

Audibility and sound measurement

SPHSC 509

Lecture 1

Example: dB HL, dB SL

Immittance:

Y _{226-Hz}	AD	AS
Press (daPa)	-10	-
Vol (cm ³)	1.0	1.2
Static Admit (mmho)	1.3	-

Tympanometry
WNL AD
Flat tympan/normal values AS

Acoustic Reflex Thresholds (dB HL)

Stim	Probe	.5K	1K	2K
AD	C			
	I	90	90	90
AS	C			
	I	NR	NR	NR

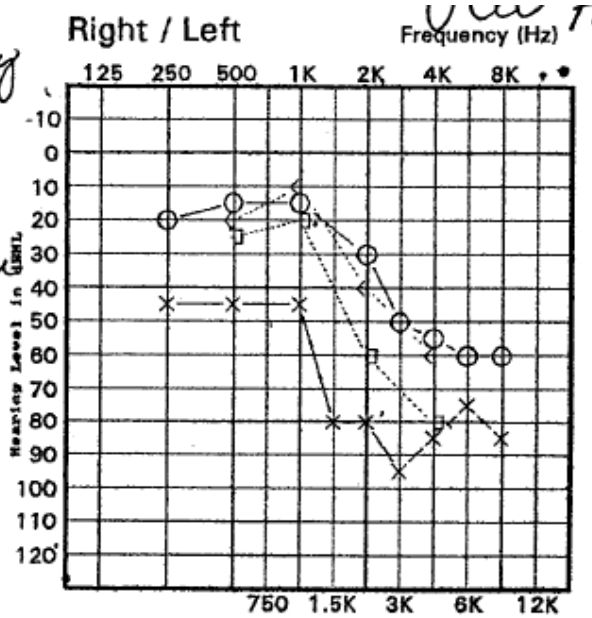
Acoustic Reflex Decay (ms)

Probe	Stim	.5K	1K
C	AD		
I	AS		

LDLs:

dBHL	.5K	1K	2K	3K
AD	85			80
AS	100			115

Right / Left



Audiogram Symbol Key

	right	left
AC unmasked	○	×
AC masked	△	□
BC unmasked	<	>
BC masked	⊔	⊓
BC forehead masked		
BOTH BC forehead unmasked	∨	∨
Sound Field	\$	\$
Examples of NR	⊕	⊗

Earphones
EAR Inserts
 TDH-39s

Otосcopy
Clear
 Impacted

PT Stimulus
Steady Pulsed
 FM

Effective Masking Levels To Non-Test Ear

AC	L						
BC	L						
	R						

AC Thresholds (kHz)

	.25	.5	1	1.5	2	3	4	6	8
AD									
AS									

Speech Audiometry

	PTA	MCL	UCL	SRT	Speech Discrimination
RIGHT	20	65		25	100% / 70
LEFT	56	80		55	92% / 90 / 45
				CD <input checked="" type="checkbox"/>	Tape <input type="checkbox"/>
					MLV <input type="checkbox"/>

Example: dB HL, dB SL

Immittance:

Y-226-Hz	AD	AS
Press (daPa)	20	5
Vol (cm ³)	1.6	1.6
Static Admit (mmho)	0.8	0.9

Acoustic Reflex Thresholds (dB HL)

Stim	Probe	.5K	1K	2K
AD	C	abs	abs	abs
	I	105	abs	abs
AS	C	100	95	95
	I	100	100	105

Acoustic Reflex Decay (ms)

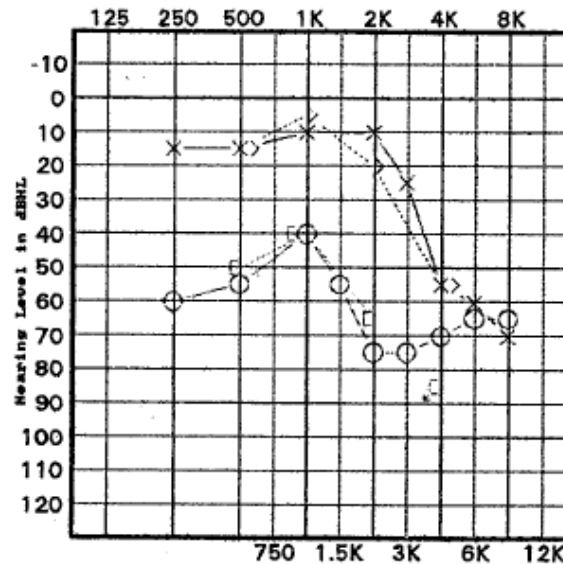
Probe	Stim	.5K	1K
C	AD	CNT	CNT
I	AS	CNT	Neg

LDLs:

dBHL	.5K	1K	2K	3K
AD				
AS		DNT		

Right / Left

Frequency (Hz)



Audiogram Symbol Key

	right	left
AC unmasked	○	×
AC masked	△	□
BC unmasked	<	>
BC masked	□	□
BC forehead masked		
BOTH		
BC forehead unmasked	∨	∨
Sound Field	\$	\$
Examples of NR		
	○	×

Earphones
EAR Inserts
TDH-39s

Otосcopy
Clear
Impacted

PT Stimulus
Steady
Pulsed
FM

Effective Masking Levels To Non-Test Ear

	125	250	500	1K	2K	4K	8K
AC ^L							
AC ^R							
BC ^L							
BC ^R			50	55	55	75	

AC Thresholds (kHz)

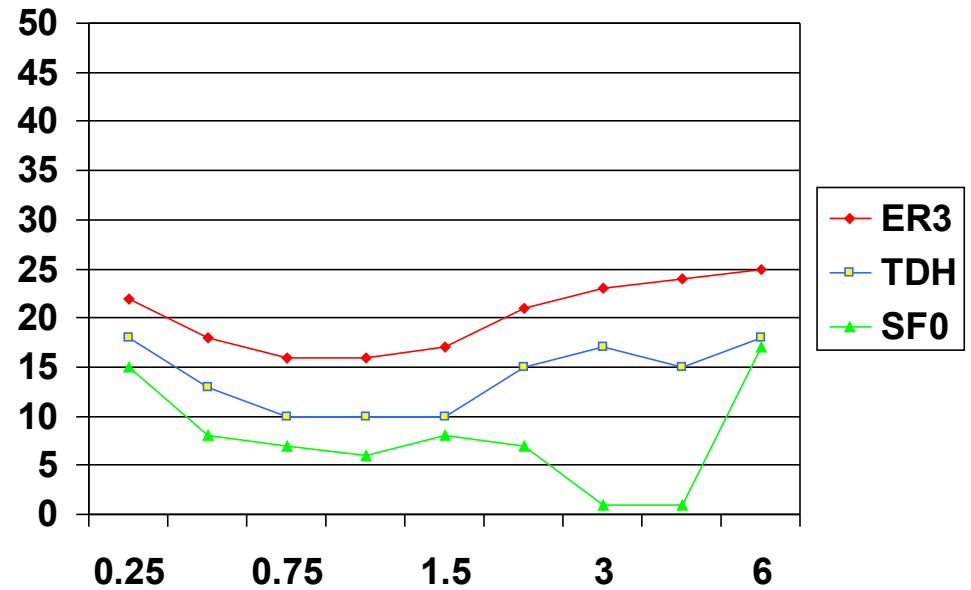
	.25	.5	1	1.5	2	3	4	6	8
AD									
AS									

Speech Audiometry (% @ level/masking)

