NAVSEA
NAVAL SEA SYSTEMS COMMAND

Human Systems Integration Directorate

Workplace Compliance/Crew Safety Issues

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Hearing Loss Degrades Combat Performance – Word Intelligibility

	Good Hearing	Poor Hearing
Time to Identify Target	40 sec	90 sec
Incorrect Command Heard by Gunner	1%	37%
Correct Target Identification	98%	68%
Enemy Targets Killed	94%	41%
Wrong Target Shot	0%	8%
Tank Crew Killed by Enemy	7%	28%

Ref: Tank Gunner Performance and Hearing Impairment
(Garinther & Peters, Army RD&A Bulletin 1990, Jan-Feb 1-5)

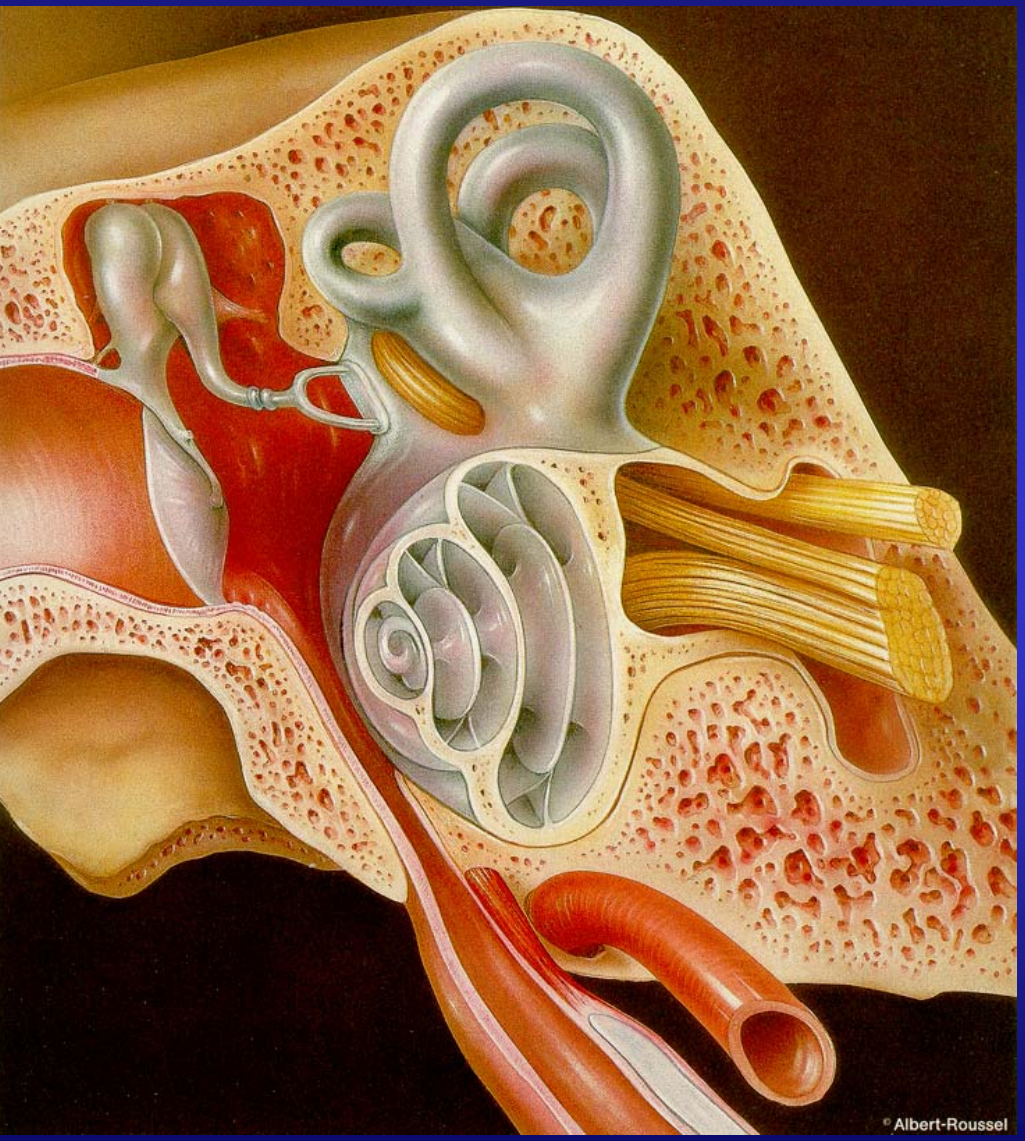
Bad Bad Bad Move !

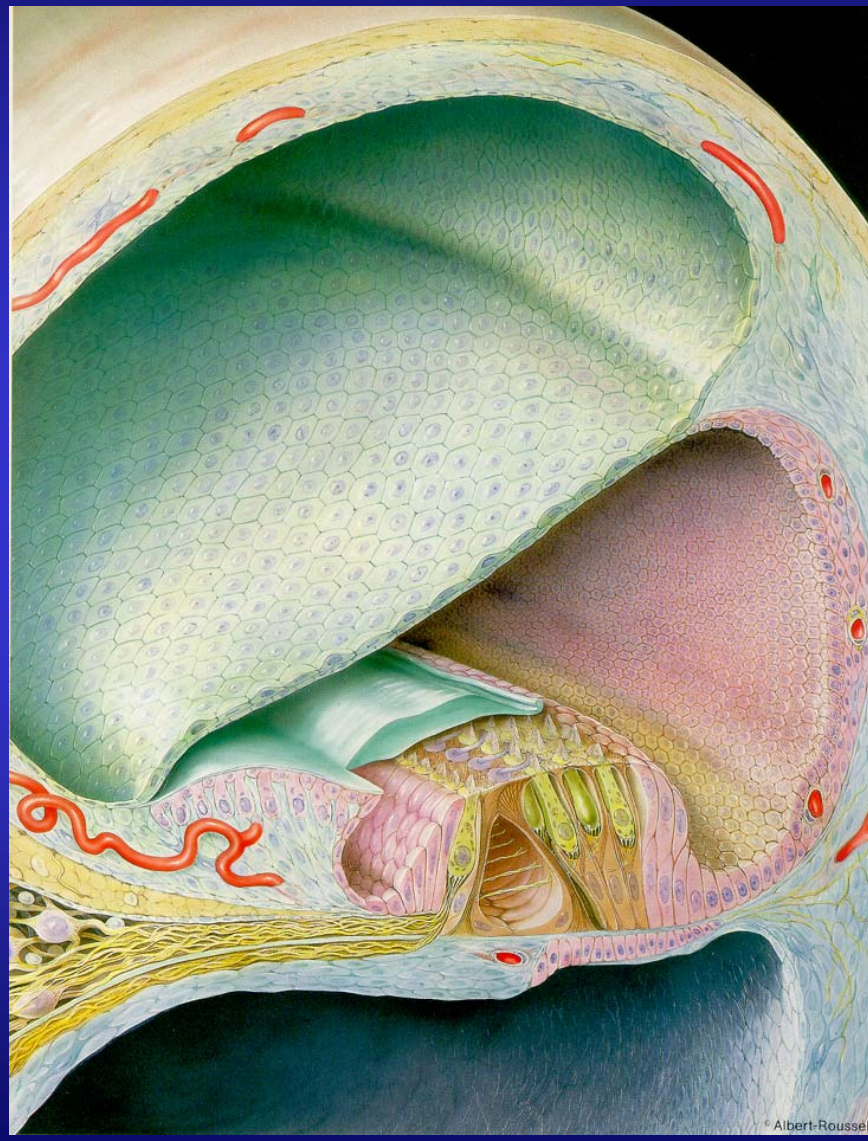
Bad Bad Bad Move !

Collision !

