

HEARING AIDS FOR TINNITUS

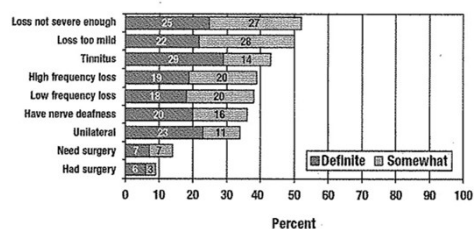
Rich Tyler

Hearing Aids for tinnitus

- First recommended by
- SALTZMAN & ERSNER (1947)

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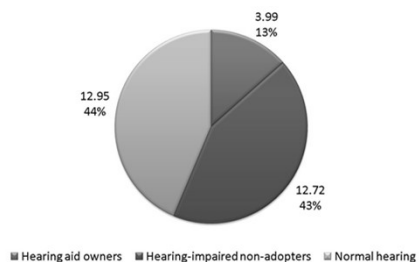
Reasons people have not obtained hearing aids



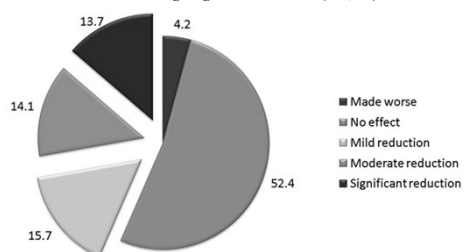
Kochkin, 2007

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Figure 1. Tinnitus population (millions, 2008)



Kochkin, Tyler & Born (2011) Copyright Tyler

Direct Query on Hearing Aids.
Effectiveness in mitigating effects of tinnitus (n=1,314)

Kochkin, Tyler & Born (2011)

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Hearing Aids could help tinnitus because:

- Improve Communication
 - Therefore Reduce Stress
- Amplify Background Sound
 - external low-level sounds (distraction/partial masking)
- Produce Noise,
 - therefore Partial Masking

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Typical assumption for hearing aid fitting

- Background noise is undesirable
- Therefore
 - Noise reduction circuits
 - Focused directionality microphones
 - Do not amplify low level sounds as much as high level sounds (input output function)

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General approach for fitting hearings for tinnitus

- Best fitting possible for communication
 - Reduce stress, enjoy life
- Low-level noise desirable
 - Amplify low level everyday background sounds
 - Do not attenuate low-level everyday background sounds
- Cannot Determine Effectiveness In Sound Proof Room

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Fit hearing aids to enable environmental sound to partially mask

- Use Open ear molds to allow background sound
- Widely focused directional microphones
- Higher gain at low levels
- No noise reduction
- Consider Extending Low Or High Frequency Range Of Amplification
- Perhaps have a “tinnitus program” in multi-memory hearing aids

Hearing aids for those with mild hearing loss

- Many experience tinnitus reaction benefit when using hearing aids
- Marginal hearing aids candidate often consider hearing aids for tinnitus
- Many report benefit
- Good to get patients experienced using hearing aids

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Hearing aids can make tinnitus worse !!

- Does not happen very often
 - 1 in 100?
- Amplified sound exacerbates tinnitus
- Turn gain down, reduce maximum output
- Tactile sensation around ear could make tinnitus worse
 - Try alternative aid/earmold strategies

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Post Masking Effects of Hearing Aids (and maskers)

- **Acoustic stimulation can reduce the magnitude of the tinnitus after the hearing aids are turned off!!!**
- **Can be for minutes or hours in different patients**

Other hearing assistance strategies

- use assistive listening devices, Frequency Modulation (FM) or loop system to provide background sound to patient but not to others in room
- Improve hearing ability and might help with tinnitus

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Summary- Hearing aids for tinnitus

- All benefits of hearing aids!!!!
 - Improve communication
 - Stress reduction
- Amplification of background sounds can reduce tinnitus
- Possible relief after hearing aid use

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Suggested Readings

- Kochkin, S., Tyler, R., & Born, J. (2011). MarkeTrak VIII: The prevalence of tinnitus in the United States and the self-reported efficacy of various treatments. *Hear Rev*, 18(12), 10-27.
- Searchfield, G. D., (2006). Hearing aids and tinnitus. *Tinnitus treatment: Clinical protocols*, 161-175.