	PTA	MCL	UCL	SRT	Speech Discrimination
RIGHT				60	28% / 90, 36% / 100, 52% / 10.
LEFT				20	100% / 65
				CD <input checked="" type="checkbox"/>	Tape <input type="checkbox"/>
					MLV <input type="checkbox"/>

Effect of transducer

KHz	ER3	TDH	Sf 0 deg
.25	22	18	15
.5	18	13	8
.75	16	10	7
1	16	10	6
1.5	17	10	8
2	21	15	7
3	23	17	1
4	24	15	1
6	25	18	17

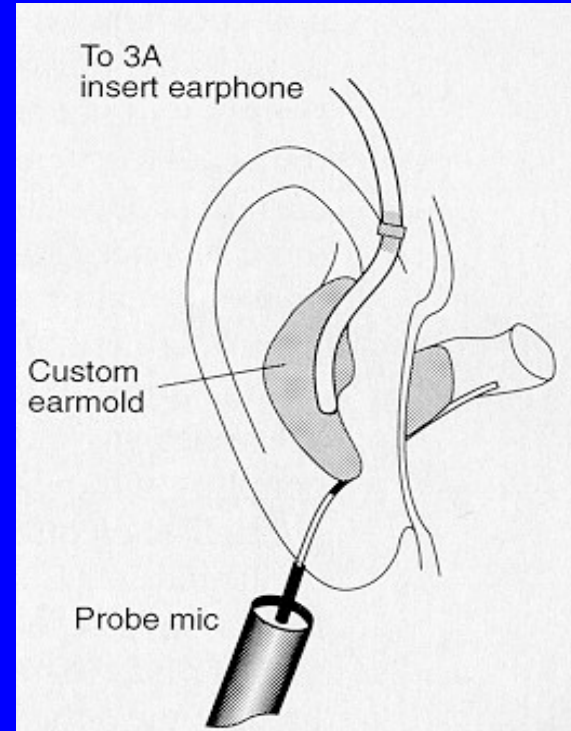
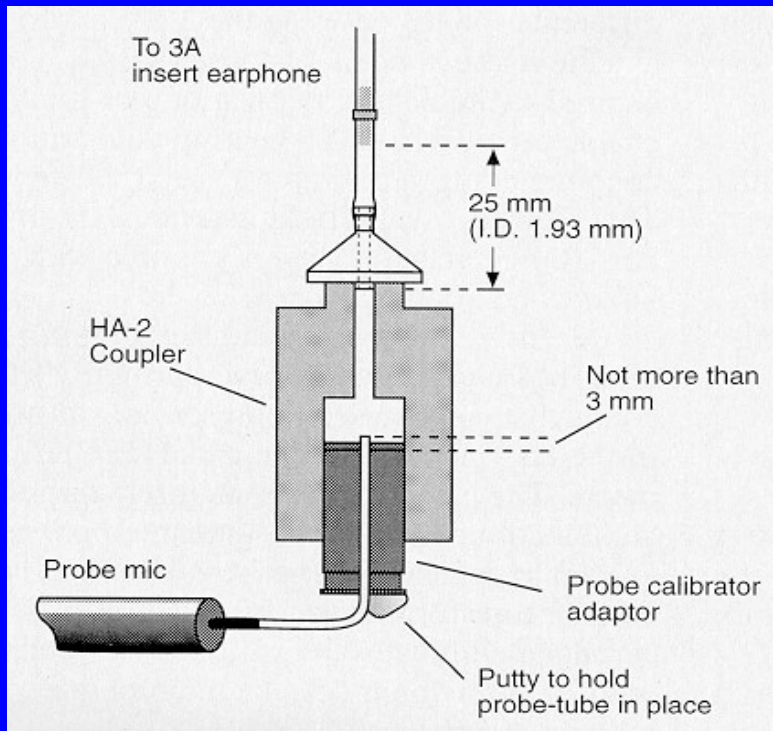


Useful conversions

Freq	RETSPL (HL -> 6cc SPL) For TDH49	HL->2cc SPL For TDH49	RETSPL (HL->2 cc SPL) For ER3A, HA2 coupler	Avg adult RECD	Avg adult REDD
25	26.5	20.7	14	-6	16
5	13.5	9.9	5.5	0	12
1	7.5	5.5	0	3	10
2	11	5.2	3	5	16
3	9.5	5.7	3.5	5	15
4	10.5	-0.5	5.5	8	13
6	13.5	-0.2	2	13	16
8	13		0		
Ref:	ANSI S3.6 1996	Hawkins et al 1990	ANSI S3.6 1996	Hawkins et al 1990	Bentler & Pavlovic 1989
Ex: ER3A(dBHL) + ER3A-RETSPL + RECD = dB SPL(TM) Ex: TDH49 + REDD = dB SPL(TM) For speech: speech in dB HL + RETSPL(1 kHz) + 12.5 = speech in dB SPL					

