Picture Identification Test

- Developed by Ross & Lerman 1970 and revised by Cienkowski, Ross & Lerman 2009
- 4 lists of 25 words each
- “Show me the....., Where is the.....”
- Adaptive classroom babble noise added



Picture book



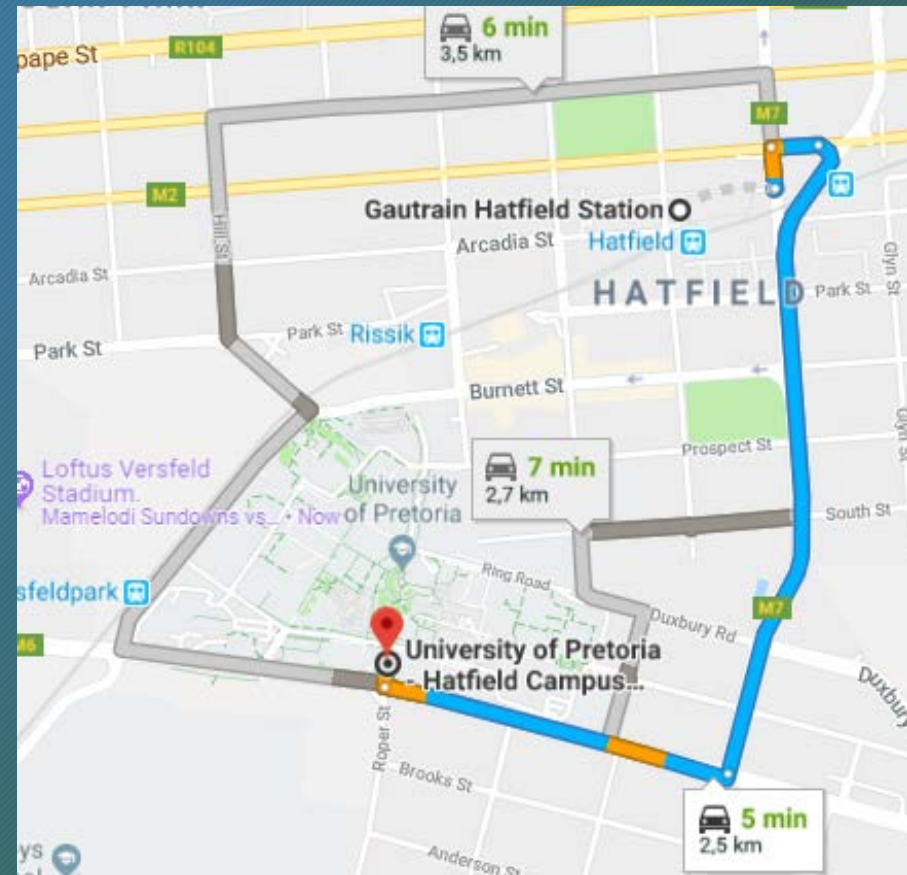
- “South African version” revised – cultural & SA context applicable
- Printed / digital version
- 6 pictures per page (one test word)
- Black and white line drawings



4. PRESENTATION LEVELS (dBHL)

Which presentation level method will yield the maximum score?

Different opinions – GOALS?



Presentations Levels – Different methods (Kramer, SJ. 2014)

Supra-thresholds measurement
= Words must be audible
(Mueller & Hornsby, 2013)

Sensation level approach

- SRT + 30/40 dBHL (60% - Kamm et al, 1983)
- 2000 Hz sensation level (Guthrie & Mackersie, 2009)

