Old Dogs and New Tricks
An Update on Pure Tone Audiometry

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PROCEDURE UTILIZATION
1 JULY 93 - 30 JUNE 94
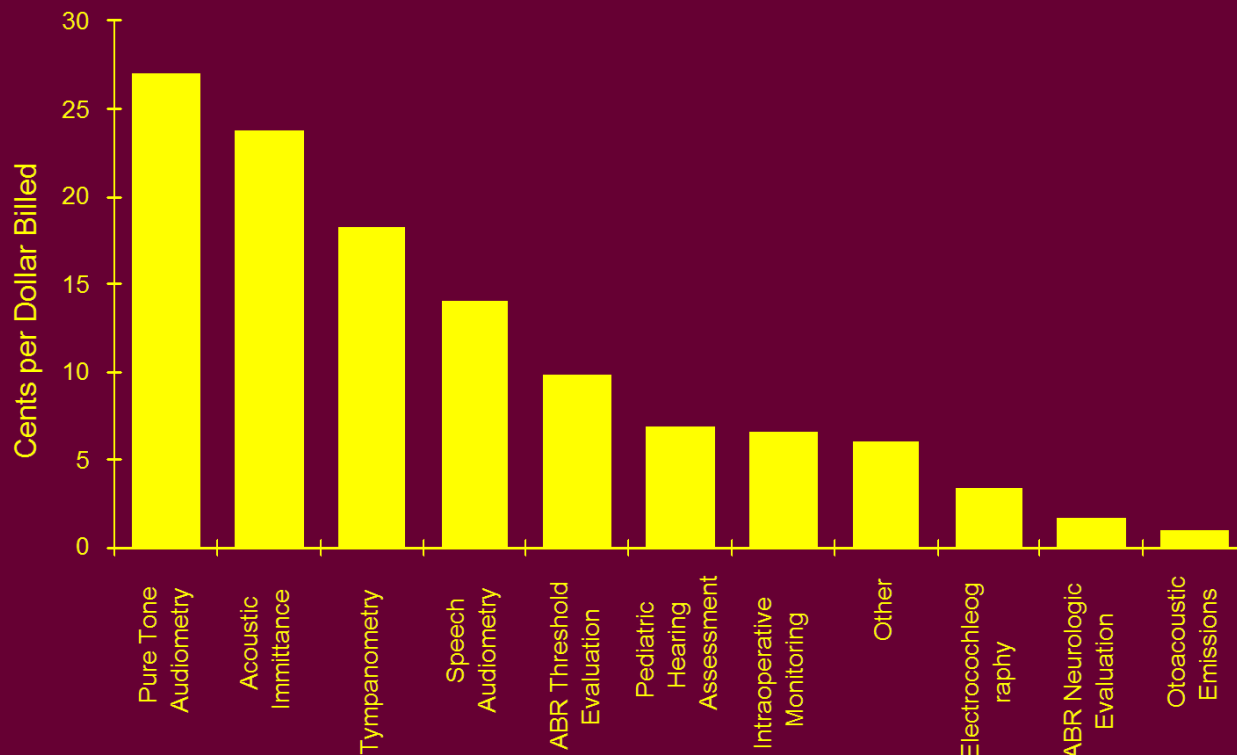
Bar chart titled with y-axis "Cents per Dollar Billed" ranging 0 to 30.

Procedure	Cents per Dollar Billed
Pure Tone Audiometry	27
Acoustic Immittance	24
Tympanometry	18
Speech Audiometry	14
ABR Threshold Evaluation	10
Pediatric Hearing Assessment	7
Intraoperative Monitoring	6.5
Other	6
Electrocochleography	3
ABR Neurologic Evaluation	1.5
Otoacoustic Emissions	1

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Test Environment

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Test Environment

Audiometric Sound Room

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Test Environment

Circumaural Earphones

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Sound Room Attenuation — a line graph of ATTENUATION (dB) versus FREQUENCY (Hz)