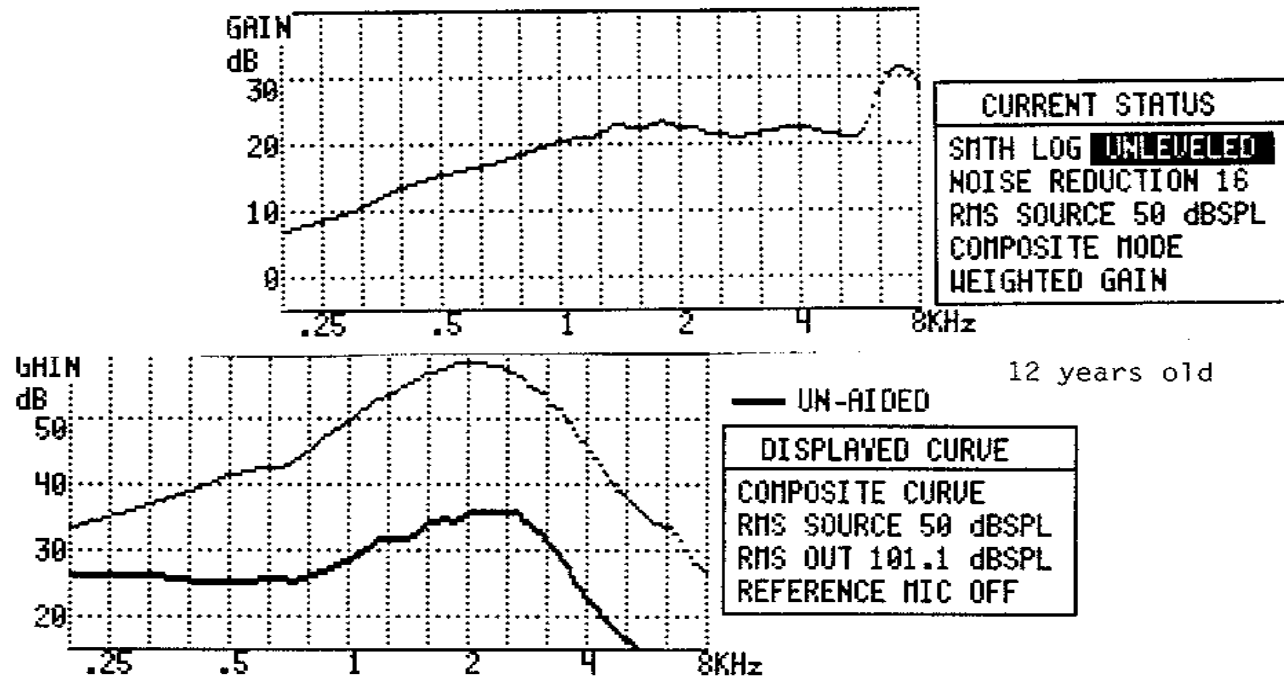
RECD

Hardware Requirements



Moodie et al., 1994

RECD=REAR-2CCR



- 12 year old child with Down Syndrome
- Response is similar to that of a 1-month old
- *Typical* RECD for older children and adults is < 5 –10 dB across frequencies
- http://www.boystownhospital.org/Research/areas/ClinicalBehavioral/real_ear.asp

REDD – Difference in dB, across frequencies, between the SPL measured in the real-ear and the audiometer dial setting that produced it. Used to convert to dB SPL with TDH phones

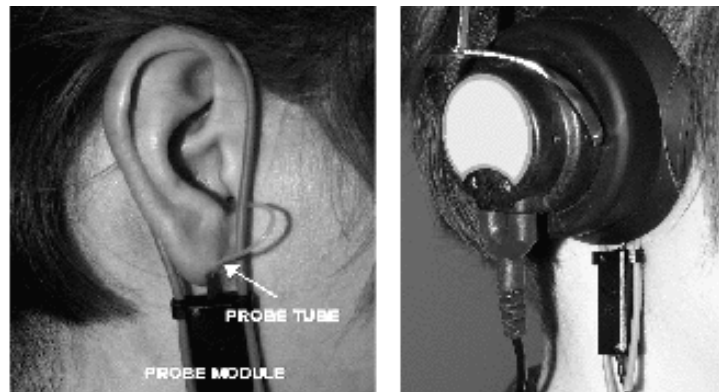


Figure 11. Setup for the real-to-dial difference (REDD) measurement on the Audioscan RM500 showing placement of probe tube/probe module (left) and subsequent placement of headphones (right).

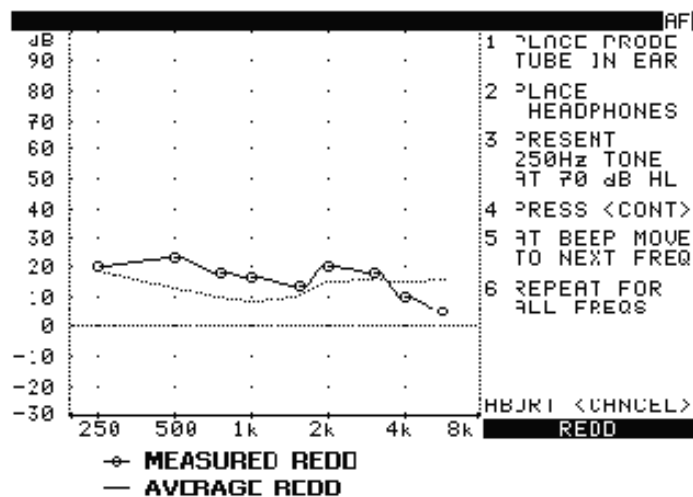


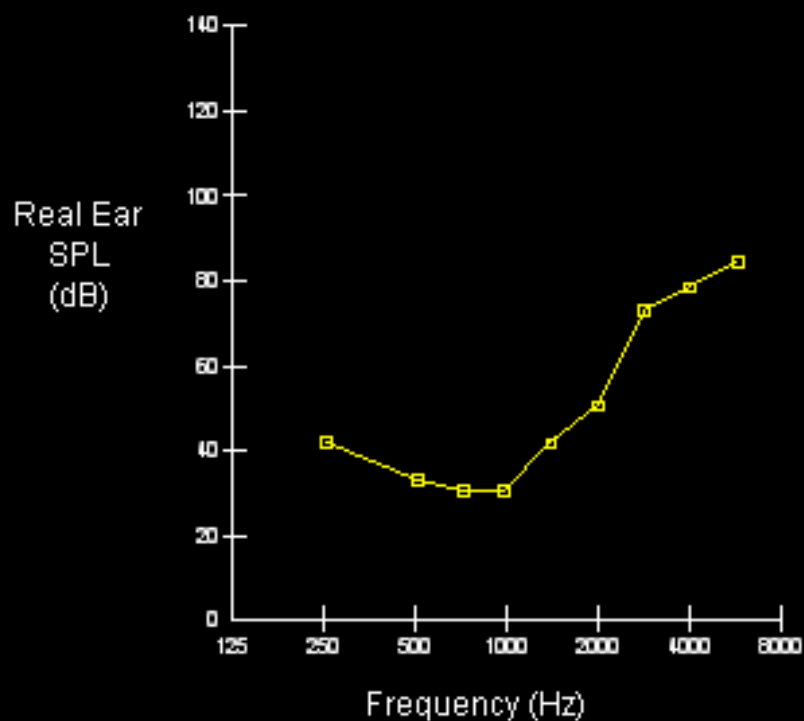
Figure 12. Example of the real-ear-to-dial difference (REDD) measurement screen on the Audioscan RM500. The individual REDD values are shown by the connected points. The average adult REDD (dotted line) is also displayed for comparison purposes.

