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## Turning a Nightmare into a Dream: Taking Care of Musicians and Engineers

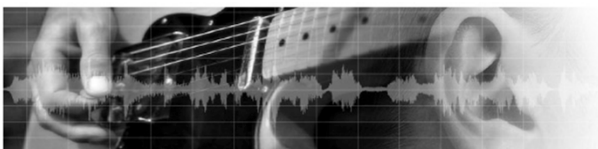
Presenter: Brian Fligor, ScD, PASC

Moderator: Carolyn Smaka, AuD, Editor in Chief, AudiologyOnline

Allied Health Media

AudiologyOnline

- Technical Assistance: 800-753-2160
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  - Must complete outcome measure with passing score (within 7 days for live webinar; within 30 days of registration for recorded/text/podcast formats)
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## Turning a Nightmare into a Dream: Taking Care of Musicians and Engineers Audiology Online 2015 NIHL Expert Seminar Series

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## Turning a Nightmare into a Dream: Taking Care of Musicians and Engineers

### Disclaimer:

The views expressed herein are mine, based on 15 years of practice of audiology fitting custom hearing protection, consumer earphones, in-ear monitors, and hearing aids to musicians, engineers and music enthusiasts. These views are not intended to reflect the views of my employer, Lantos Technologies. Any representation of benefits of amplification and/or hearing protection devices are for educational purposes, and not intended as promoting any particular company.

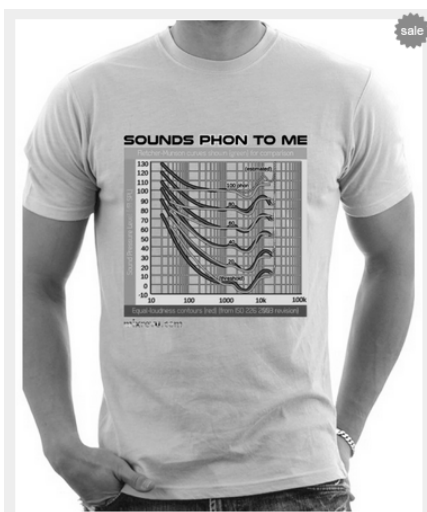
## Learning Objectives

After this course, participants will be able to:

- 1) describe the values these patients bring when they seek audiological care.
- 2) address prevention and treatment needs that are acceptable to this population.
- 3) counsel patients with critical listening needs how best to utilize audiological care.

## Agenda

- Defining our target population, values
- Risks and mitigations for sound-induced tinnitus and hearing loss
- *Suggestions* for hearing aid fittings for music appreciation
- Tinnitus treatment, specific to musicians and audio engineers



<http://merch.mixrevu.com/en/home/7-fletcher-munson-tee.html>

## Who are you? (Hoo, hoo, hoo, hoo)

- Musicians
  - Almost infinite ways to classify!
    - Instrument (vocalist, lead guitarist, DJ, violinist); music genre; work setting
    - Personality types
- Engineers
  - Focus on “Audio” (e.g., “Sound”), also acoustical, electrical, etc.
    - Live sound (“Front of House” vs. “Monitors”); studio (production, post-production, mastering, design)
    - Electroacoustic engineers (speakers, receivers, microphones)

### In common?

- Talented/highly skilled; brave; know hardware and software
- Competitive contractors; sound exposed but unregulated
- Need an audiologist the way everyone needs a dentist! (- Benj Kanter, Columbia College)