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Earphones

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Earphones

Supra-aural
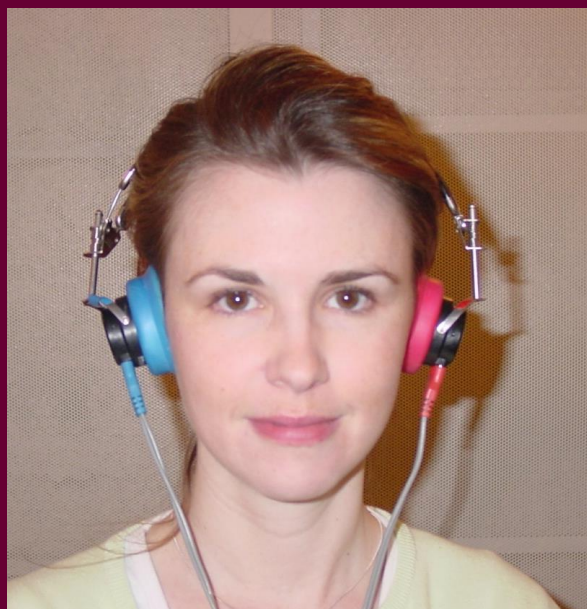
Interacoustics DD45

Telephonics TDH

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Earphones

Insert Earphones

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Earphones

Circumaural Earphones
Sennheiser HDA200

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Sennheiser HDA 200

Sennheiser HDA 300

Sennheiser HD 280 Pro

Peltor HT79A

Circumaural
Earphone Options

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Bone Conduction

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Audiometric Bone Vibrators

Radioear B71

Radioear B81

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Bone Conduction

SUPRA-AURAL EARPHONE

OCCLUDED

UNOCCLUDED

Sound Pressure Level (dB) vs Frequency (Hz)
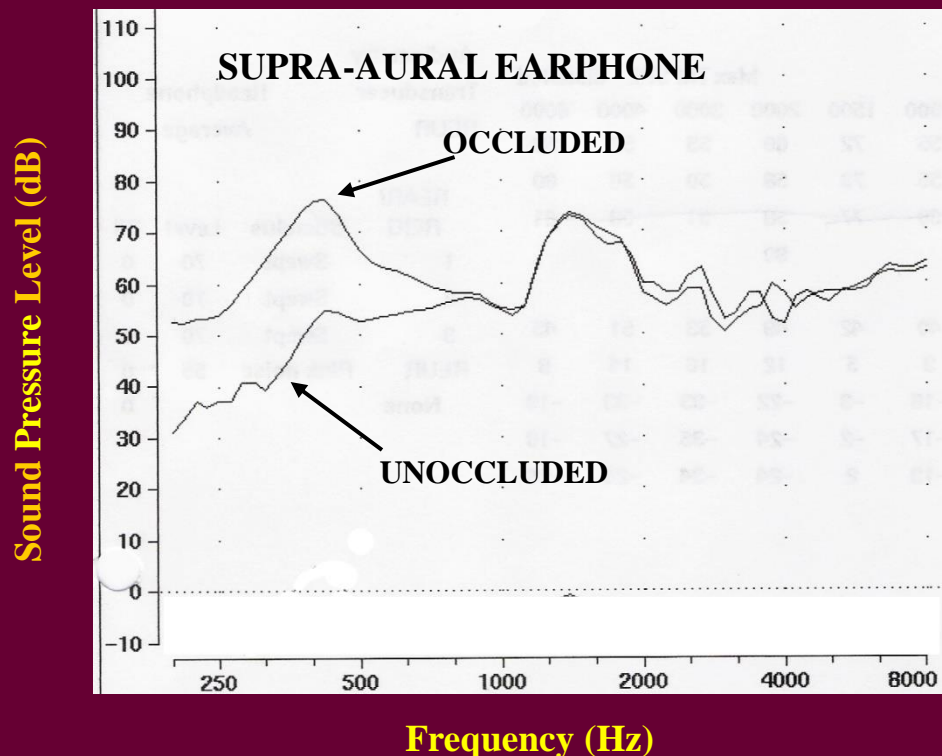
OCCLUSION EFFECT

Sound Pressure Level in the ear canal unoccluded and with the ear covered by a TDH earphone with supra-aural cushion. The sound source was a bone vibrator placed on the forehead.