SPLogram

SPLogram - Speech - LEFT EAR



Speech SPLogram



Thresholds

- Normal
- Measured

Upper Limits

- Predicted
- Measured

Unaided

- +12
- Average
- 18

Aided Target

- Average

Measured

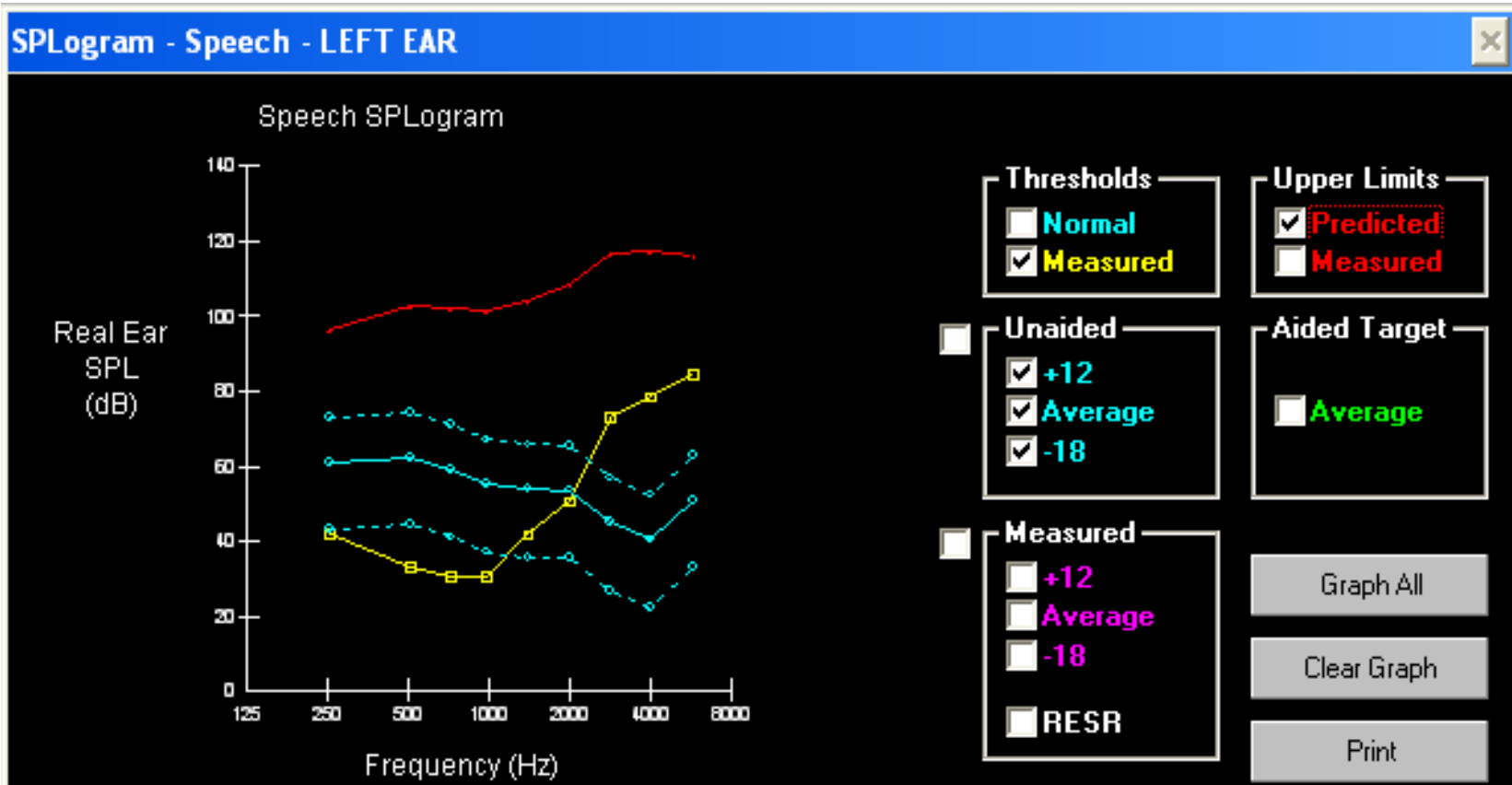
- +12
- Average
- 18
- RESR

Graph All

Clear Graph

Print

SPLogram + speech spectrum



LTASS

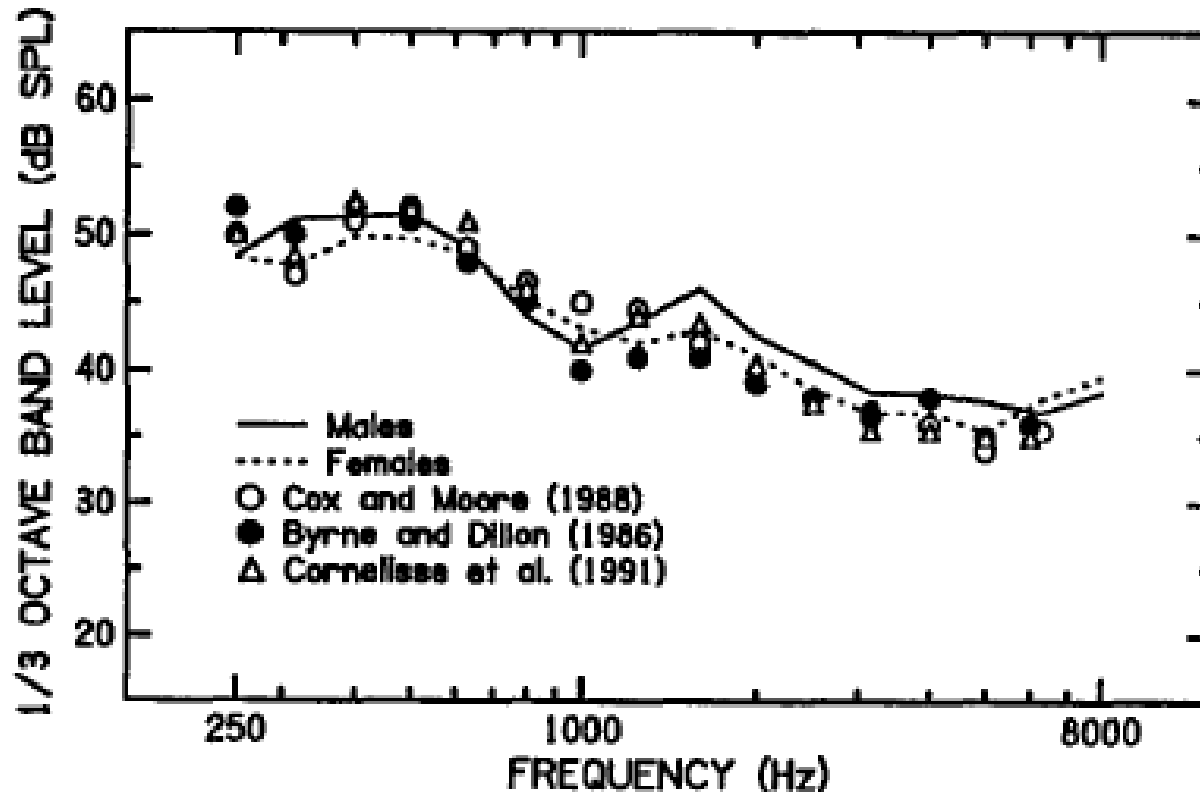