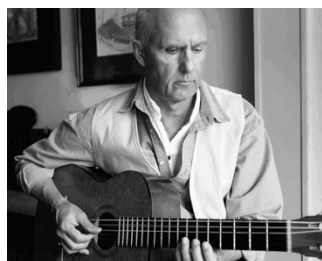
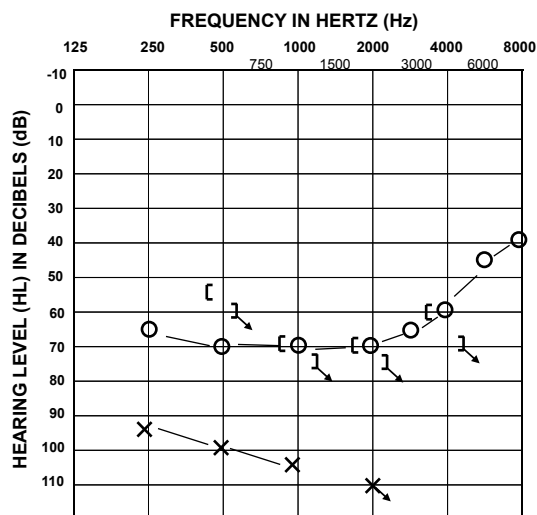
## A Musical Journey Interrupted... Continues



1973 – Stu Nunnery: Evolution Records (Billboard Top 100, #1 Brazil)  
2015 – “Deja S2”: Stu Nunnery

Kickstarter <http://kck.st/1z45o8j>  
Phonak Blog <http://openears.phonak.com/author/buskerman880/>  
CD baby [www.cdbaby.com/Artist/StuNunnery](http://www.cdbaby.com/Artist/StuNunnery)  
Facebook: <https://www.facebook.com/MusicAndFanPage>

## A Musical Journey Interrupted... Continues



Kickstarter <http://kck.st/1z45o8j>  
 Phonak Blog  
<http://openears.phonak.com/author/buskerman880/>  
 CD baby  
[www.cdbaby.com/Artist/StuNunnery](http://www.cdbaby.com/Artist/StuNunnery)  
 Facebook:  
<https://www.facebook.com/MusicAndFanPage>

## When “Grumpy” Walks in the Door



**Sound Engineering Declared Grumpiest  
 Profession In The World**

<http://wundergroundmusic.com/sound-engineering-declared-grumpiest-profession-in-the-world/>

## Populations at Risk

### Occupational noise exposure (unwanted byproduct)

- U.S. mandated in Hearing Conservation Programs for all workers exposed to  $\geq 90$  dBA, 8-hr TWA (offered to all workers exposed  $\geq 85$  dBA, 8-hr TWA)
- 9 million workers in the U.S.; 40 million worldwide
- Regulations, incentives, fines...
  - NIHL *still* among highest incidence work-related injuries (11.8% of non-fatal injuries in 2011; Bureau of Labor Statistics, 2012)

## Bamboozle Road Show, June 2010

- Stage Levels 94 – 108 dBA (drum kit)
- Audience 90 – 117 dBA



## Populations at Risk

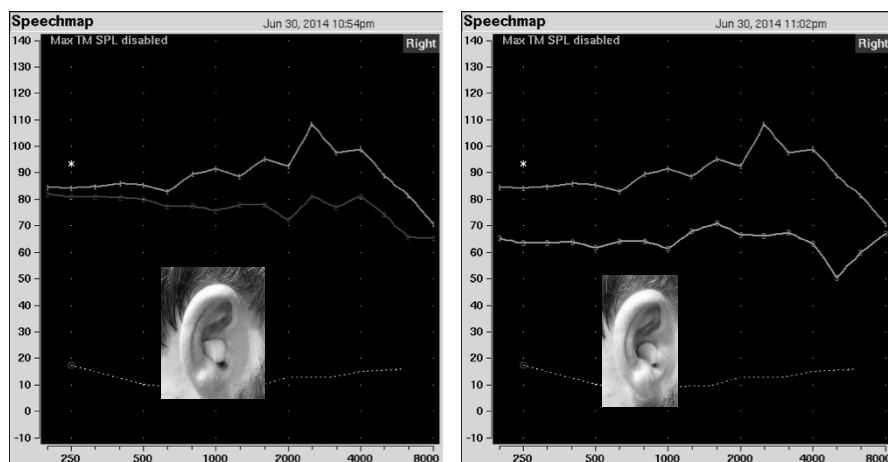
### Music exposures (intent of the activity)