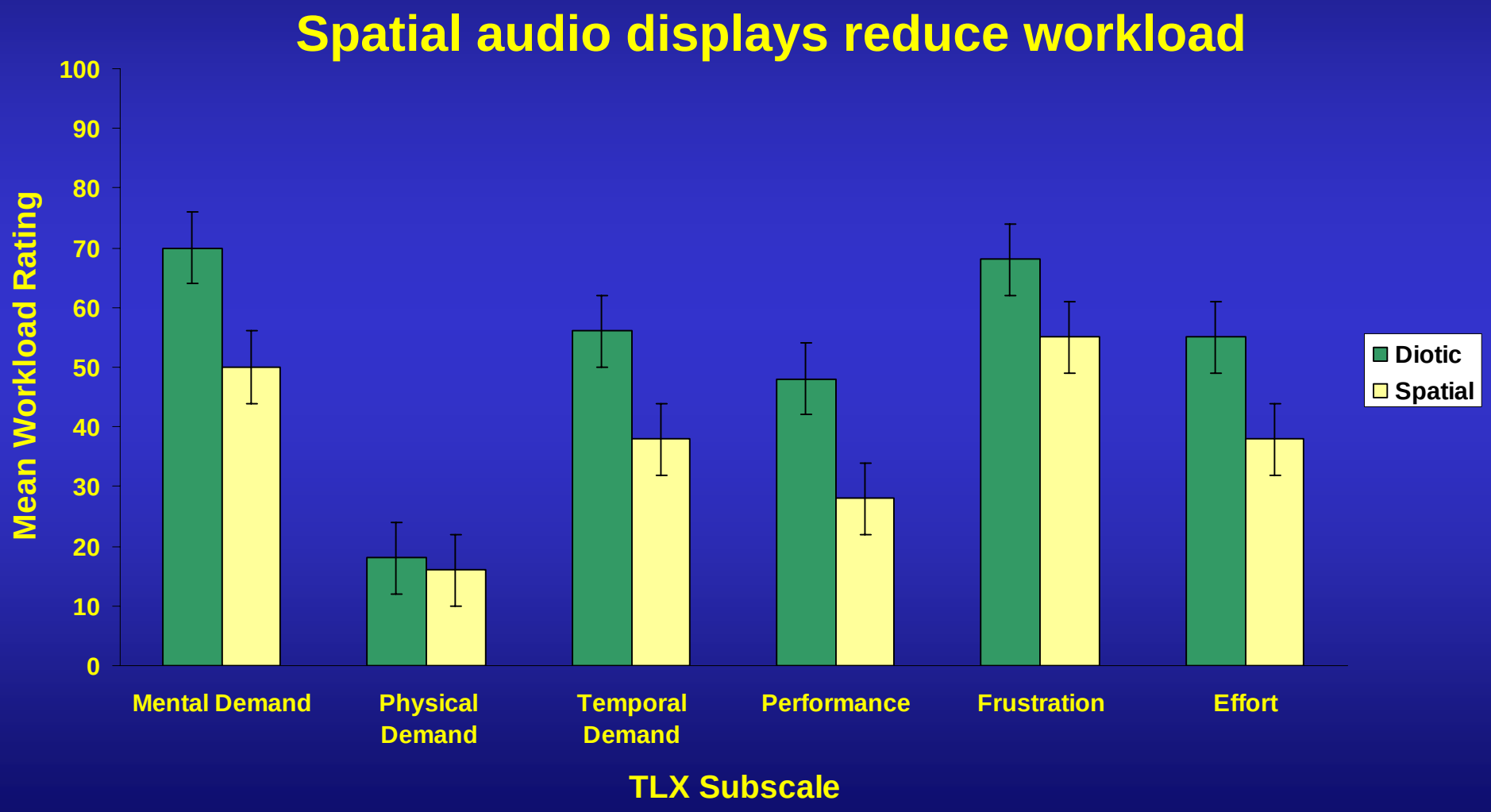
Inner ear

Magnified cross section of cochlea





Communication Channel Separation

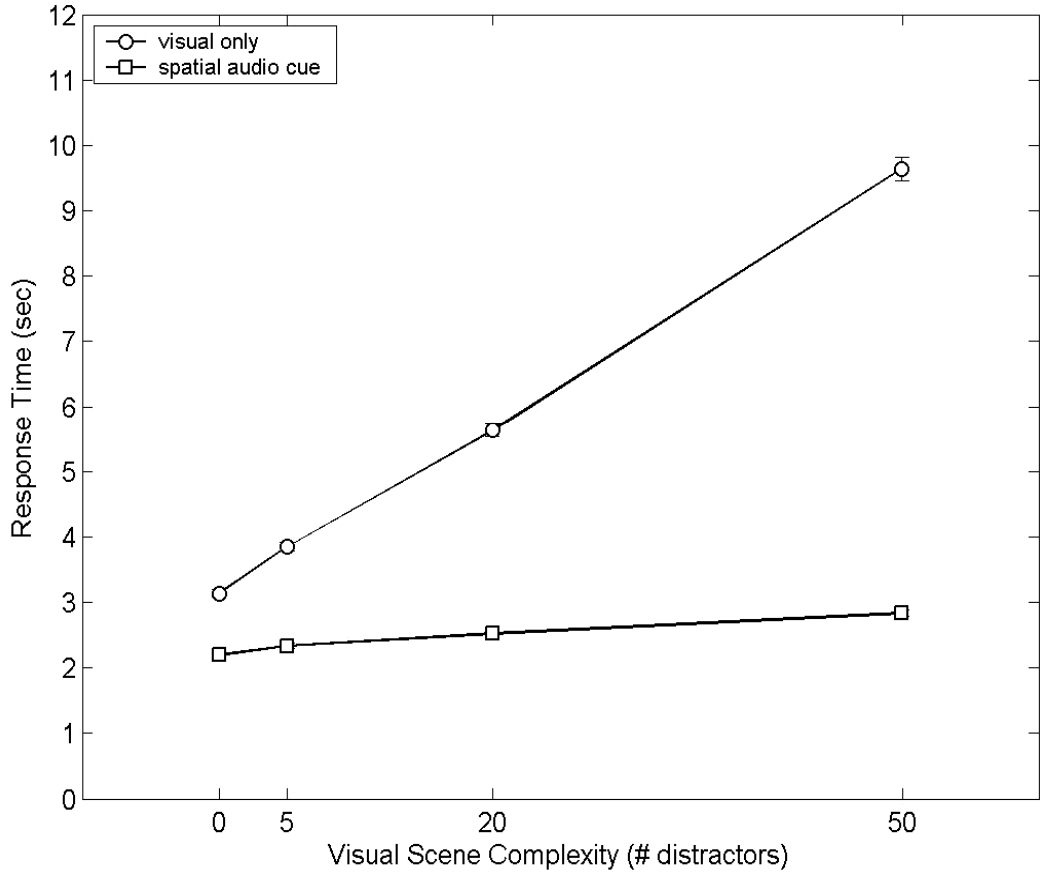


Ref: Popik

Locate Objects of Interest

Target Acquisition and Threat Avoidance

- Auditory cue spatially coincident with visual target substantially reduces target acquisition times
- Benefit increases with increasing visual scene complexity, or when object of interest is outside VFOV
- Benefit even when target is in immediate field of view