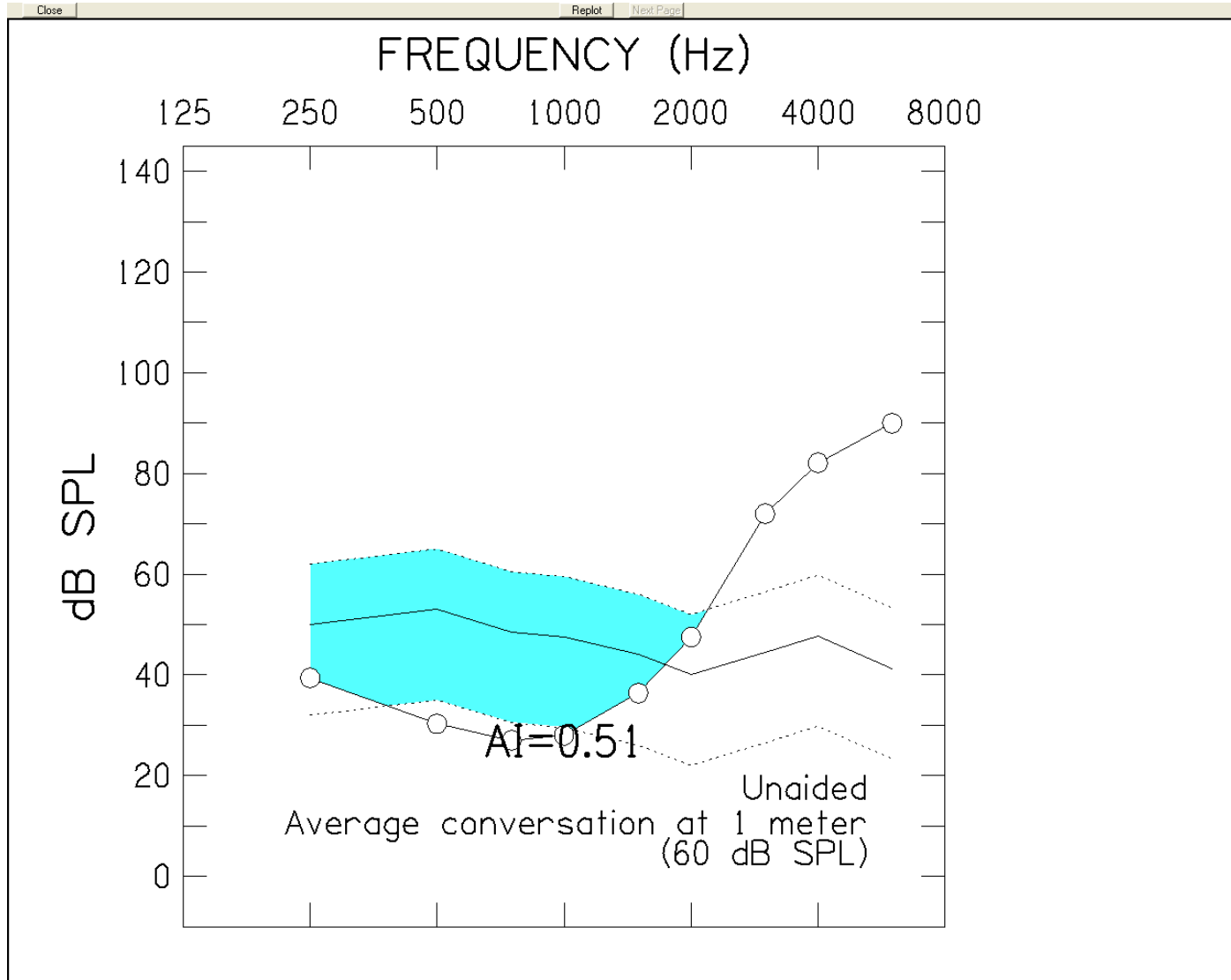


FIGURE 1. Mean $\frac{1}{3}$ -octave band levels (dB SPL) as a function of frequency for males (solid line) and females (dashed line). Data also are shown from three previous investigations for comparative purposes.

Articulation Index



Speech banana

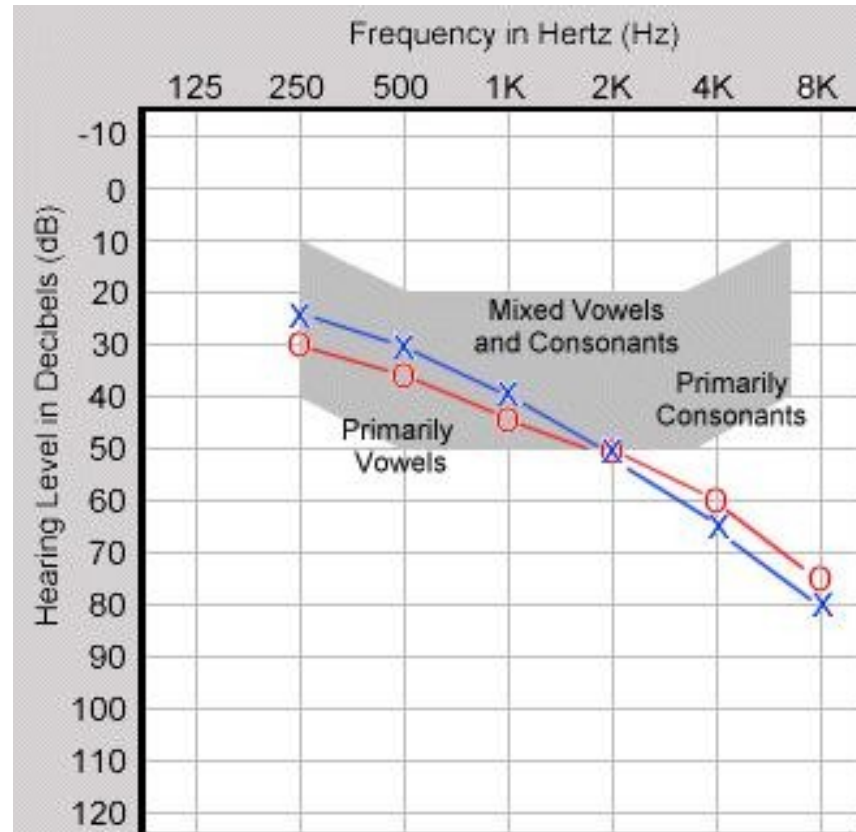


Figure One Audiogram
The "Speech Banana"