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Bone
Conduction

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Air-Bone Gaps

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Air-Bone Gaps

What's wrong with this audiogram?
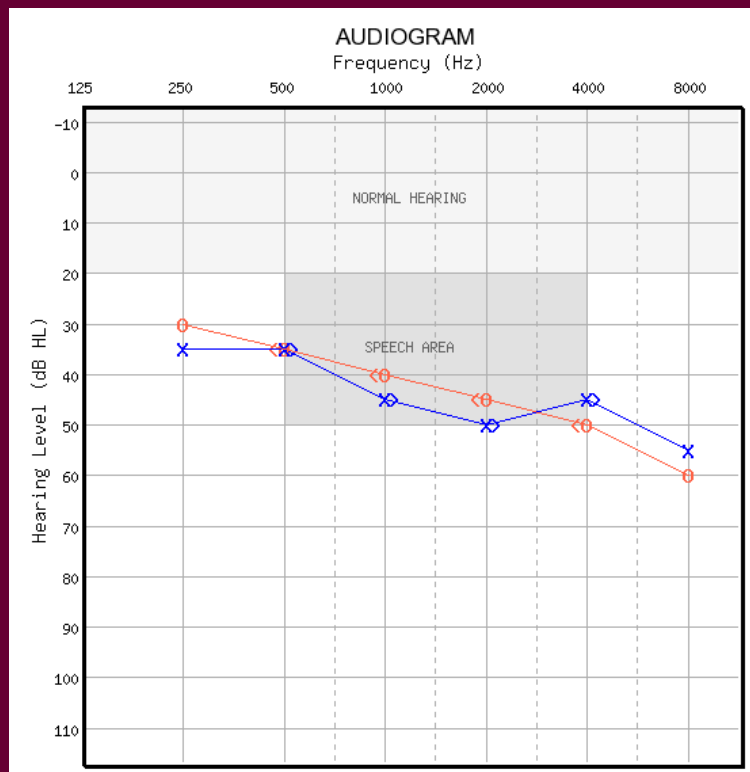
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Air-Bone Gaps

INTERTEST VARIABILITY AND THE AIR-BONE GAP

Gerald A. Studebaker
University of Oklahoma Medical Center
Oklahoma City, Oklahoma

Studebaker (1967). Intertest variability and the air-bone gap. *J. Speech Hear Dis 32*, 82-86.

- The air-bone gap is a normally-distributed variable that has the combined variance of air conduction and bone conduction thresholds
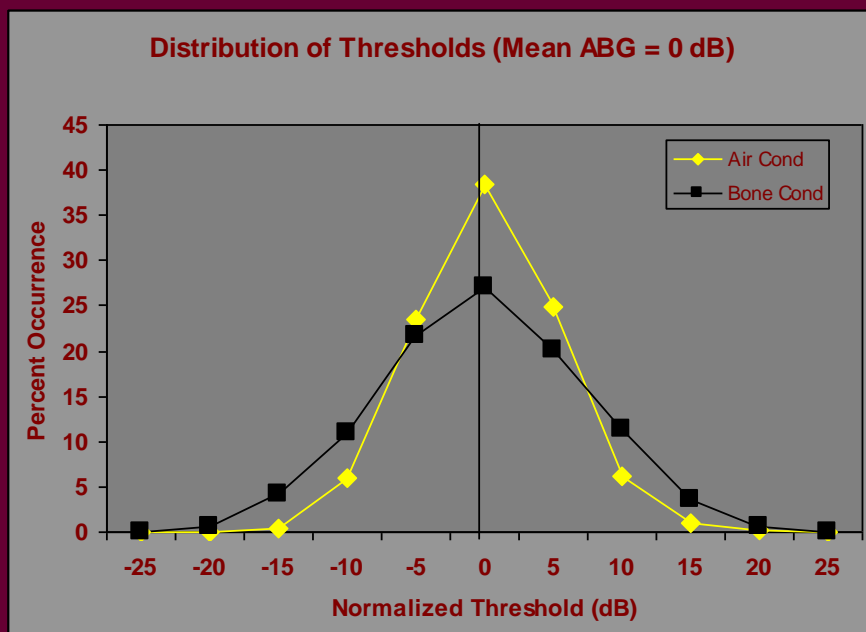
- Air-bone gap is zero 38% of the time