Loudness approach

MCL / below UCL for speech

Mixed approach

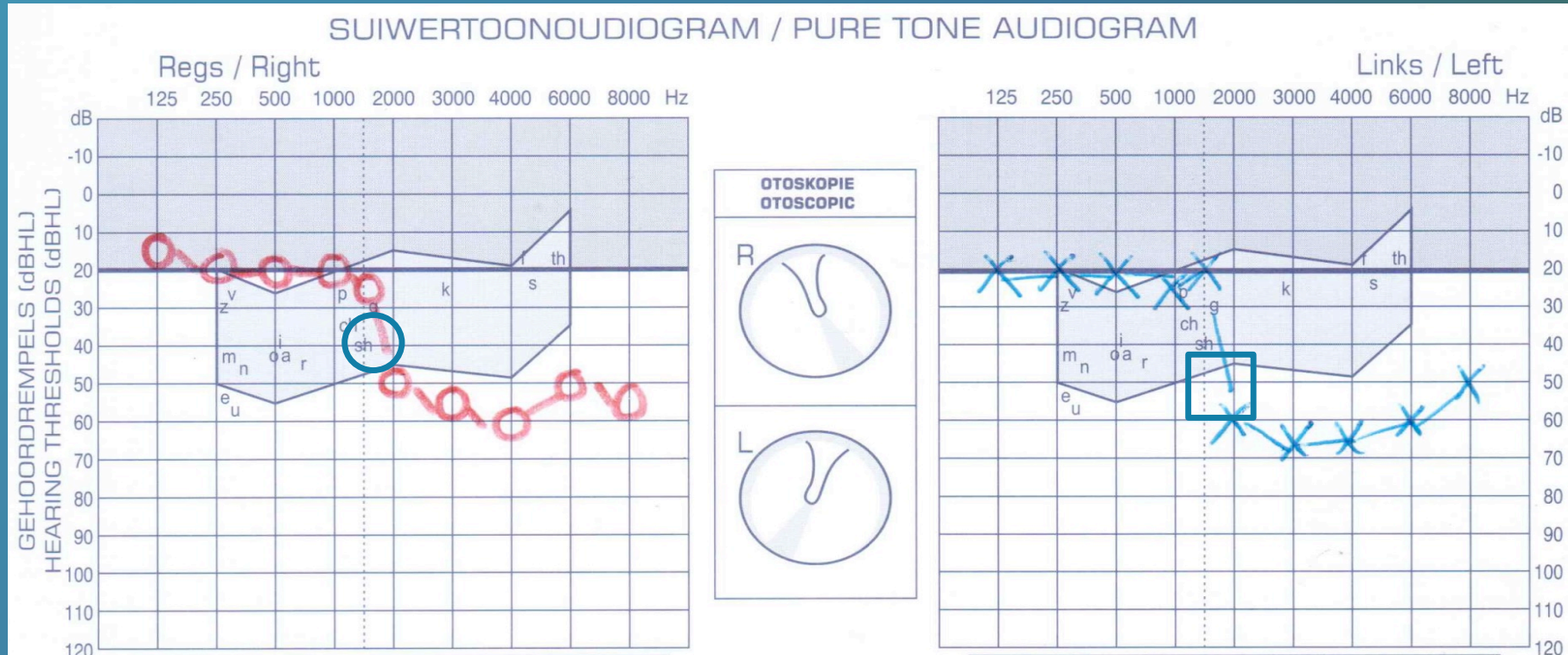
SRT + 5dB & SRT + 25dB &
LDL - 10dB (Wits)

Fixed level approach

75/80 dBHL



2kHz SL method by Guthrie & Mackersie (2009)



2kHz =
50 dB

Let us add to the above:
< 50 dB re 25 dB SL
*50 – 55 dB re 20 dB SL
*60 – 65 dB re 15 dB SL
70 – 75 dB re 10 dB SL

2kHz =
60 dB



5. NUMBER OF POINTS ON PI CURVE

Procedure code (821110): two points

Max % score (2kHz SL method)

Second point: Louder OR softer

Softer: 35 dB (children) - distance
(Madell, 2011)