- Musician (amplified) stage levels 100 – 110 dBA
  - Highest adoption of full-custom (in-ear monitors) – pro musicians
- Concert attendance: 103 – 112 dBA  $L_{A8hn}$  (~5000% dose)
- Orchestral, drum corp, chamber musician: own instrument/neighbors > 100 dBA at fortissimo
  - Monitoring needs
  - Communication needs
- Kahari et al (2003): 74% of 139 pro musicians MIHD
- Santos et al (2007): NIPTS in 11 of 30 DJs in Brazil
- Royster et al (1991): 52.5% of CSO “noise notches”

Can't we just stick a plug in it?

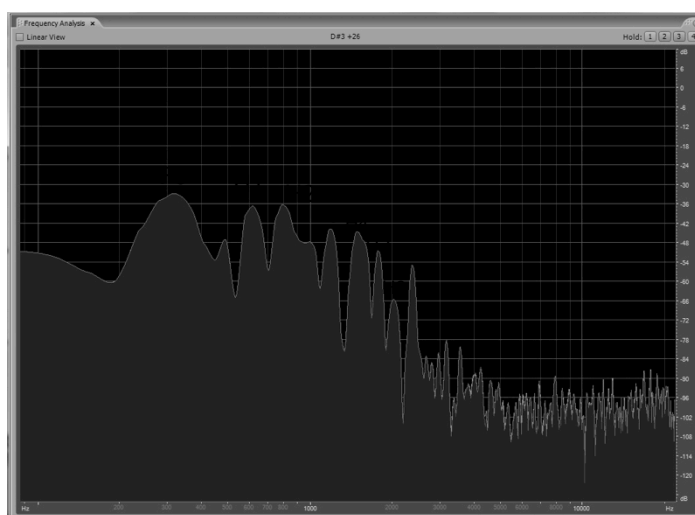


## Concerts <5% wear earplugs

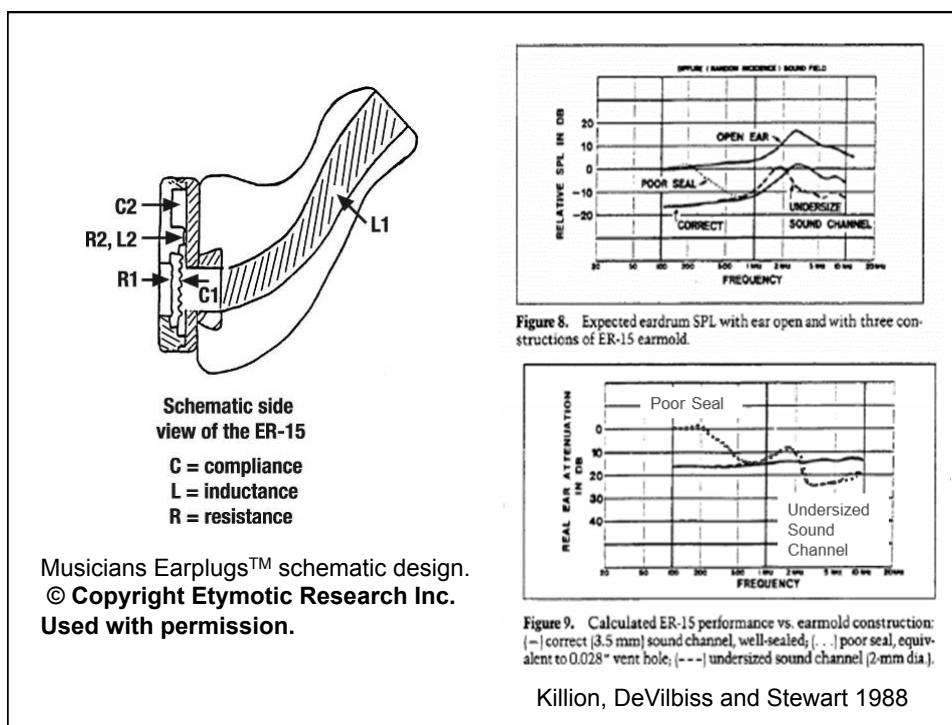
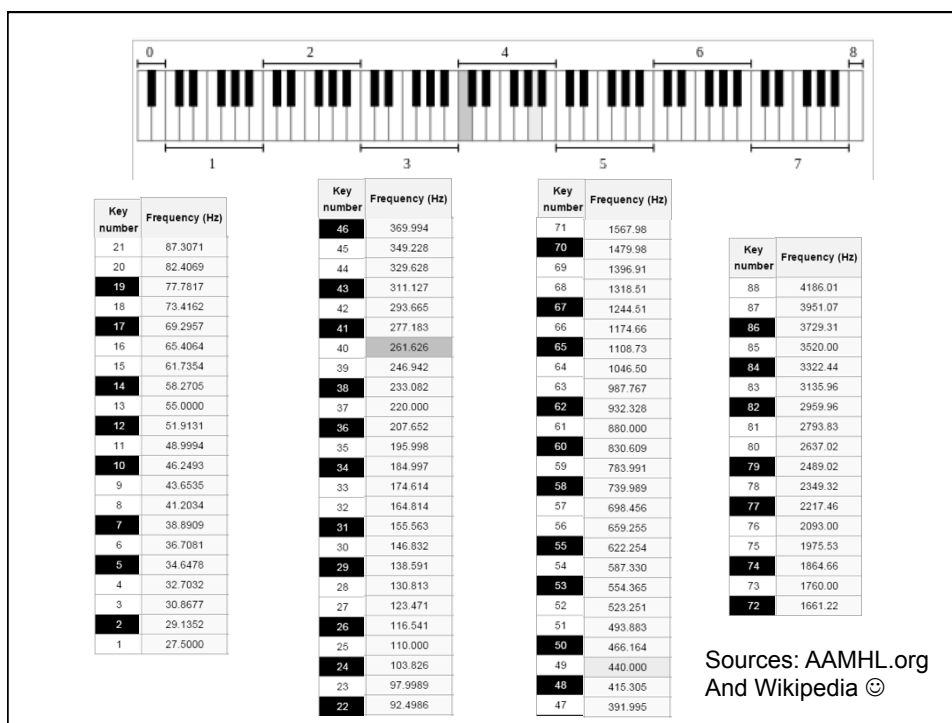


## Fundamentals, Harmonics, Timbre

D#4 on piano  
(key 43 of 88)  
F0 = 311 Hz  
H1 = 622 Hz  
H2 = 933 Hz  
H3 = 1244 Hz  
H4 = 1555 Hz  
H5 = 1866 Hz  
H6 = 2177 Hz  
H7 = 2488 Hz