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Air-Bone Gaps

Distributions of air- and bone-conduction thresholds

Air conduction standard deviation = 5 dB
Bone conduction standard deviation = 7 dB
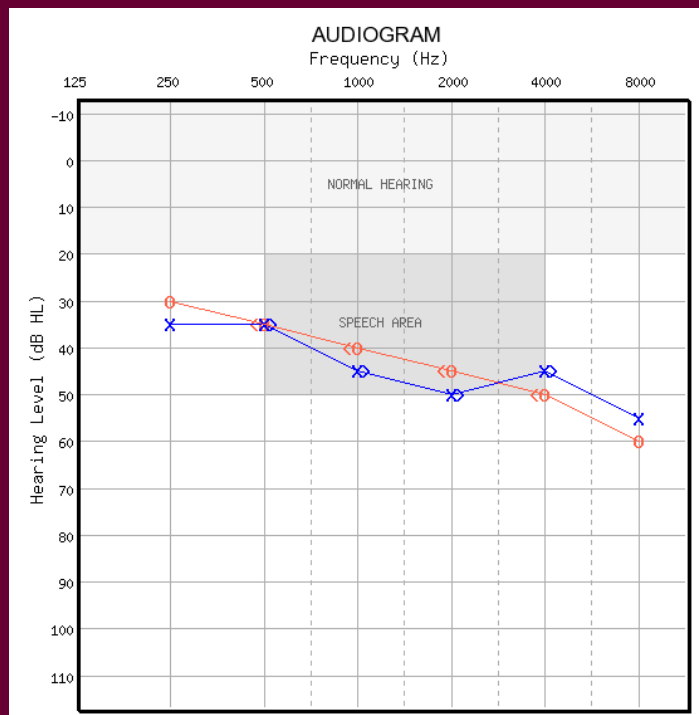Air Bone Gap standard deviation – 8.6 dB

The air-bone gap is zero 21% of the time

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Probability of 0-db air-bone gaps at 8 frequencies = 1/245,083

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Air-Bone Gaps

The Dirty Little Secret

(adults only – some material may be offensive)

Bone Conduction Testing is a Biased Experiment

In manual pure-tone audiometry
Air Conduction and Bone Conduction are NOT Independent

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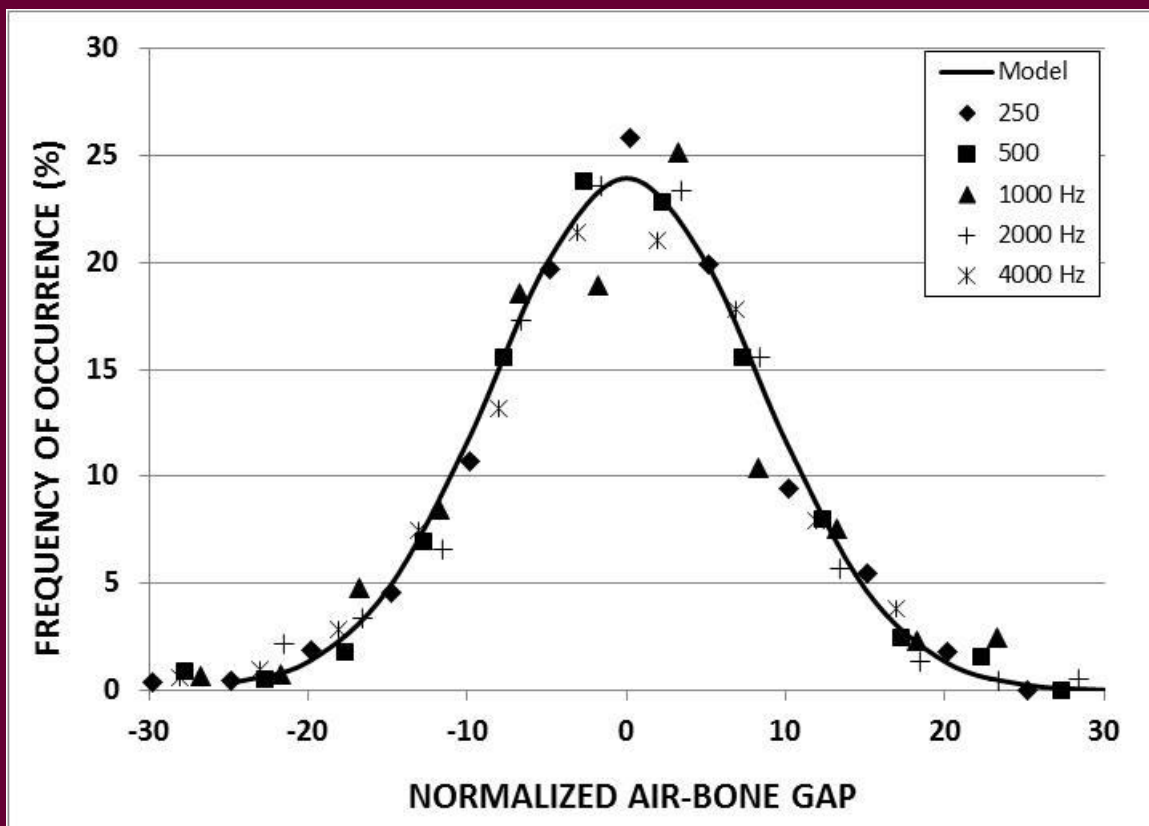
Distributions of Air-Bone Gaps
Busselton Healthy Ageing Study