Softer: 50 % = SRT score

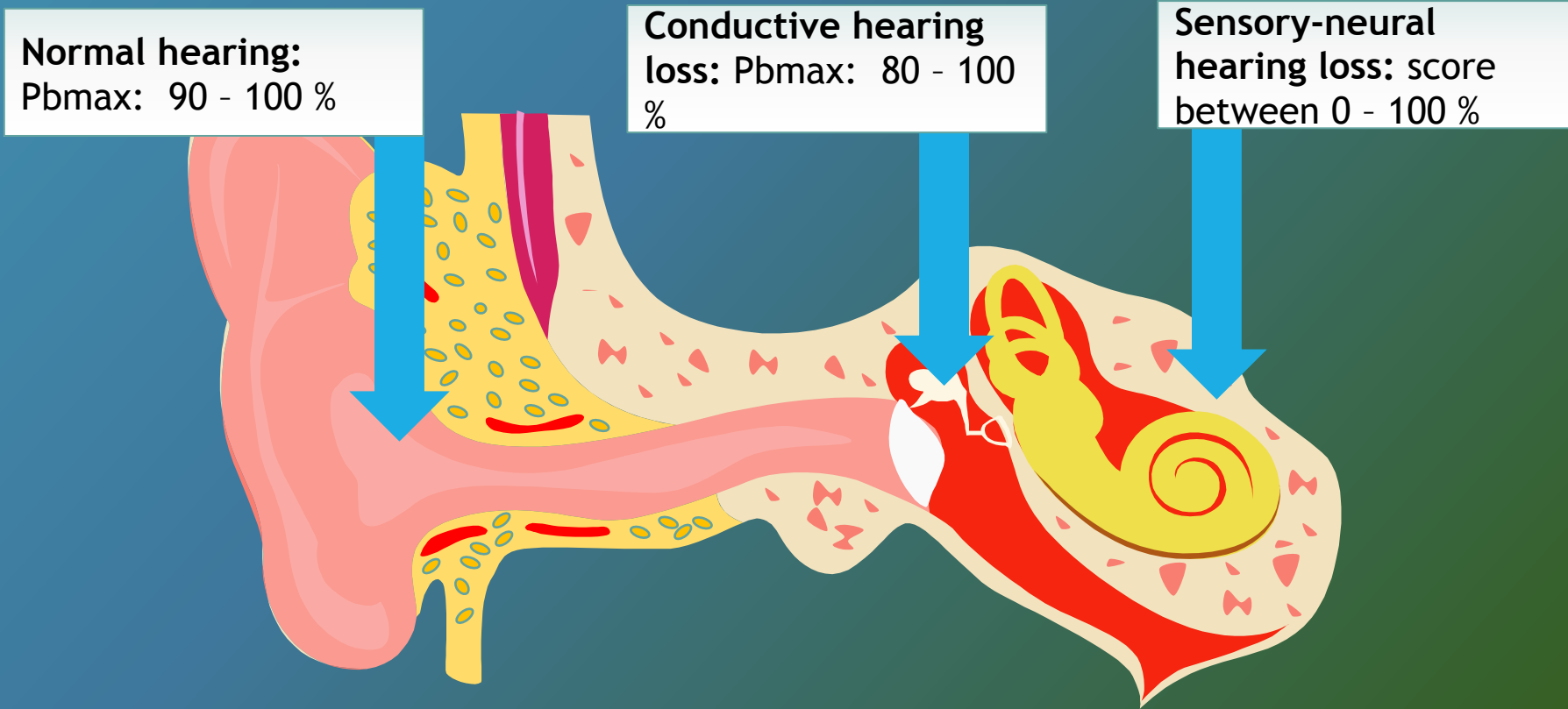
Louder:
(90 dBHL- Martin, 2015)

Normal speech level 50 dB
(Madell, 2011)



6. INTERPRETATION OF FINDINGS

What to expect from types of hearing losses (Bess in Gelfand, 2006)



Normal hearing thresholds

Schoepflin JR, (2012):