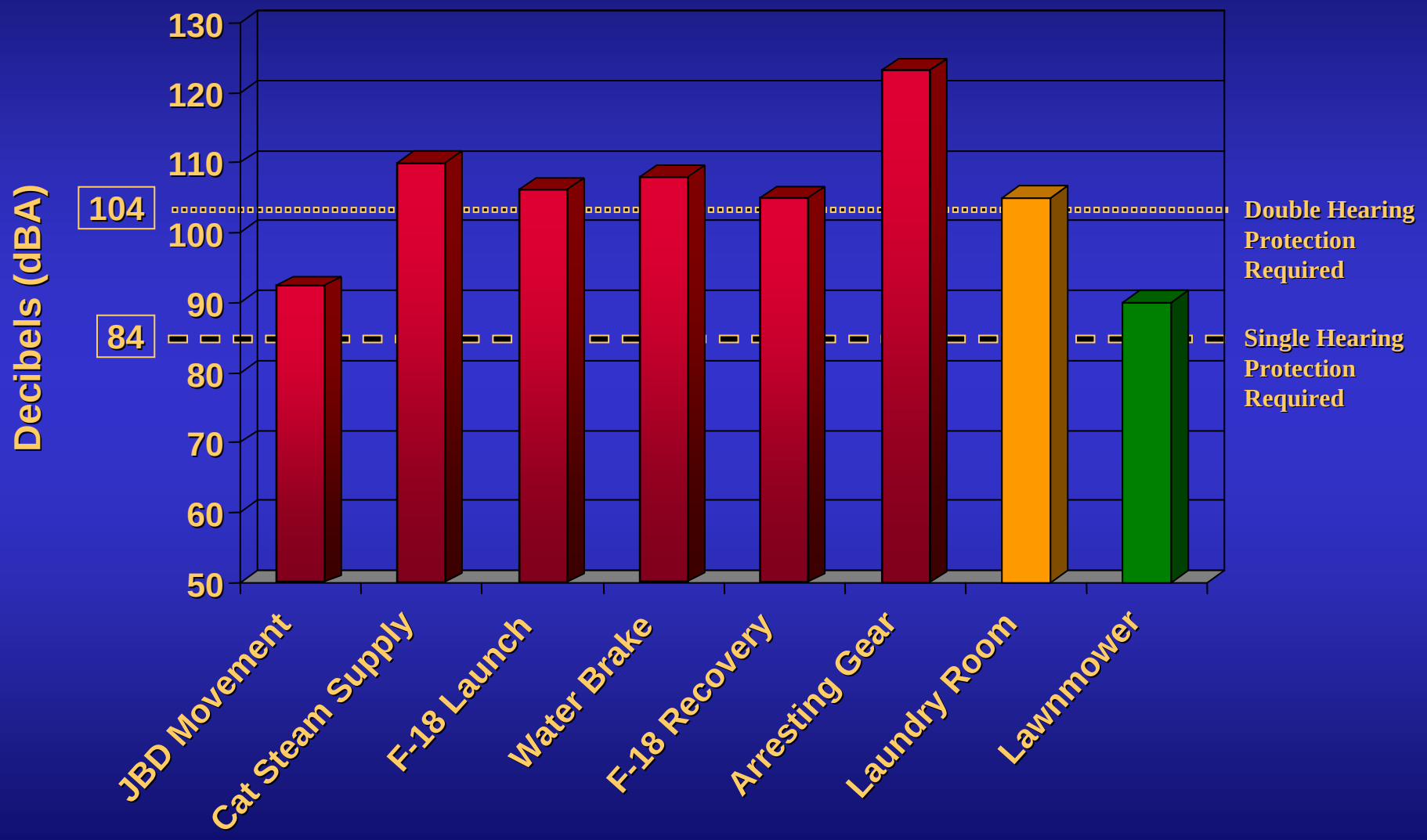


Ref: Popik

IA2-36 Diego the saber-toothed tiger (voiced by Denis Leary) expresses his displeasure with the antics of Sid the Sloth (voiced by John Leguizamo).
Photo credit: Blue Sky Studios

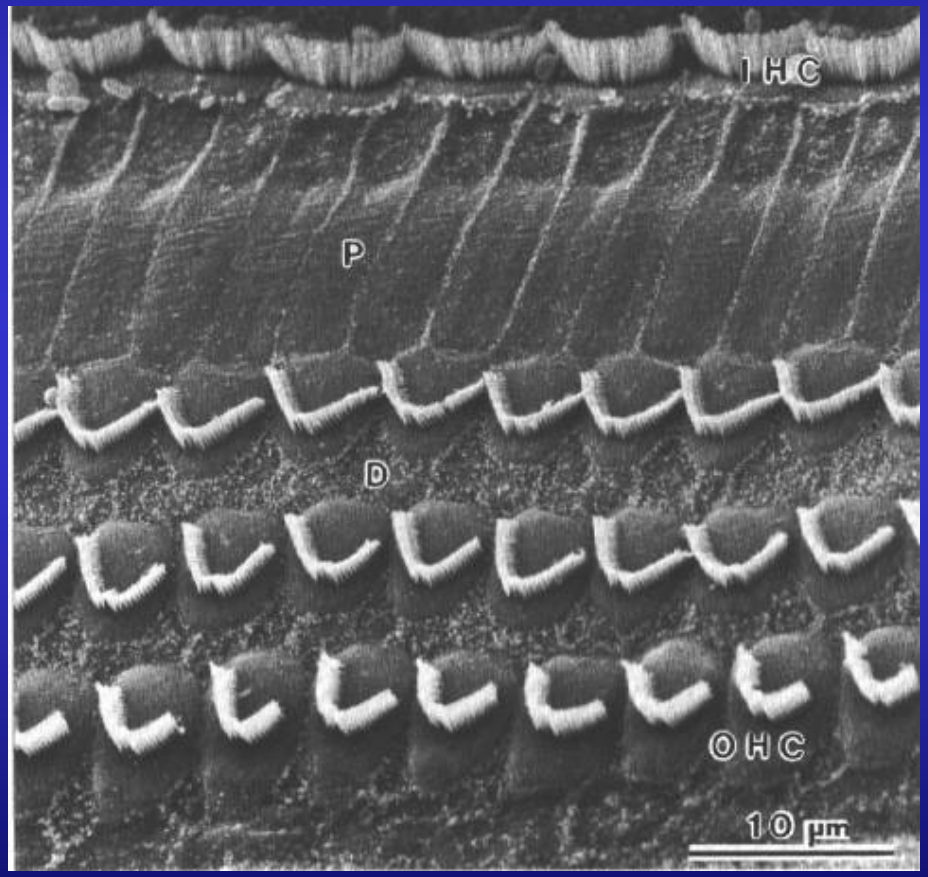
ICE AGE THE MELTDOWN TM & © 2006 Twentieth Century Fox Film Corporation. All rights reserved. Not for sale or duplication.

CVN Airborne Noise (Gallery Deck)