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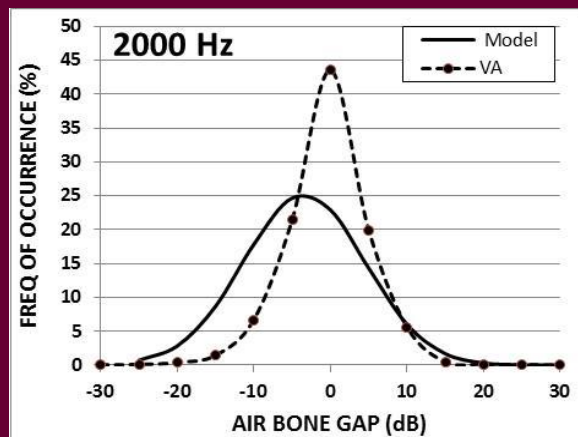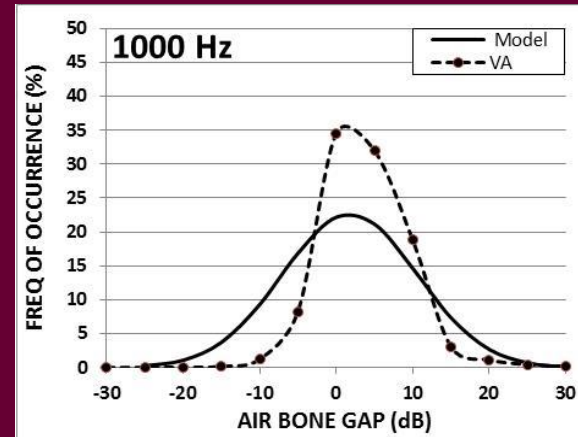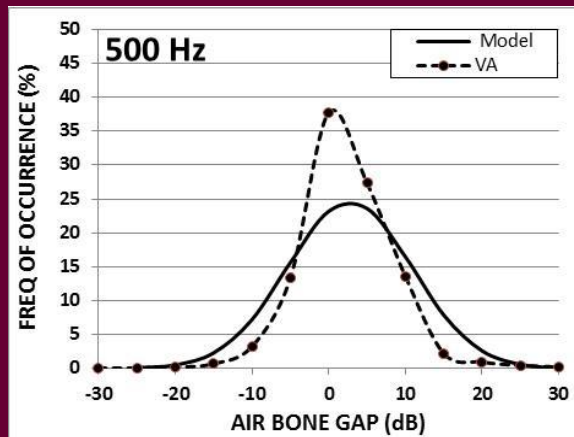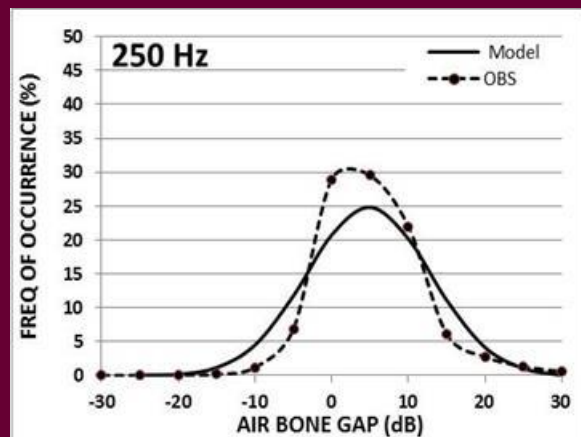## AudiologyNow!2014