Pbmax @ 25 – 40 dB Sensation level

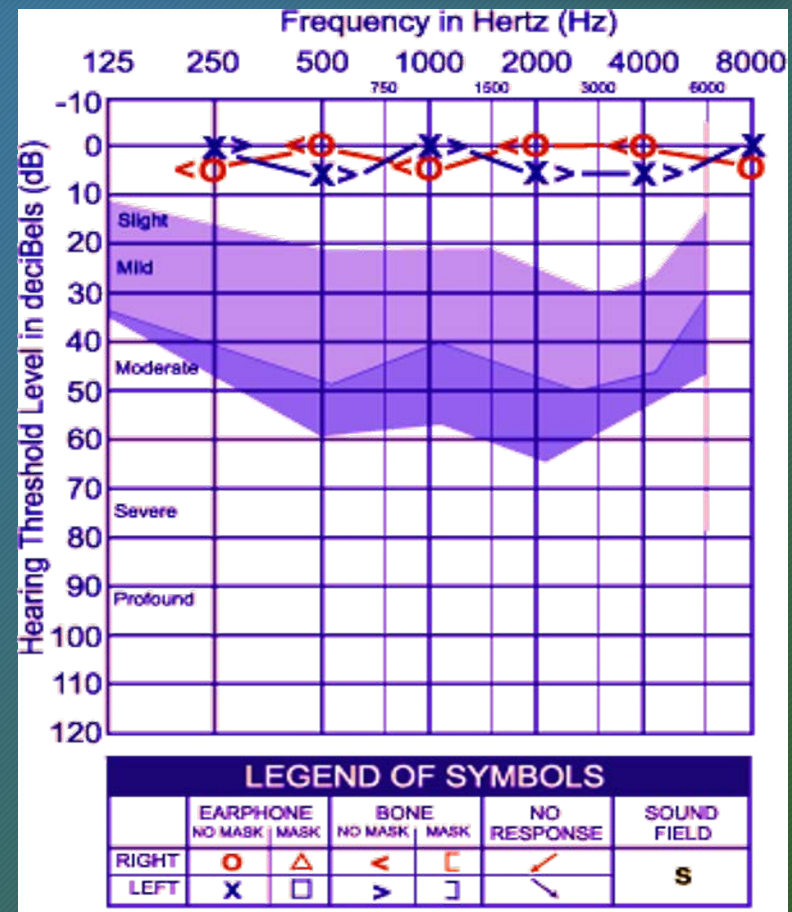
SL re: SRT

Example: SRT left ear = 10 dB

Expected Pbmax @ 35/40/45/50dB

WR: 94 % – 100 % at 27 dB SL re SRT

(Olsen & Matkin, 1991)



Describe the impairment OR WR Ability: Adults (Pbmax) Kramer & Brown (2019)

90 - 100 %

None impairment / Excellent or normal WR ability

75 - 89 %

Slight difficulty / Good WR ability

60 - 74 %

Moderate difficulty / Fair WR ability

50 - 59 %

Great difficulty / Poor WR ability

< 50 %

Very poor



The FVEWA recorded wordlists were presented, and whole word scoring was done. Mr. S obtained 24% (right ear) and 100% (left ear) WR in quiet. The right ear presents with very poor word recognition ability and the left ear with excellent WR ability.

[illegible]

Categories for scoring WR for children (Madell et al. 2011)

WRS (% correct)	WR Ability
90 - 100	Excellent
80 - 89	Good
70 - 79	Fair
< 70	Poor



7. SPEECH IN NOISE (SIN) TESTING – Why? (Pre-fitting)

- Compare: WRS in quiet vs noise (significant?)
- Assist with diagnosis of impairment (ANSD & Hidden hearing loss)
- To address the patient's complaints
- Traditional test in quiet underestimate the communication challenges of children with SNHL.
- To help patient make a decision regarding amplification
- Recommend the best hearing aid technology based on ANL scores & WRS in noise
- Acceptable Noise Level test can predict with 85 % accuracy – successful hearing aid users



SIN testing – Why?

- Auditory processing ability in normal hearing children (Madell, 2010) = “figure-ground testing”

3 test conditions using babble noise:

1. 50 dB HL +5 dB S/N ipsilateral, each ear ✓
2. 50 dB HL with 0 S/N ipsilateral, each ear ✓

RESULTS: of 187 with normal hearing, scores ≥ 88 %

Start: 50 dB HL in QUIET



Speech in Noise (SIN) Testing – Why? (Post-fitting)

- Guidelines for rehabilitation and counseling
- Measure aided benefit
- Monitor over time
- Improve patient satisfaction and loyalty (MarkeTrak VIII)



Speech-in-noise (SIN) testing

Two types of noise (Hillock-Dunn, 2015)

ENERGETIC MASKERS/NOISE

- E.g. fan noise/speech-shaped noise
- Impede speech recognition → peripheral interference
- ↑ speakers in background → “noise like” speech

INFORMATIVE MASKERS/NOISE

- E.g. 2 to 4 talkers speaking/reading
- Content is audible
- Peripheral and central interference
- More difficult task
- Segregate the target from the background speech.