A fairly typical audiometric pattern for older people

Speech sounds

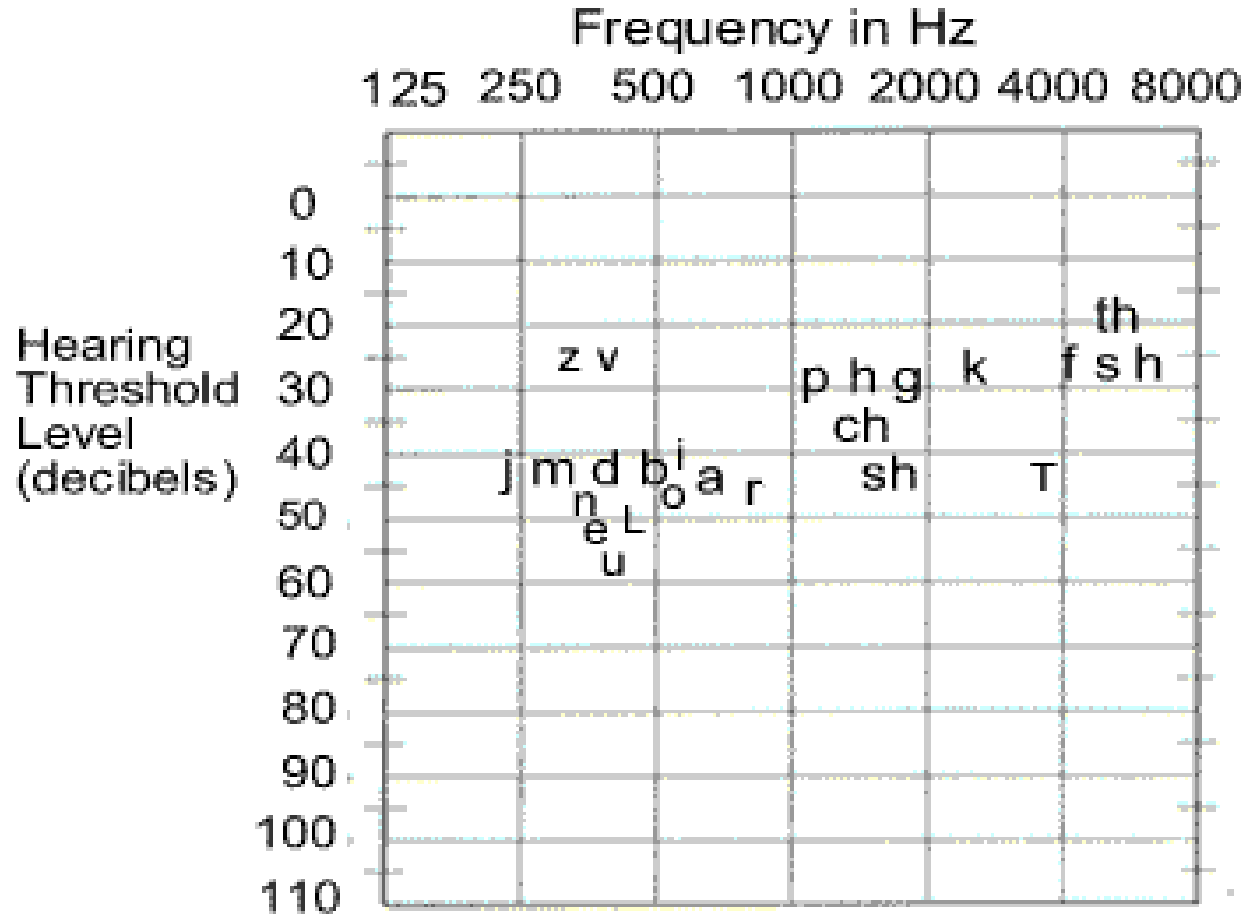


Figure 4. Short-term spectra measured at the ear for the phonemes /a/ (top panel), /u/ (middle panel), and /i/ (bottom panel). The parameter in each panel is group.

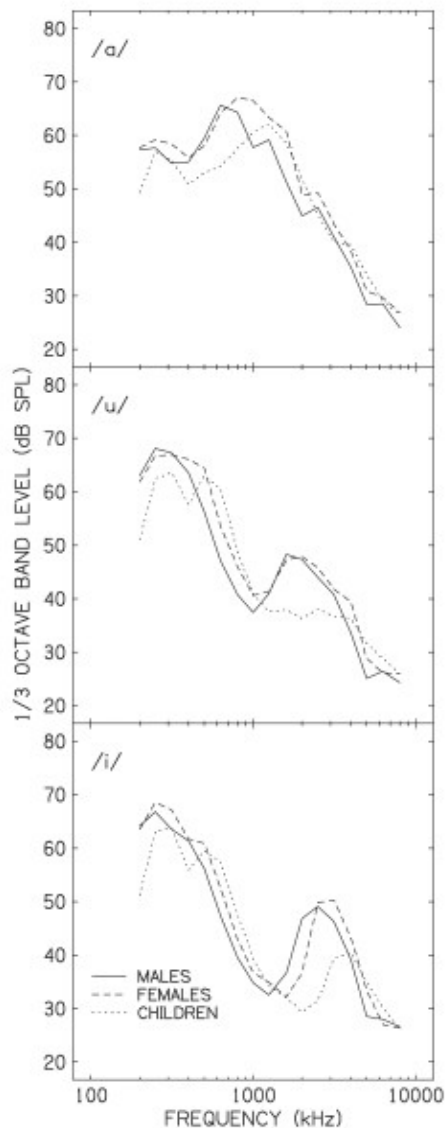
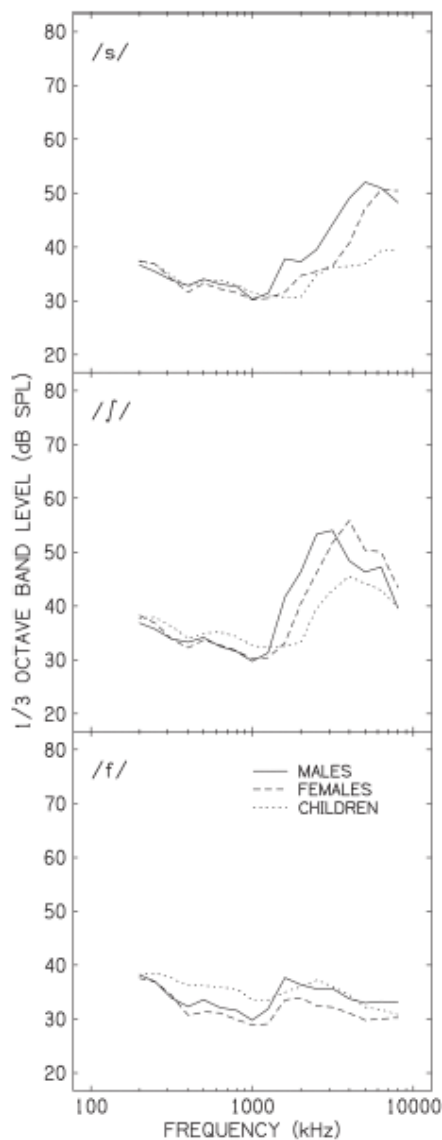