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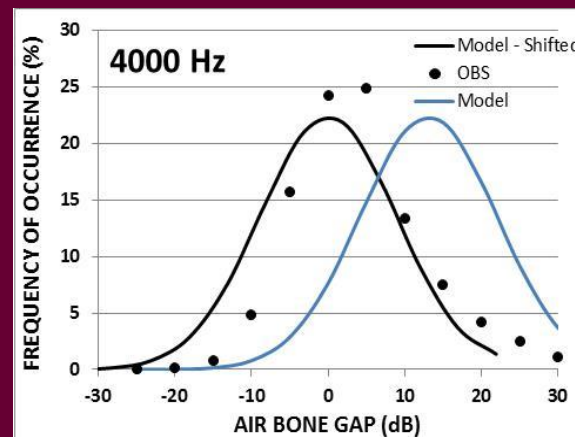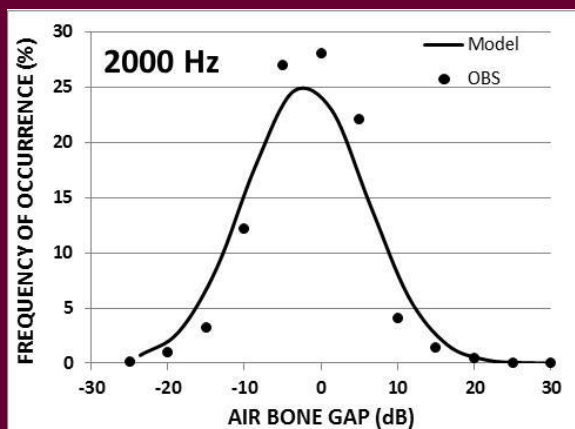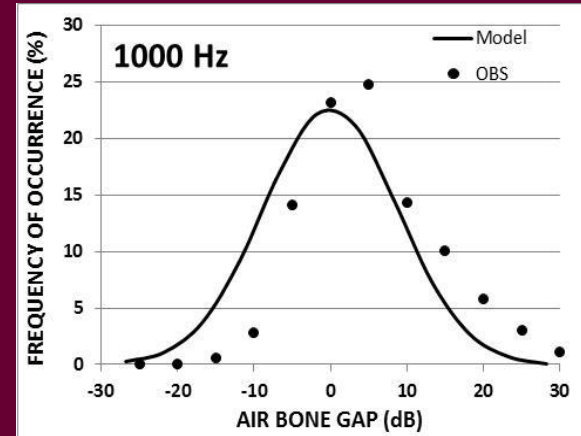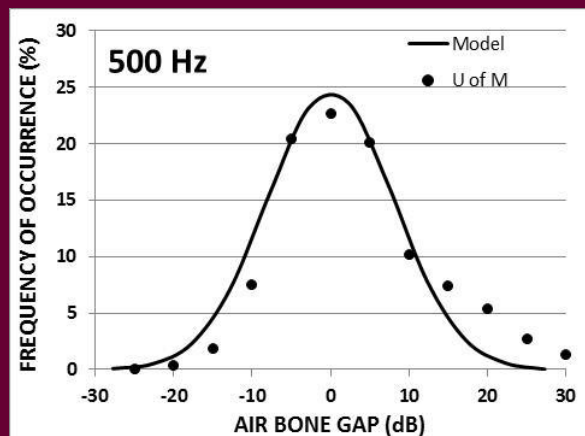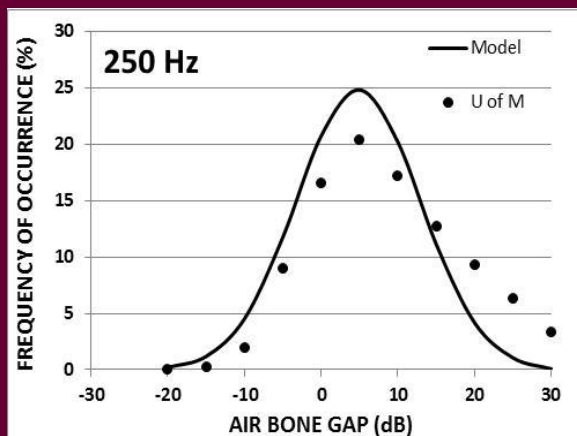
Distributions of Air-Bone Gaps
University of MN Study