Recorded SIN for South Africa

TEST	TYPE OF NOISE	ADAPTIVE/FIXED SNR
	Multi-talker adult babble noise	Fixed +10 & +5 dB SNR
	Multi-talker adult babble noise	Fixed +10 & +5 dB SNR
	Multi-talker adult babble noise	Fixed +10 & +5 dB SNR
 	Children's classroom noise Competing children's reading speech	Fixed 0, +5, +10 dB SNR Adaptive SNR

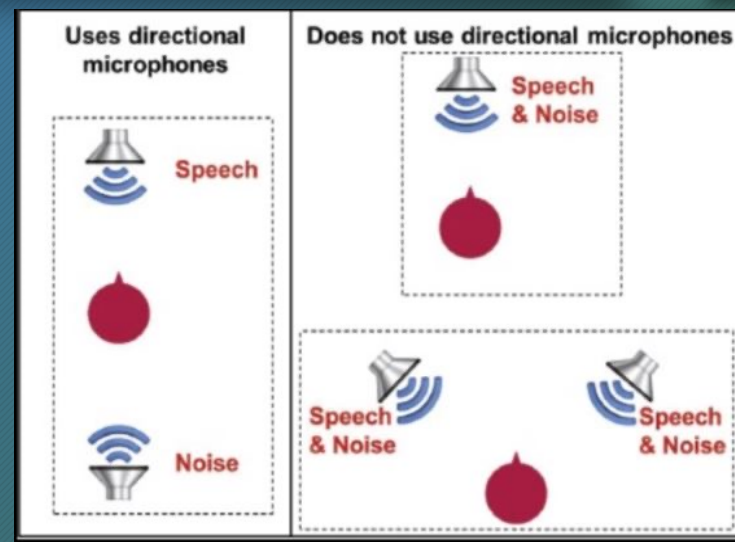


Recorded SIN for South Africa

TESTS		TYPE OF NOISE	ADAPTIVE/FIXED SNR
		Multi-talker adult babble noise	Fixed +5, 0 dB SNR and Adaptive SNR
		Multi-talker adult babble noise	Adaptive SNR
		Children's classroom noise	Adaptive SNR



Set-up when doing SIN testing





Goals of ANL test



To assess a patient's acceptance/tolerance for background noise

Determine success of hearing aid outcome

To predicting the pattern of hearing aid use (full/part/none)

Guidelines for rehabilitation strategies beyond the hearing aid fitting



ANL – What?

Easy and quick (10min) speech-in-*noise* test
(NOT speech perceptual test)

Willingness to listen in background noise will be more indicative of hearing aid use than actual speech understanding (Plyler, 2015)

Not related & no significant correlation between ANL and speech-perception-in-noise tests (SPIN, HINT, QuickSIN)



Acceptable Noise Level (ANL) test – RSA's version

South-African Male reading a passage
“A trip through South Africa” & “Ons reis deur Suid-Afrika”

Determine the MCL for running speech –
in dBHL

Then the multi-talker babble noise is
switch on

Determine the Babble noise level (BNL)

$ANL = MCL - BNL$



Interpretation of ANL scores

LOW SCORE (≤ 7 dB)

- High tolerance for background noise
- Likely to be successful hearing aid wearers
- Likely to wear hearing aids on a regular basis and become full-time users (Nabelek et al, 2006)



What do we do with mid range scores?

MID SCORES (8 – 12 dB)

- May or may not be successful with hearing aids
- Good (8) or bad (12) prognosis for regular use and acceptance of hearing aids
- Prediction for hearing aid use is unclear (Nabelek et al, 2006)
- May require more follow-up counselling



What do we do with high scores?