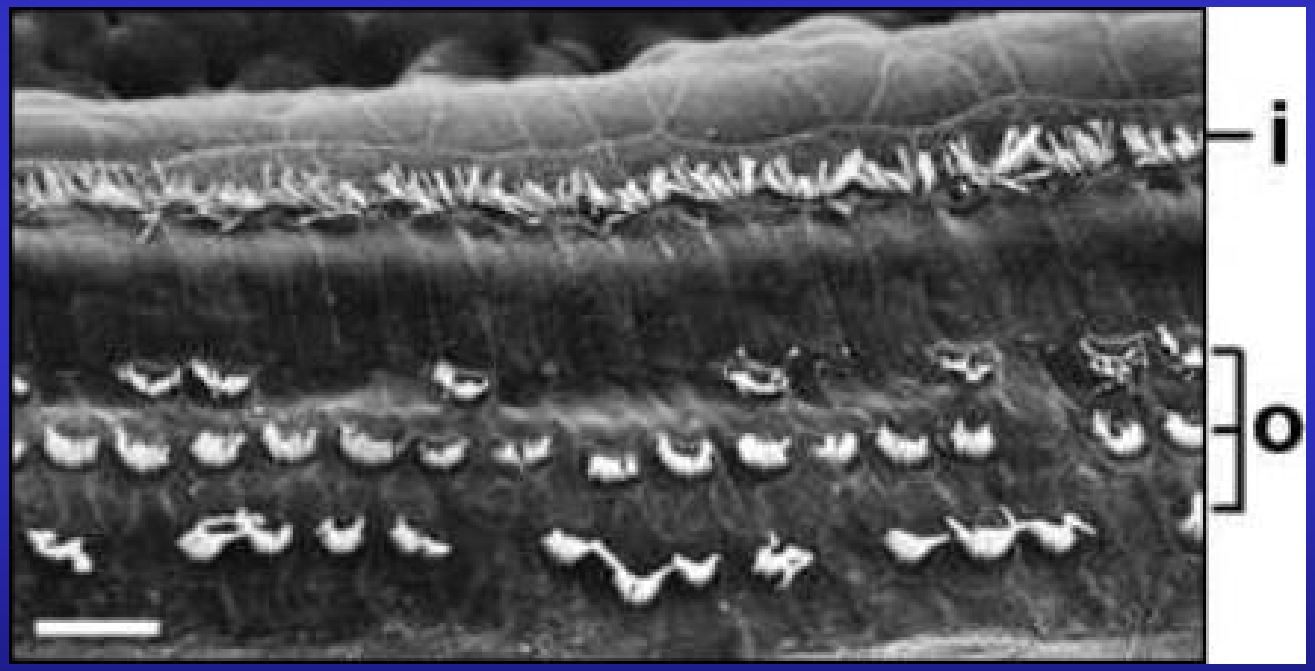


Ref: CVN 72, CVN 74 Trial Data

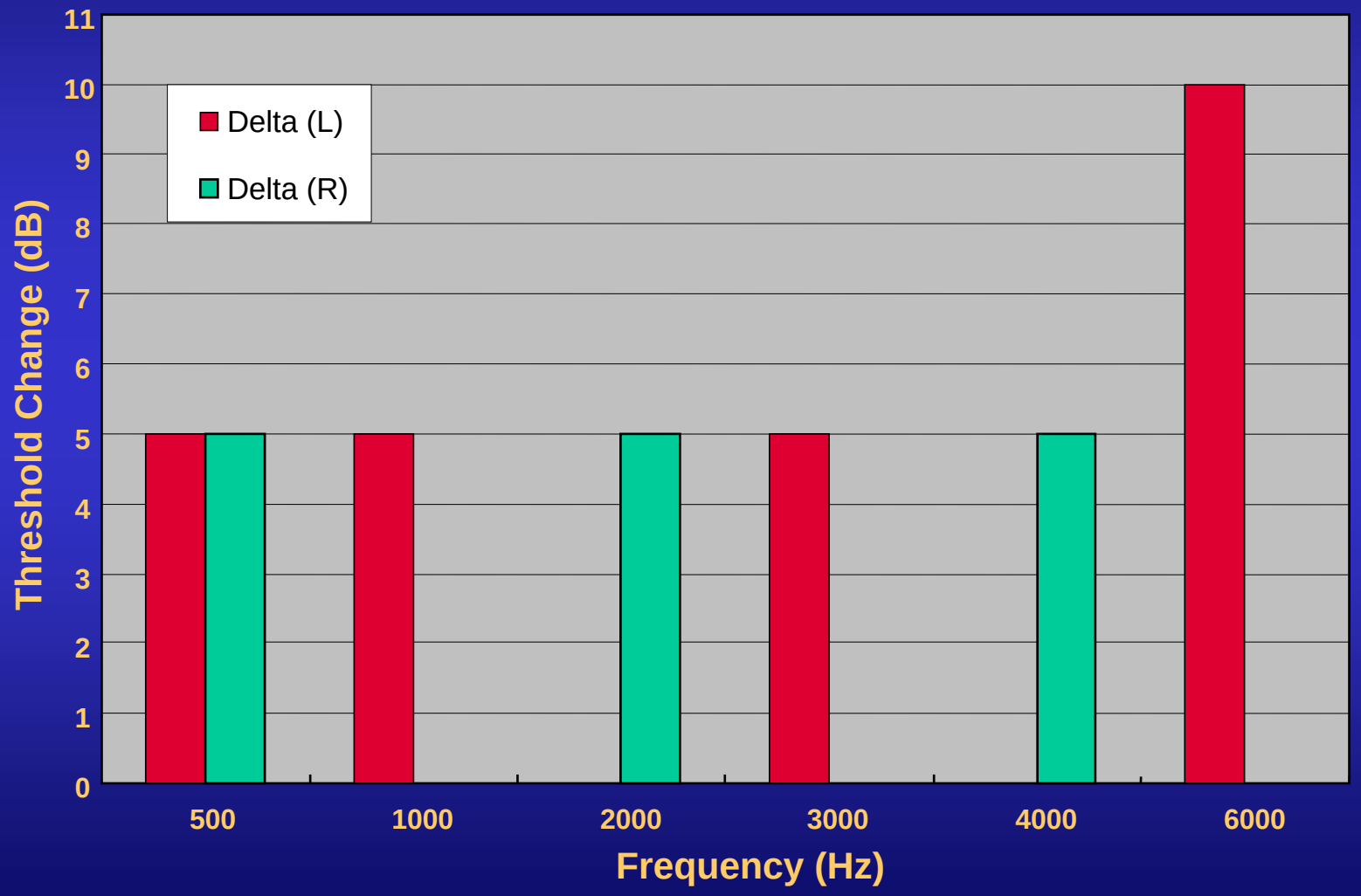
Normal Hair Cells



Not Normal Hair Cells