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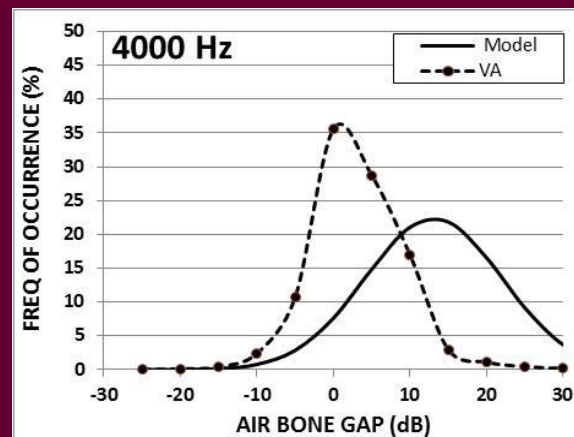
Distributions of Air-Bone Gaps
VA (DALC) Database

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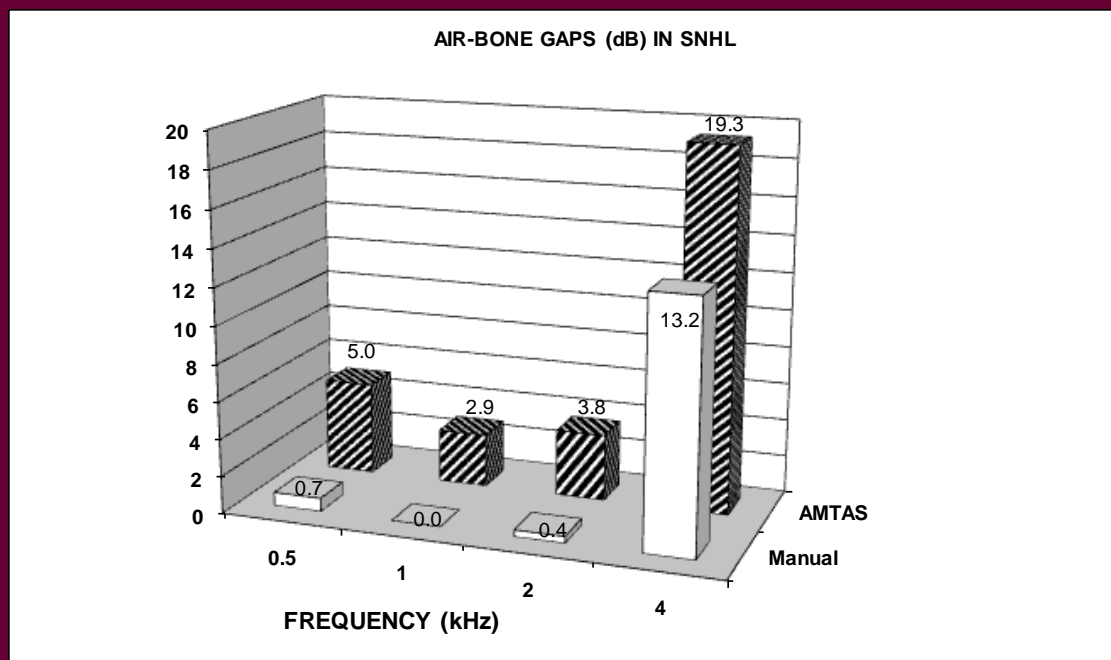
Air-Bone Gaps