HIGH SCORE ≥ 13 dB

- Low tolerance for background noise
- “At risk” for reduced utilization of hearing aids
- Less likely to wear hearing aids regularly (Nabelek et al, 2006)
- Willing to listen at high / good SNRs
- Require additional post-fitting counselling, guidance & aural rehabilitation



Case study: Mrs B – 86 y

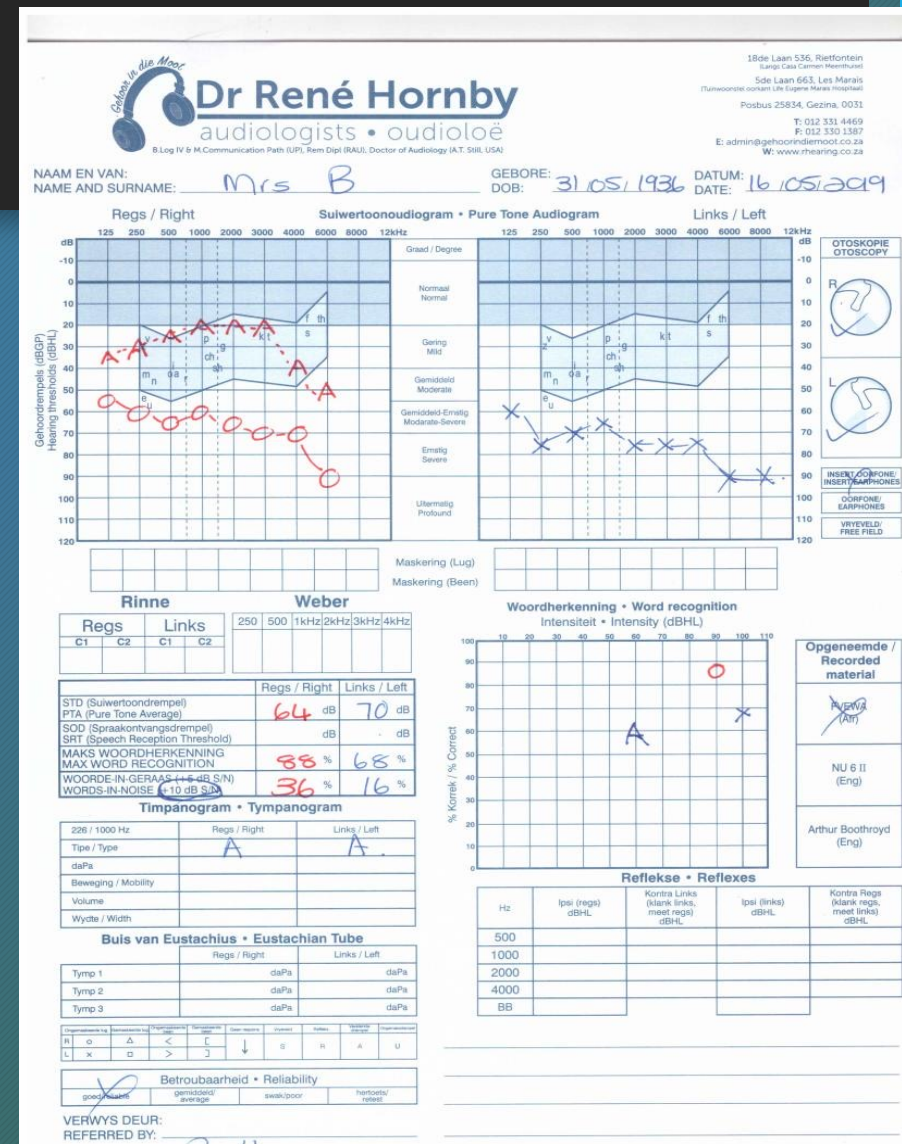
Long time hearing aid user

Full time user

One to one conversations

Difficult hearing in groups & dining room

Difficulty hearing over distance (church)



THANK YOU FOR LISTENING !!!

Ingredients (What?)