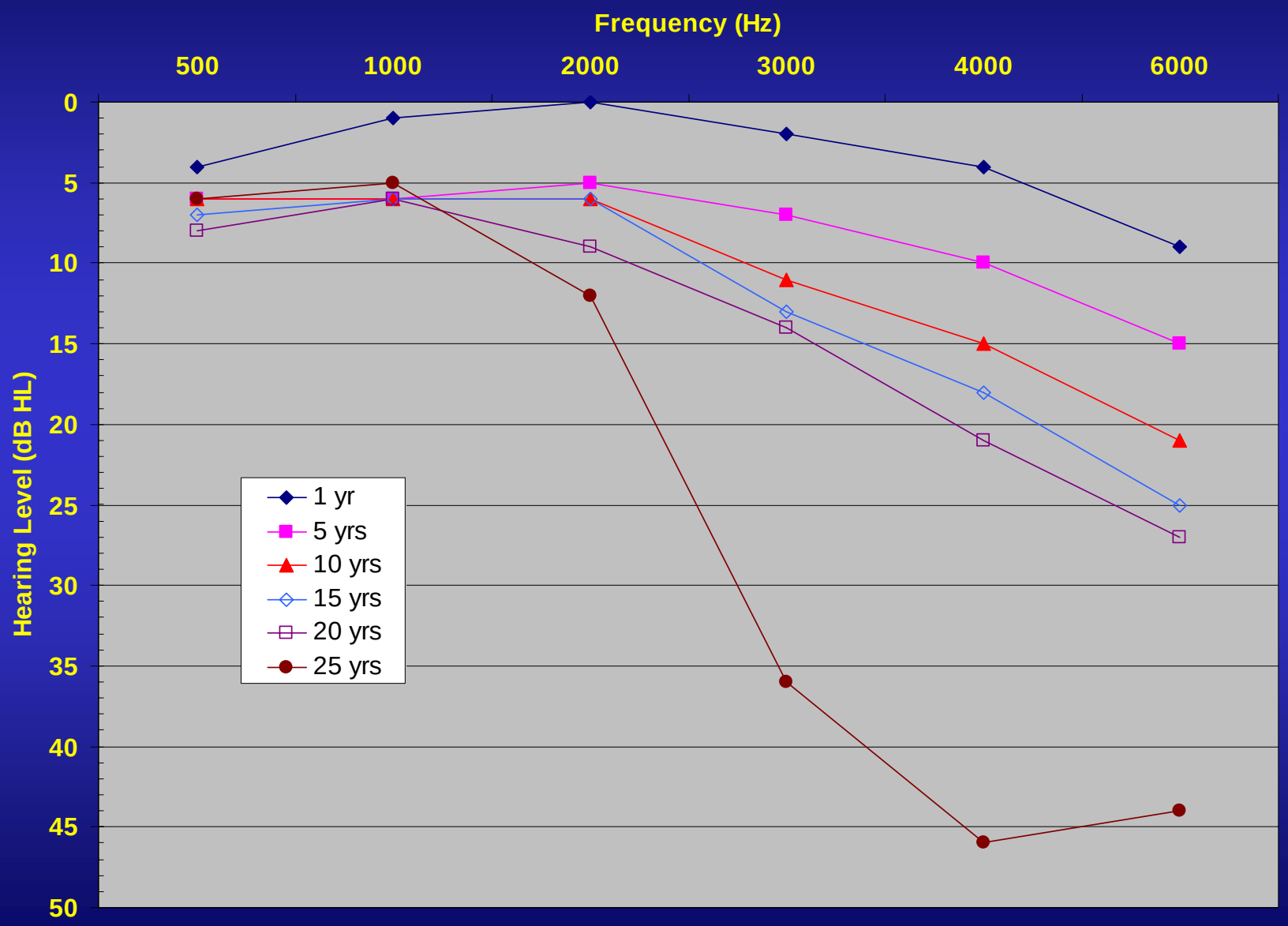


Audiogram Recovery



Ref: Medical Records, Nov '96

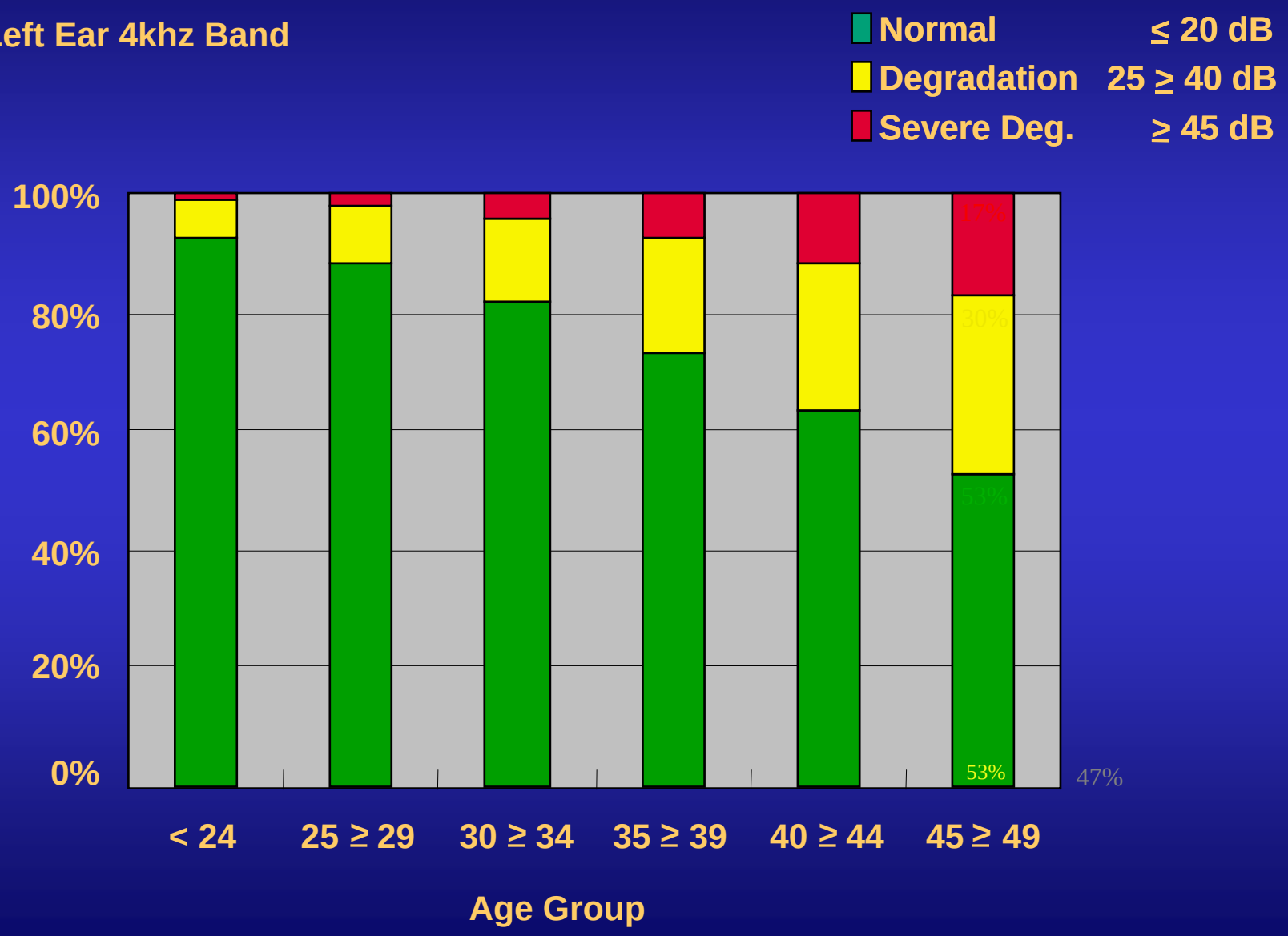
Hearing Loss for US Navy Divers (Left Ear)