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Tinnitus Sound Therapy

Rich Tyler

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Neurophysiological Models

- Tinnitus result of changes in spontaneous activity
- Can reduce prominence of abnormal spontaneous activity by adding background sound

Low level noise makes tinnitus more difficult to detect
(from Tinnitus Activities Treatment)

Tinnitus 

Low Level Noise 

Tinnitus in Low Level Noise 

Psychological Mechanisms

- Attention Model
 - Distract from tinnitus
 - Compete with tinnitus
 - Decrease prominence
- Habituation Model
 - Continuous, unimportant

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Tinnitus Activities Treatment

- Decrease the prominence
 - For thoughts and emotions
 - For sleep
 - For concentration
 - e.g. in office, when reading
- Broadband noise easier to listen to than narrowband noise, single steady-state tones

Treatment developed

- Vernon (1984)
 - wearable devices
 - Total masking; but patient must decide on actual level so not disturbing

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Masker counseling

- Always combine with counseling
- Beneficial long-term effects
 - During masking- less attention on tinnitus
 - After masking – less troublesome
 - Helps to break ‘vicious cycle’
 - Can move on to life without focus on tinnitus
 - Not just immediate effects, some adapt 2-3 months later

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Differences among Sound Therapies

- Level
- Sound quality
- Philosophy
 - Tinnitus or reaction to tinnitus
- Mechanisms
 - Line-busy, brain remapping,...

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Level of the background sound

- Total masking
 - covers tinnitus completely
 - person hears a ‘masker’ instead of their tinnitus
 - Effective for some
- Partial masking
 - tinnitus and the acoustic sound can be heard
 - reduces the prominence and/or loudness

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Partial Masking

- Tyler and Babin (1986) “both the noise and tinnitus are heard but the tinnitus is reduced in loudness”. Patients should “use the lowest level masker that provides adequate relief.
- Bentler and Tyler (1987) “urge the patient to use the lowest level of masker level that provides adequate relief”

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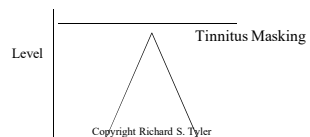
“Mixing Point”

- Coles (1987) “the masker can be turned up until its loudness is equal to that of the tinnitus, when the patient will often have to listen hard to hear the tinnitus.”
- Hazell (1987) tinnitus “just audible through the masking sound”.
- Jastreboff (1995) “where the patient perceives that the tinnitus sound and the external sound start to mix or blend together” (Tinnitus Retraining Therapy).
- Jastreboff and Hazell (2004)
 - Added“below the level creating annoyance or discomfort”

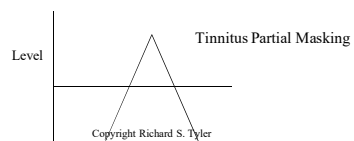
Tinnitus Activities Treatment

- Mixing point too loud for most patients
- Mixing point should **not** be the goal in Partial Masking
- Use lowest level that is effective
- Some prefer total masking
- Mixing point is not superior to total masking
- Tyler, R., Noble, W., Coelho, C., & Ji, H. (2012). Tinnitus Retraining Therapy: Mixing Point and Total Masking Are Equally Effective. *Ear Hear* 33(5):588–594

Complete/Total Masking



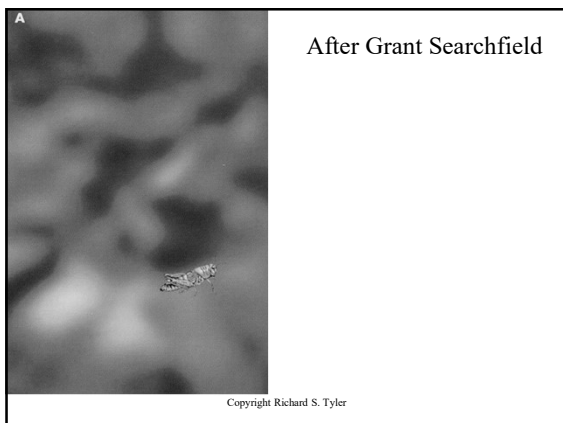
Partial Masking

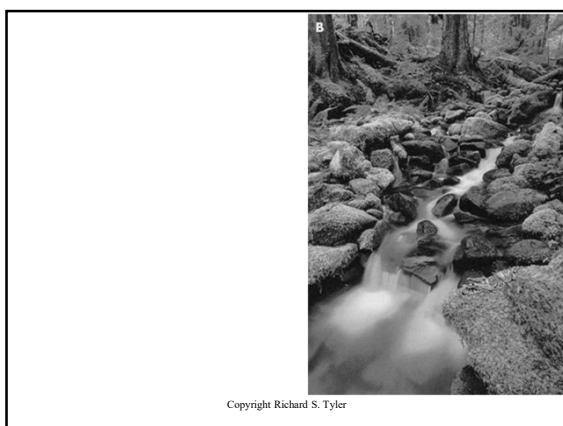


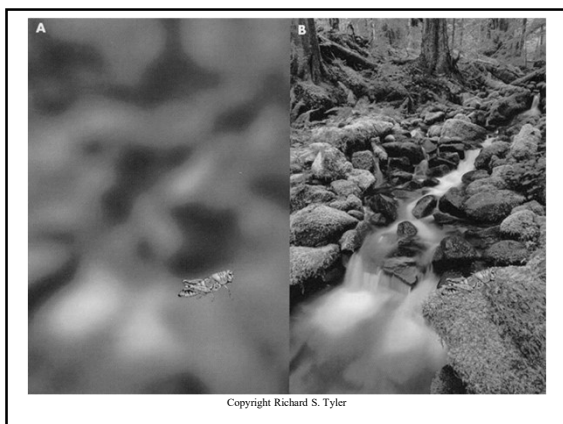
Strength of Perception Depends on Contrast