1. Recorded Material
2. Correct terminology
3. Materials available
4. 2000 Hz SL presentation level
5. Number of points on PI curve
6. Interpretation of findings
7. Testing in “noise”

Questions?

rhornby@lantic.net

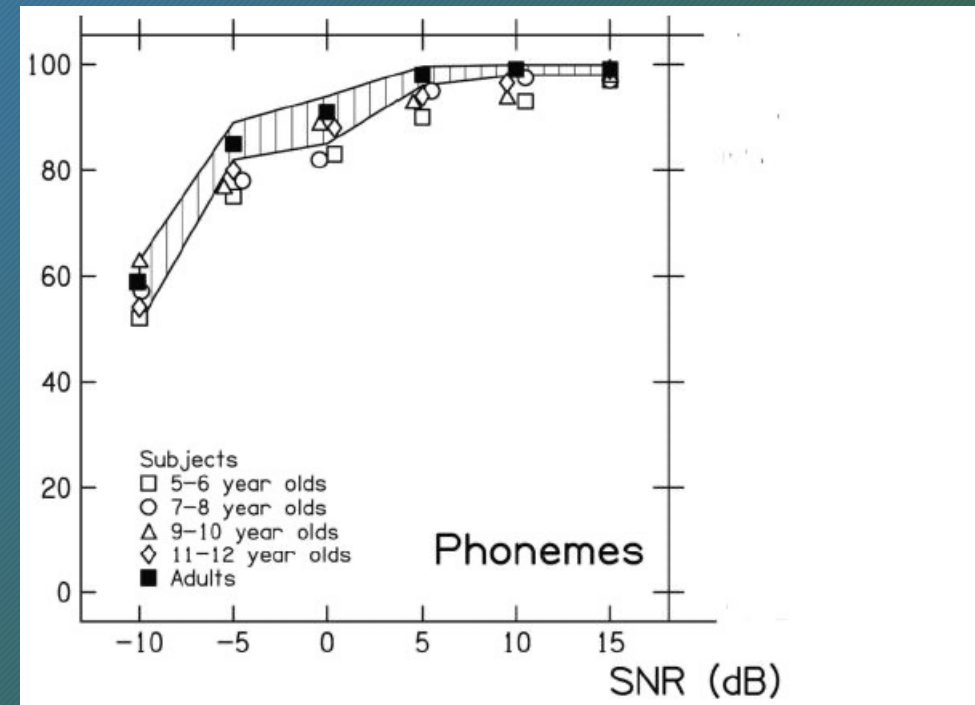
Recorded Feb 2021

Information was accurate
and relevant at time of
recording



Norms of AB with normal hearing patients (McCreery)

Age	10 dB SNR
5-6 years	93.9%
7-8 years	97.3%
9-10 years	94.6%
11-12 years	96.6%
Adults	99%



Norms for SIN for children and older (Madell, J)

continued

SPEECH PERCEPTION STANDARD SCORES

			Male				Female			
Condition	CA	List	N	WR%	SD	95% CI	N	WR%	SD	95% CI
Quiet 50 dB	3-5	NU-C	14	98	3.7	96-100	12	98	3.2	96-100
Quiet 50 dB	6-8	PBK	13	98	3.1	97-100	12	98	3.2	96-100
Quiet 50 dB	9+	W-22	13	99	1.9	98-100	6	96	5.1	92-100
Quiet 35 dB	3-5	NU-C	19	95	5.2	92-97	13	96	4.8	93-98
Quiet 35 dB	6-8	PBK	23	97	3.7	95-98	24	98	3.1	97-99
Quiet 35 dB	9+	W-22	17	98	2.8	97-100	9	96	4.2	93-98
50 @ +5 SNR	3-5	NU-C	28	93	4.6	91-95	16	94	4.1	92-96
50 @ +5 SNR	6-8	PBK	13	94	4.5	92-96	25	95	5.1	93-97
50 @ +5 SNR	9+	W-22	17	97	4.1	95-99	7	93	3.8	90-96
50 @ 0 SNR	3-5	NU-C	23	91	6.9	88-94	17	92	6.5	89-95
50 @ 0 SNR	6-8	PBK	18	91	5.4	89-93	28	93	6.0	90-95
50 @ 0 SNR	9+	W-22	19	95	4.7	93-97	11	93	4.8	91-96
35 @ 0 SNR	3-5	NU-C	23	90	6.1	87-93	16	92	6.0	89-94
35 @ 0 SNR	6-8	PBK	28	91	6.2	88-93	28	90	6.1	87-92
35 @ 0 SNR	9+	W-22	18	91	6.2	88-94	11	90	7.0	86-94

Test Protocol for WIPI & ODPI (Jane Madell)