Ref. E. Cudahy, NSMRL

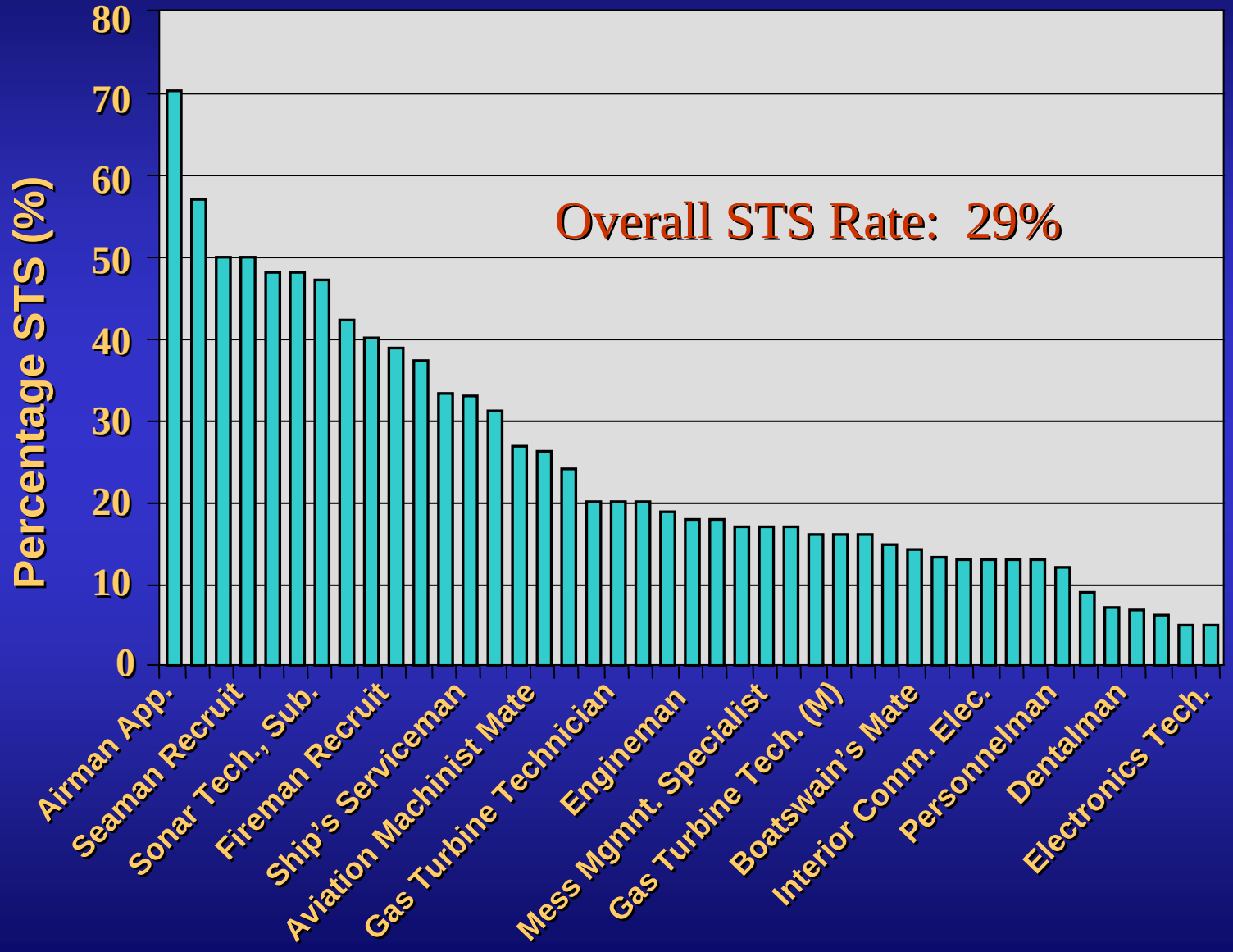
L4K Hearing for Enlisted by Age Group

L4K - Left Ear 4khz Band



Ref: Captain Bohnker, NEHC '01

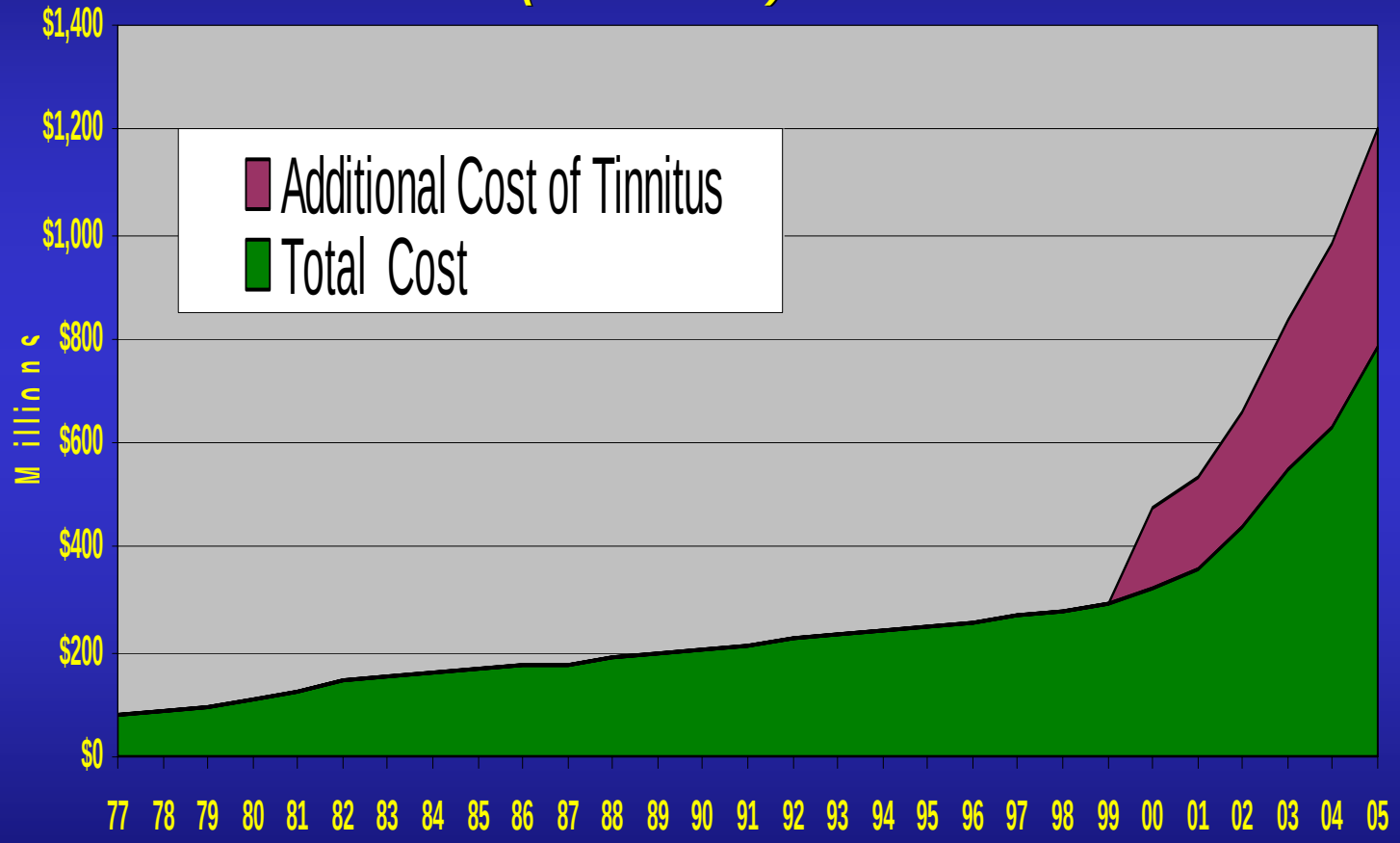
Significant Hearing Threshold Shift (STS) vs. Job Specialty



Ref: Wolgemuth et al (*Military Medicine*, 5/95)

Steps Must Be Taken to Reverse the Trend

Veteran Disability Benefits Paid for Hearing Loss as Primary Disability (All Services)



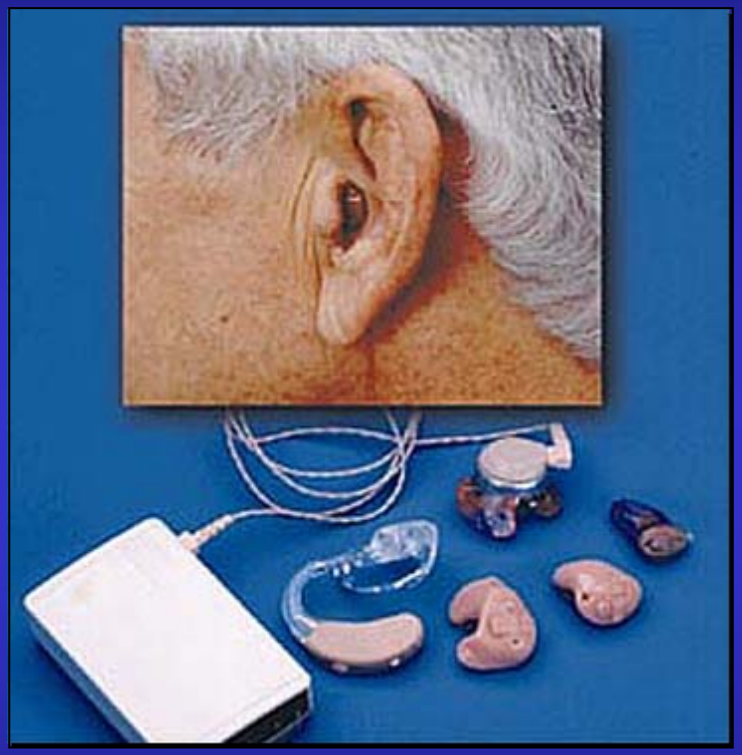
$9.3 Billion Spent Between '77 and '05

Data Does Not Include Costs For Hearing Loss as Secondary Disability

Hearing Loss Occurs Primarily During Training, Not Combat.

Ref: Yankaskas, LOTR, Army Center for Health Promotion and Preventive Medicine, Aberdeen, MD

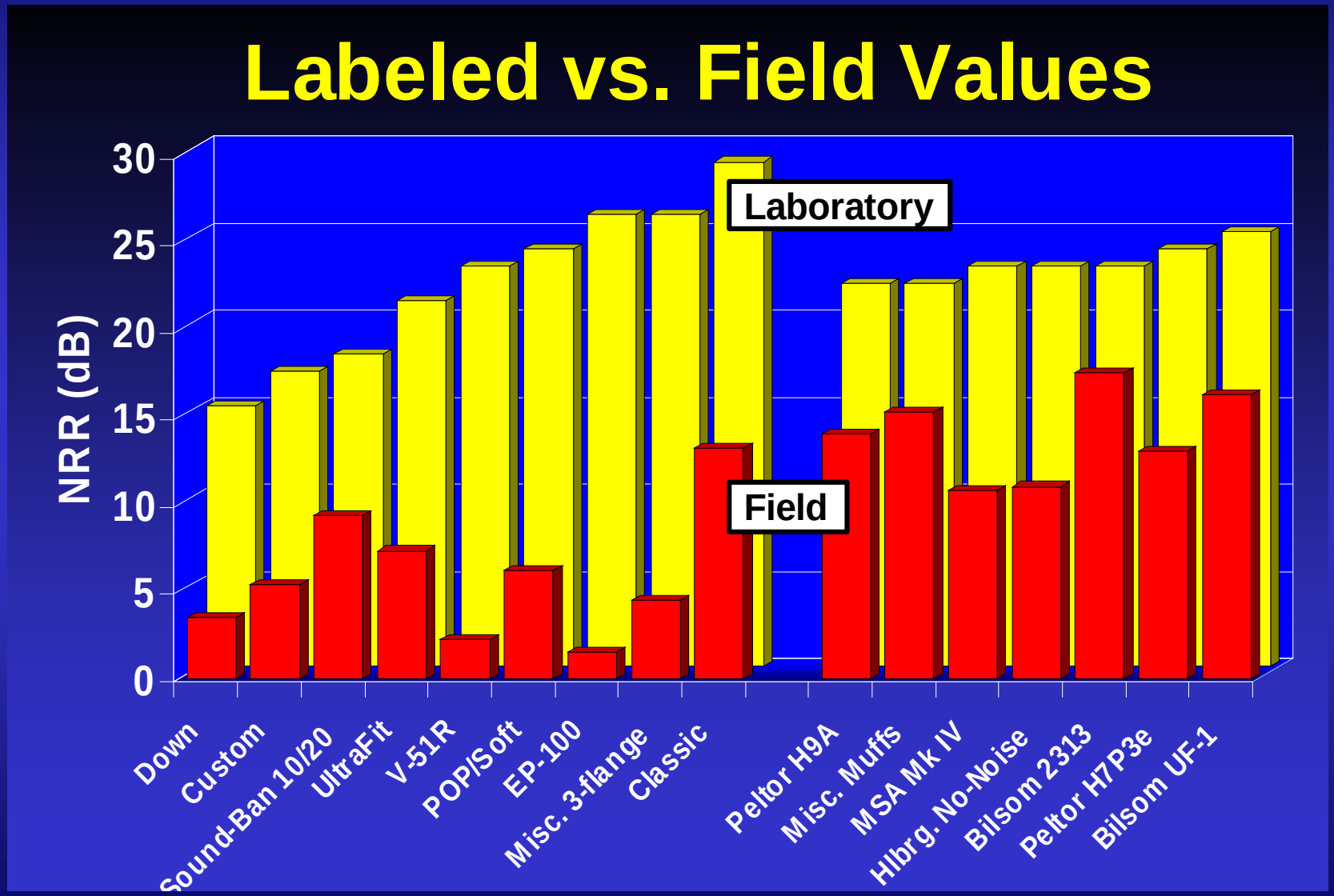
Today's Technology



"BACKFIT"