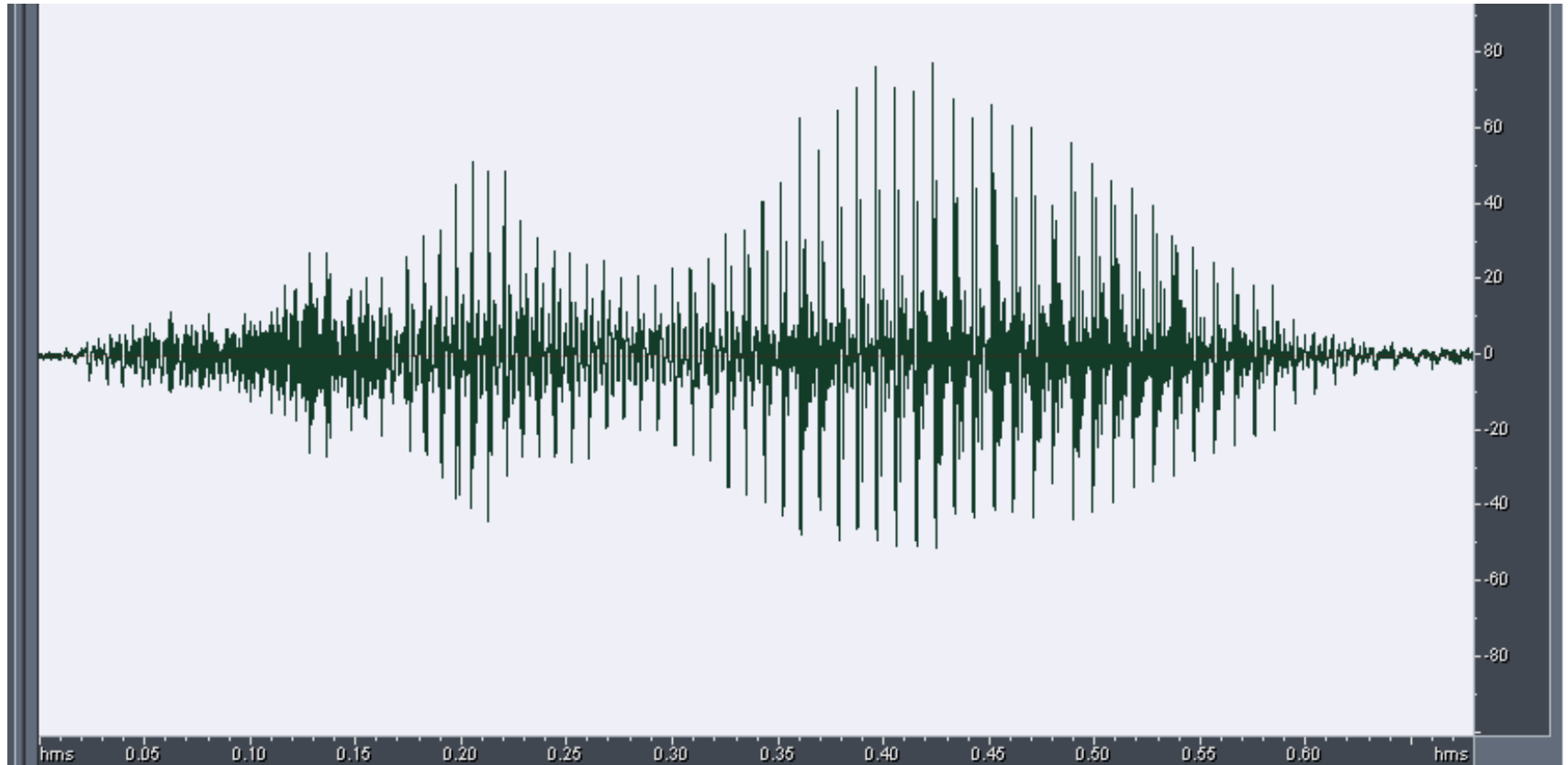
Figure 5. Short-term spectra measured at the ear for the phonemes /s/ (top panel), /ʃ/ (middle panel), and /f/ (bottom panel). The parameter in each panel is group.