4 kHz Air-Bone Gaps

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Air-Bone Gaps

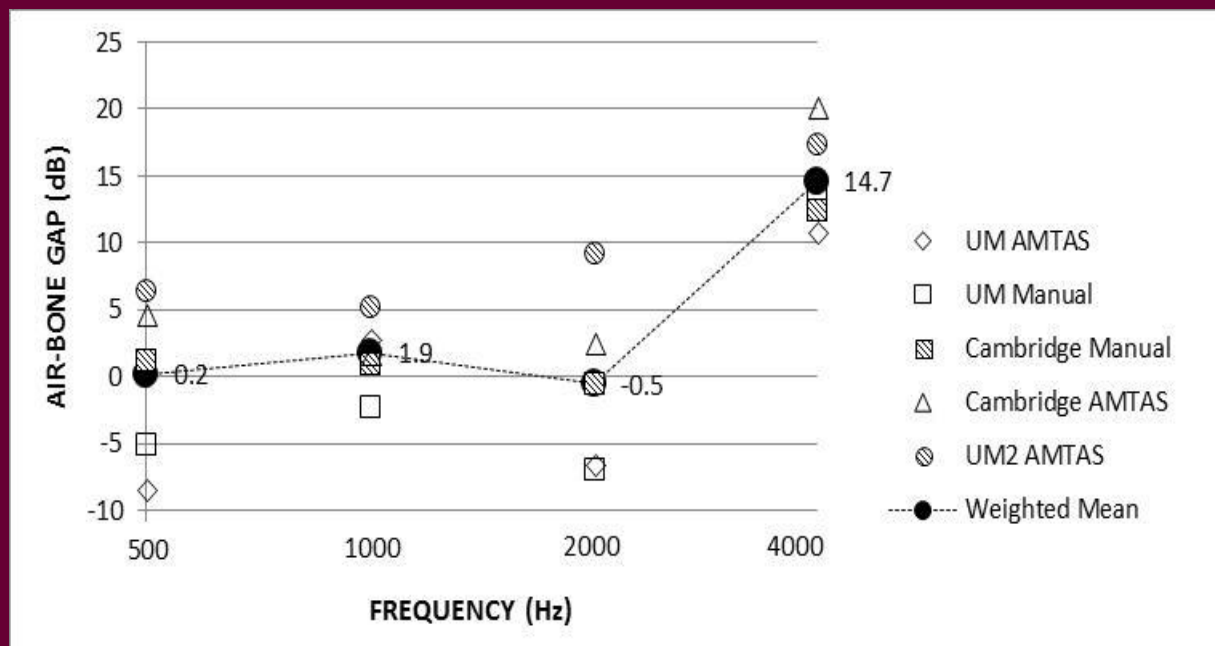## Air-Bone Gaps in Sensorineural Hearing Loss

Margolis, R.H., Glasberg, B.R., Creeke, S., Moore, B.C.J. AMTAS® - Automated Method for Testing Auditory Sensitivity: Validation Studies. *Int J Audiology*, 49, 185-194, 2010.

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Air-Bone Gaps

Margolis, R.H., Moore, B.C.J. Automated method for testing auditory sensitivity: III. Sensorineural hearing loss and air-bone gaps. *Int J Audiology,* 50, 440-447, 2011.

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Air-Bone Gaps

- How to eliminate the 4 kHz air-bone gap:

- Calibrate 4 kHz bone conduction to a Reference Equivalent Force Level 14.1 dB *lower* than standard

- Mastoid - 21.4 dB re: 1μN

- Forehead - 29.4 dB re: 1μN

Margolis, R.H., Eikelboom, R.H., Johnson, C., Ginter, S.M., Swanepoel, D.W., Moore, B.C.J. False Air-Bone Gaps at 4 kHz in Listeners with Normal Hearing and Sensorineural Hearing Loss. *Int. J. Audiology* 52:526-532, 2013.

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You <u>can</u> teach an old dog new tricks.