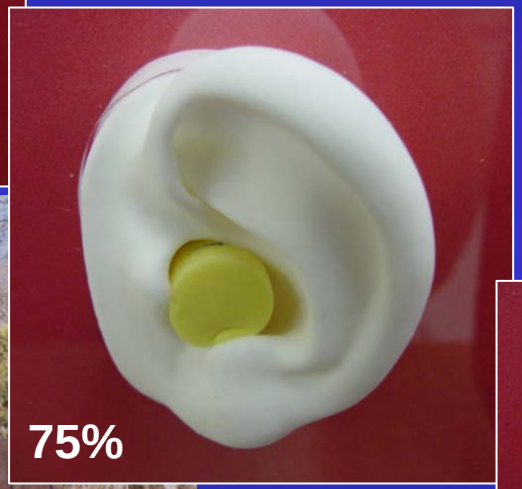
"FORWARD FIT"

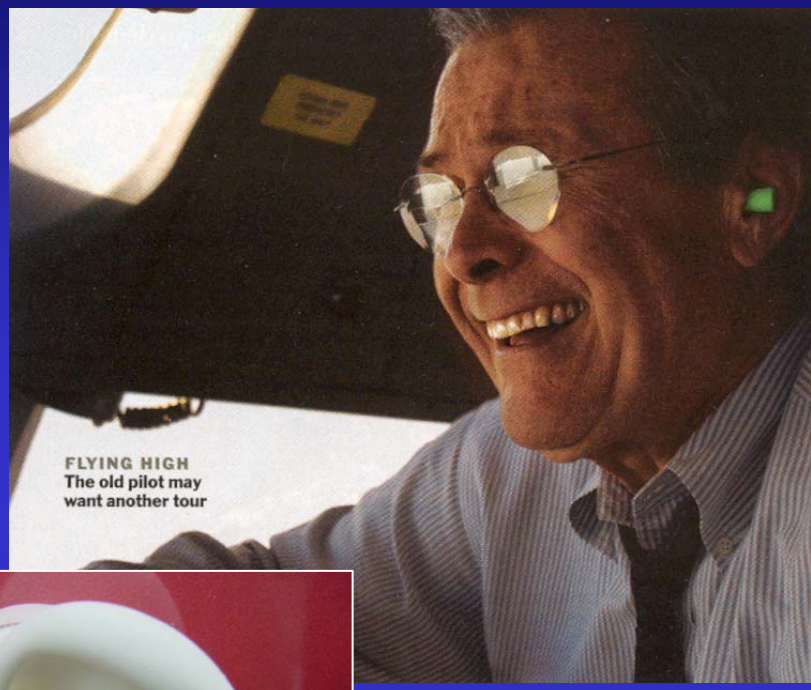
Hearing Protection Effectiveness



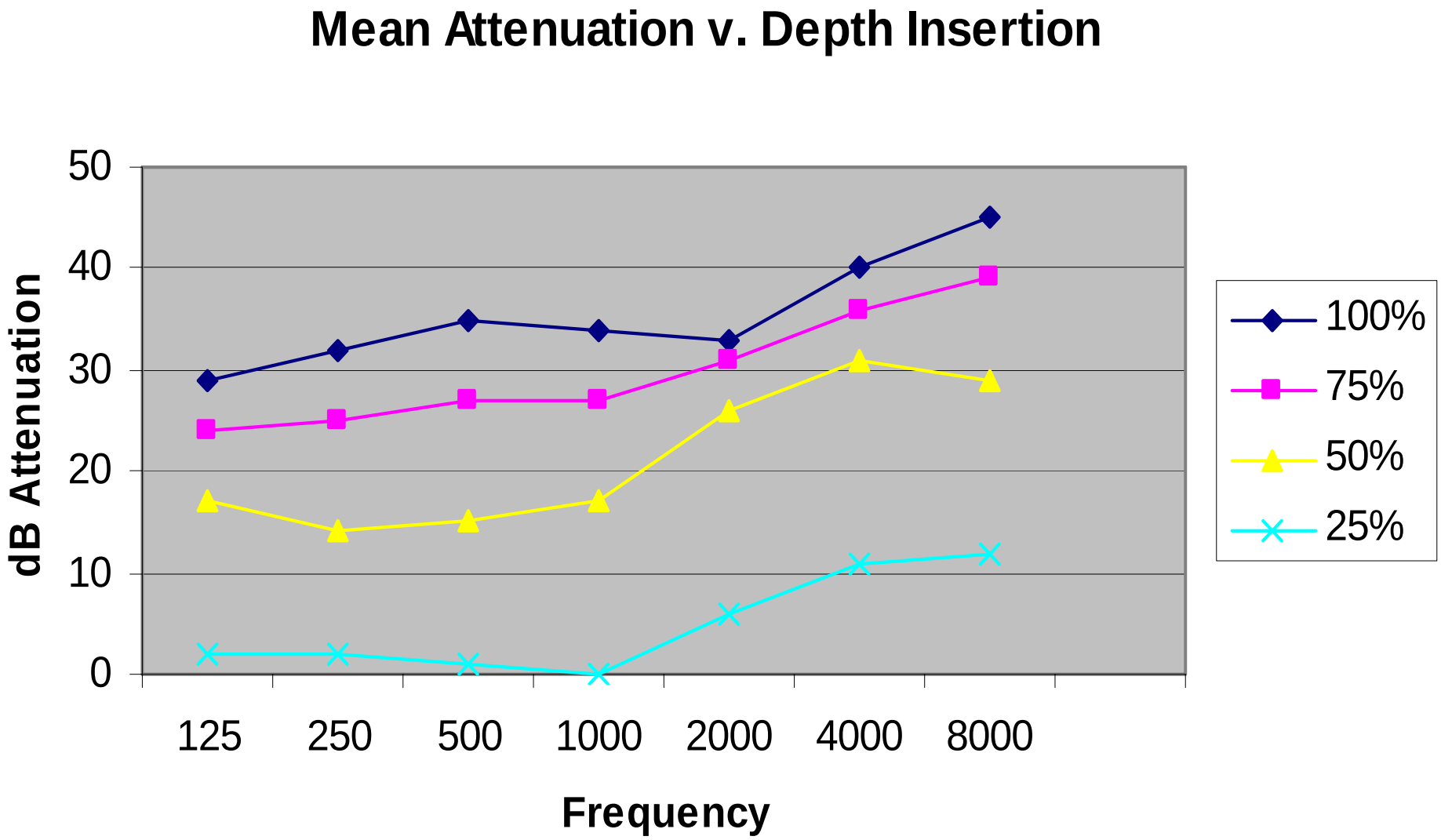
Ref: E. Berger, SAFE 02

Ear Plug Utilization





Ear Plug Performance



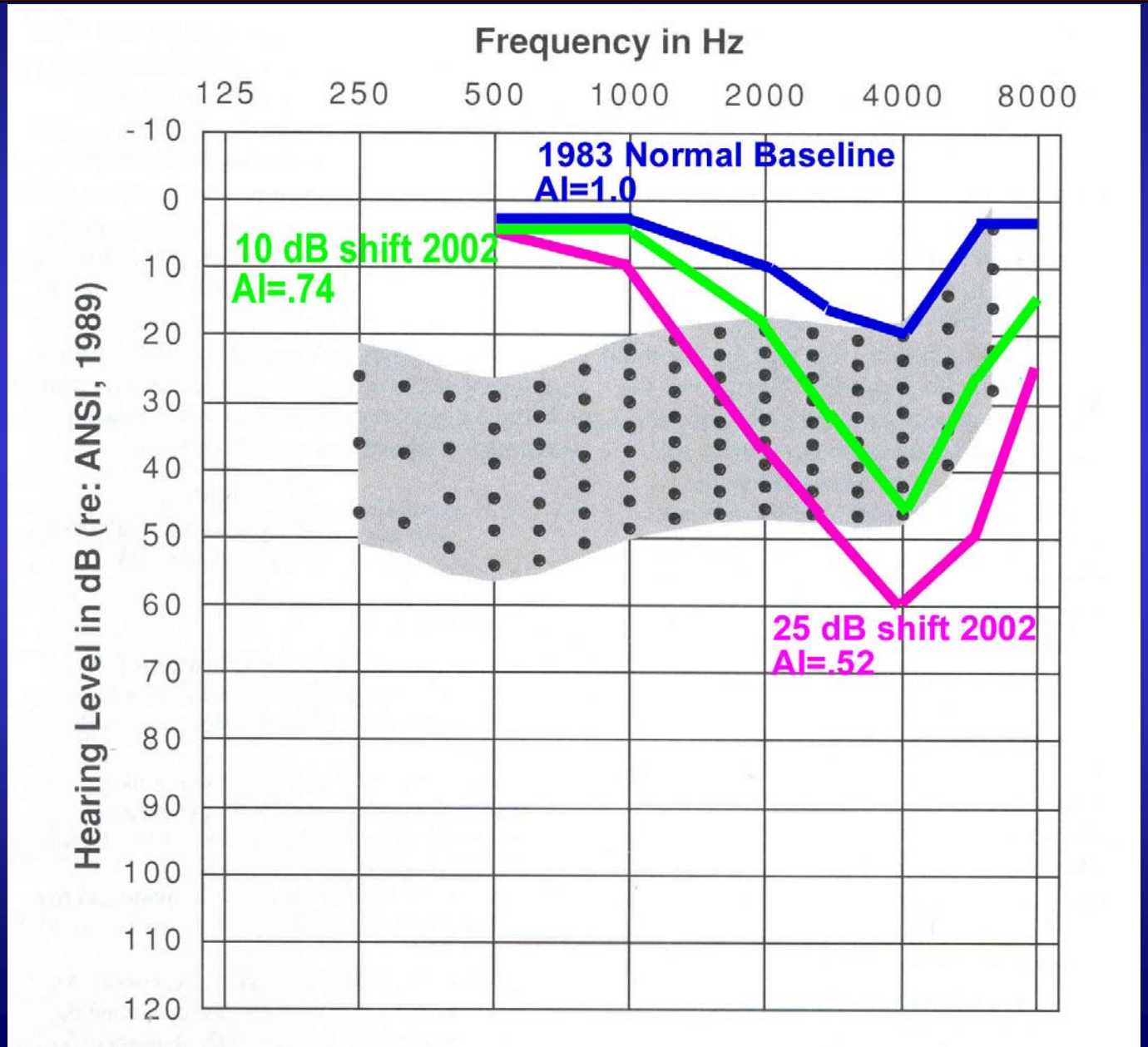
Earcup Effectiveness

Airborne Noise Requirement Comparisons

Spaces	Airborne Noise Requirements (dBA)				
	International		US Navy		
	NATO	IMO	OPNAV	LPD17	CVN [1]
Pilot House (A12)	60	65	60	60	95 SIL [2] (64)
Chart Room (A3)	60	65	70	70	95 SIL [2] (64)
Berthing (B)	60	60	70	65	77
Medical Spaces (C)	60	65	65	60	68
Engine Rooms (D)	90/110 [3]	90/110 [3]	< 85	84	95
Bridge Wing (E)	70	70	82	80	96 SIL [2] (72)

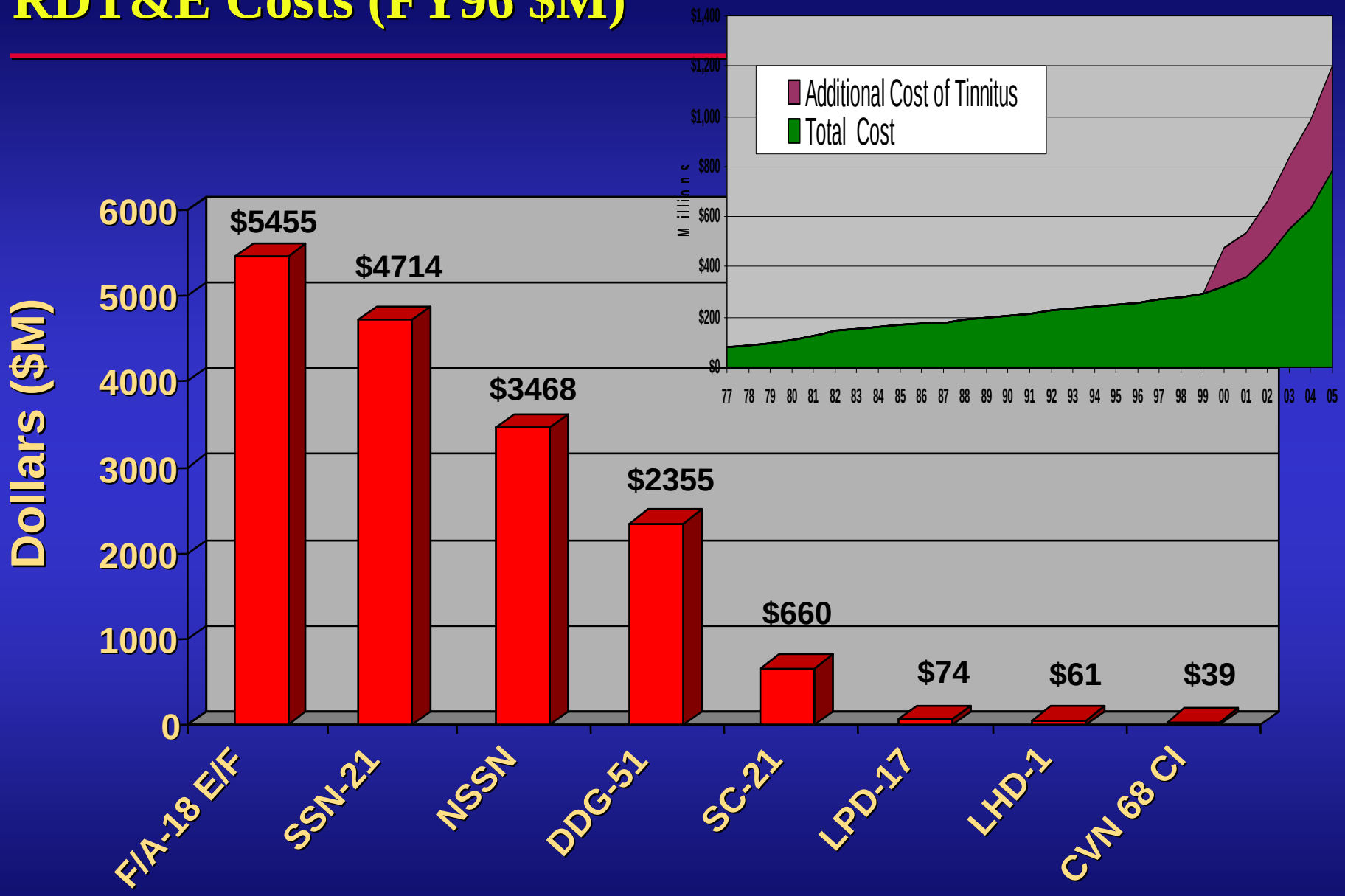
1 CVN A-Weighted equivalent
2 SIL: Speech Interface Level
3 Manned / Unmanned

Hearing vs Communication



Ref: L. Wells

RDT&E Costs (FY96 $M)



Ref: NNS&DD

Recommendations

- **Medical**
  - Continue research studies
  - Baseline Audiograms
- **How are Tinnitus, Phantom Pain & Charles Bonnet Syndrome related?**
- **Adminstrative**
  - Require noise control in all acquisitions
  - Revise noise standards to enforce aggressive hearing protection
- **Engineering**
  - Implement “total systems” approach noise control early in design process
  - Apply acoustic technology to future constructions and during major maintenance periods
  - Reference mitigation websites

References

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