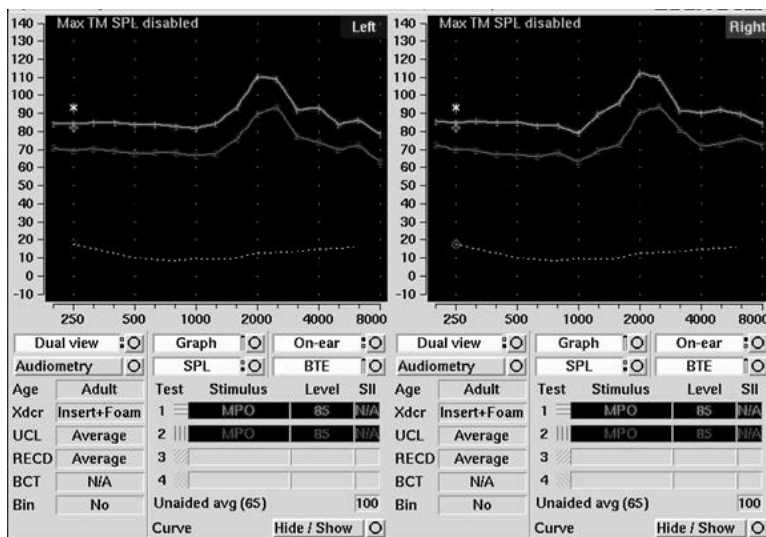




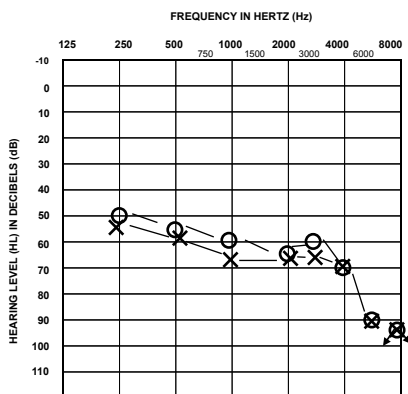


Musicians Earplugs™ schematic design.  
© Copyright Etymotic Research Inc.  
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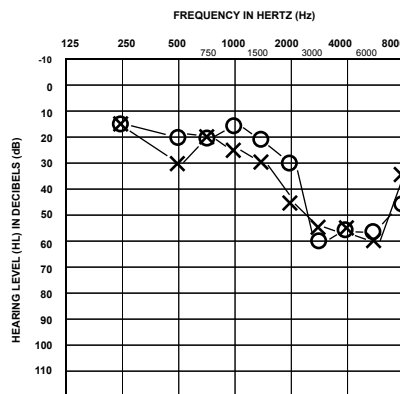
## Verified Uniform (Flat) Attenuation



## So, what about hearing loss management?



Opera singer, 50s  
Can't hear piano while singing  
Phonak Naida Q90 RICs



Trial attorney, late 50s  
Electric Bass x4 years  
Avid live music fan  
Starkey SoundLens2 110 IICs

## Considerations for hearing aids

Music  $\neq$  Speech

1. Maximum input (and dynamic range)
2. Crest Factor (Peak – RMS)
3. Spectral structure
4. Time domain envelope
5. “Intent”

## Considerations for hearing aids

Music  $\neq$  Speech

1. Maximum input (and dynamic range)
  - Speech = 80 dB (30-40 dB)
  - Music = >100 dB (60-100 dB)
2. Crest Factor (Peak – RMS)
  - Speech = 12 dB      Music = 18 dB
3. Spectral structure
  - Fundamental frequency: voice = 82 – 1046 Hz
  - Fundamental frequency:
  - piano = 27.5 – 4186 Hz; violin = 196 – 2637 Hz
  - Speech = Formants; < 8k Hz      Music = Harmonics; >10k Hz

## Considerations for hearing aids

Music  $\neq$  Speech

4. Time domain envelope

Rise-time of signal: violin bow vs. piano key strike vs. drums

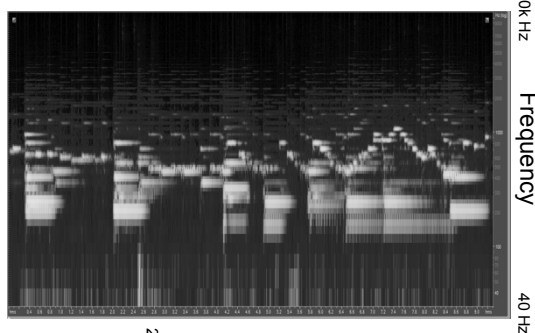
As opposed to voice-onset time

5. “Intent”