Stelmachowicz et al.
 Journal of Speech,
 Language, and
 Hearing Research •
 Vol. 46 • 649–657 •
 June 2003

Adults vs. 3-4 year
 old talkers

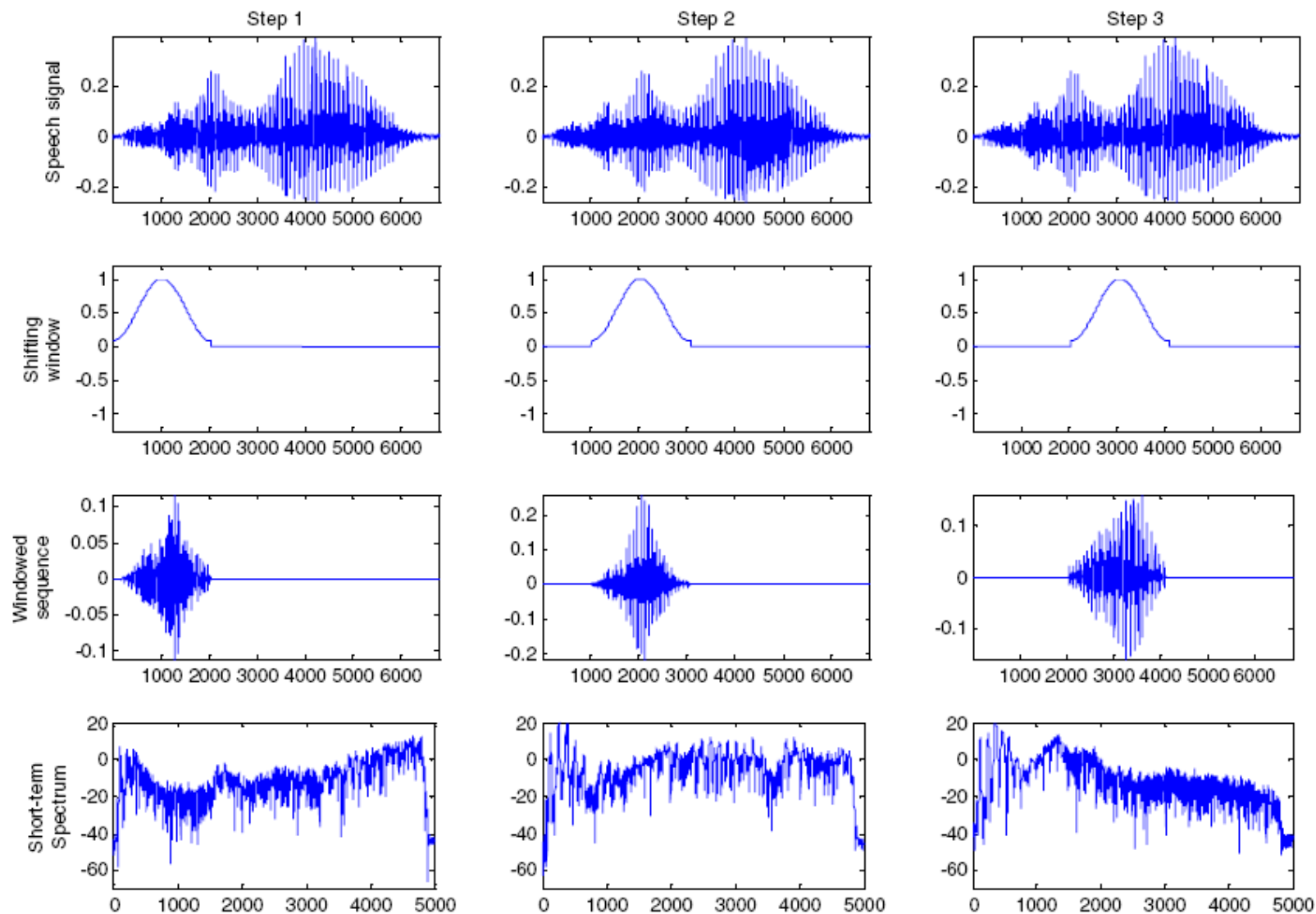
“zero” time waveform



“zero” frequency spectrum

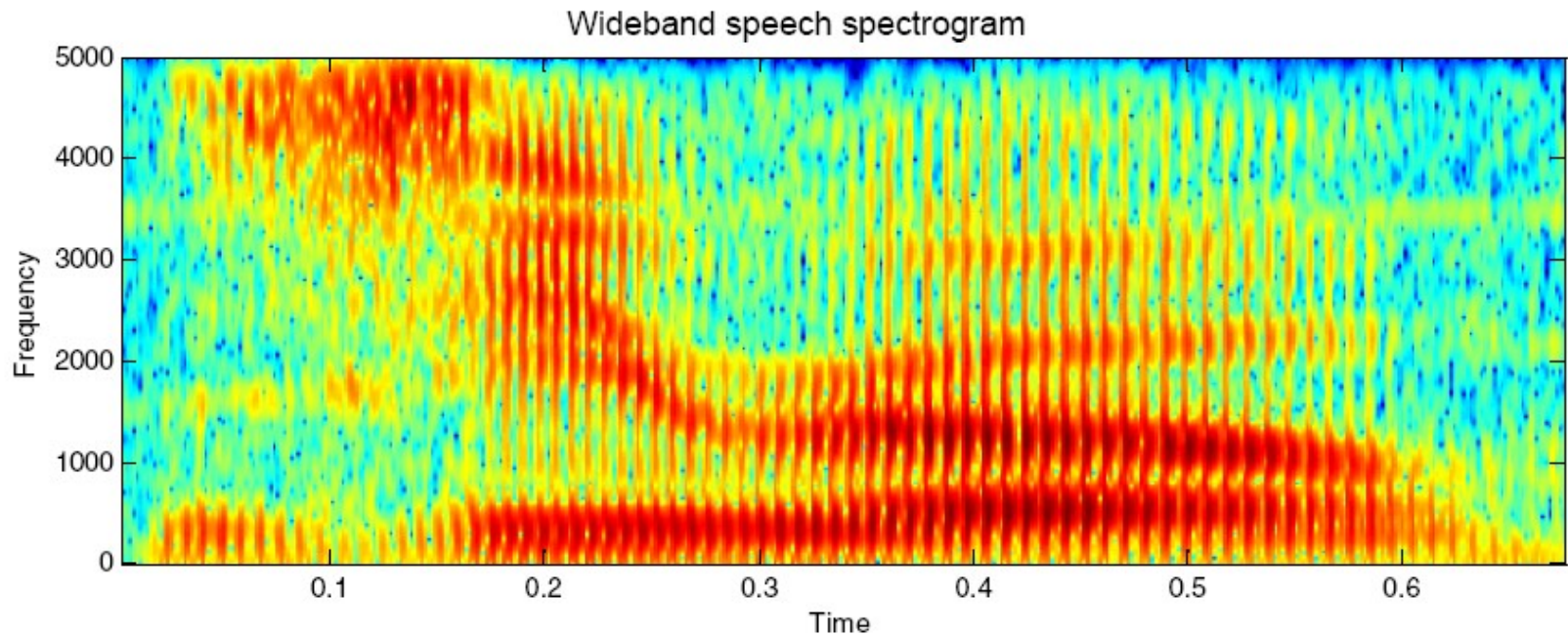


Short-term spectra



Wideband spectrogram of “zero”

Poor frequency resolution but good time resolution



Narrow band spectrogram of “zero”

Poor time resolution but good frequency resolution