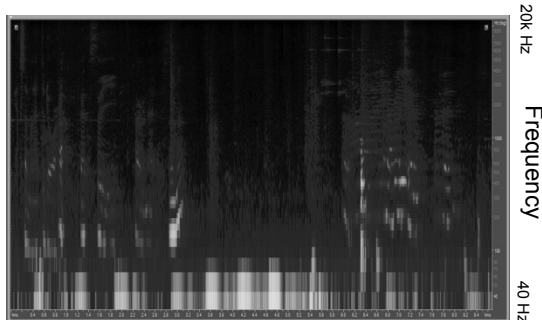
Communication of emotion, not content

Music  $\neq$   
Speech

Piano

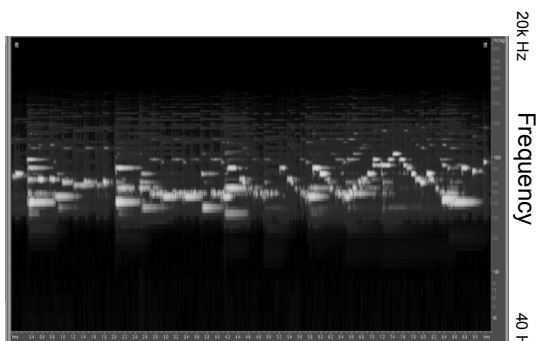


Speech

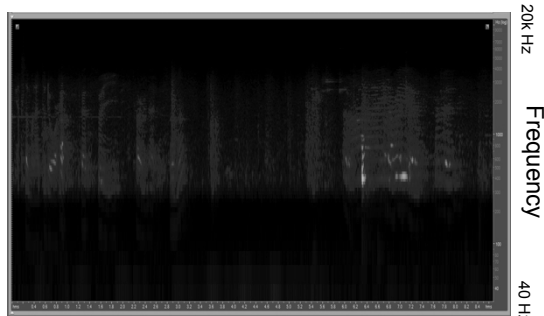


## Filtered 300 – 3400 Hz

Piano



Speech



## Management of Tinnitus: Reaction Habituation

1. It's not their fault...
2. It's not the tinnitus, it's their reaction to it.
3. The tinnitus is neutral: it's like the amplifier turned up and you hear the hum of the circuit noise
4. Enhanced environmental sound.
5. ENSURE future exposures are less than 100% noise dose (prefer 50%)
6. Connect with a team of providers in complementary fields.

## Tinnitus “Suffering”

- VERY high rate of co-morbidity with anxiety and depression
  - Are they already depressed and anxious? Low trigger for these behavioral health challenges?
- Not the perception of the tinnitus, but the reaction to it
- Inappropriate assignment of importance of the tinnitus, results in the limbic system (the “lizard brain”) expressing a fear reaction
- Thalamus (sensory gating) letting the tinnitus through “at full blast”:
  - Conditioned reflex (inappropriate assignment of cause-effect)
  - State of fight-or-flight
  - Persistence of tinnitus results in persistence of fight-or-flight (remains in hyperanxious state)

## Suggestions for hearing aids

1. Manage tinnitus first
2. Widest bandwidth possible, get more low frequencies in (custom mold); 80 Hz – 9600 Hz is a start
3. Peak input level A/D converter (>100 dB SPL)
4. NO frequency compression/transposition (e.g., SoundRecovery, Spectral IQ, etc)
5. Omni-directional microphones
6. Shut off noise reduction
7. More low-frequency gain than you think appropriate (“I need more cowbell!”)
8. Consider disabling feedback management

## Suggestions for hearing aids

1. Bring instrument to fitting sessions
2. Hand them control when possible
3. Different devices for different applications (3D Active Ambient Music Enhancement in-ear monitor; MusicPRO electronic HPD)
4. Find their favorite sound
5. Acknowledge limitations, become their student, counsel if they mourn

## Summary

- ✓ You and this patient value hearing on a primal level
- ✓ You and this patient know sound better than the majority of the world: geek out!
- ✓ Less is more (ER-25? WHY!?)
- ✓ Respect timbre
- ✓ Demystify and disempower tinnitus, manage their reaction
- ✓ Acknowledge limitations of current hearing aid technology, but try like hell