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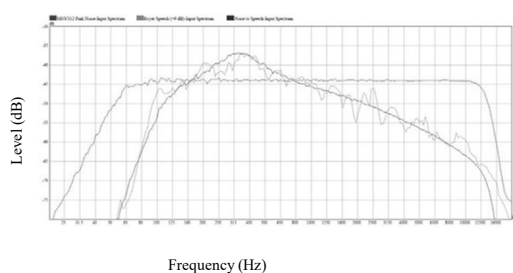




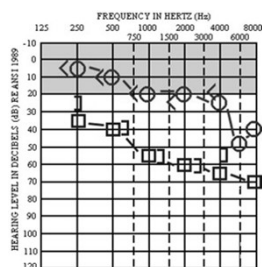
Sound Therapy Stimulus Options

- Broadband noise
- Noise modifying spectrum
- Noise modifying envelope
- Combined tones, modulated tones
- Music, processed music
- Spectrally adjusted sounds to account for the audiogram
- Notch noise or music around pitch match

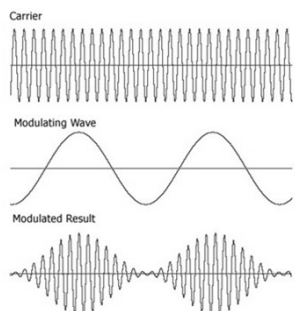
Broadband Noise and Speech Shaped Noise



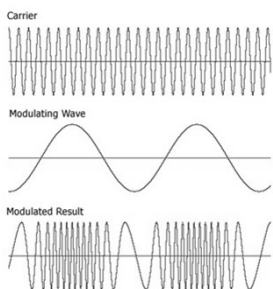
Noise to inversely match the audiogram



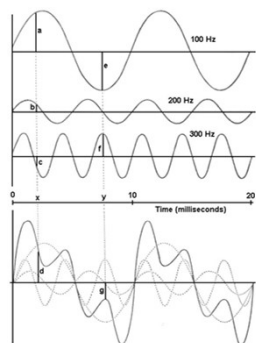
Amplitude Modulation (tones or noise)

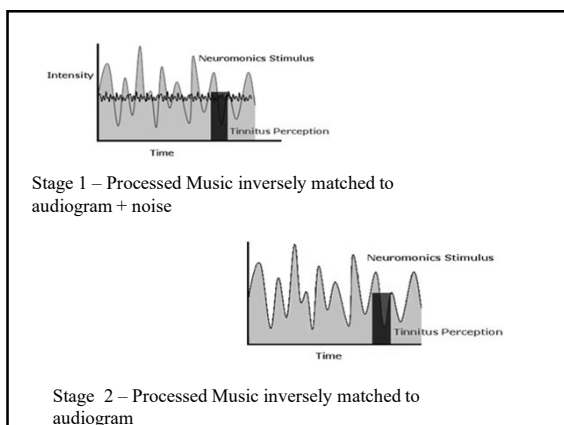


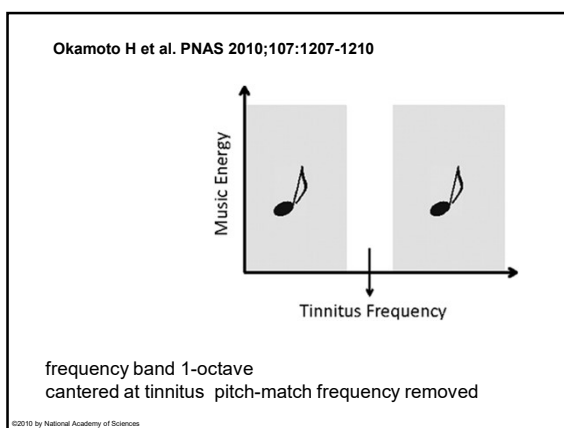
Frequency Modulation



Adding tones – spa tones, Zen tones







Background Music

- Easy to ignore
- Pleasant to listen to
- Avoid vocals
- Avoid loud background beating
- not captivating / interesting
- Music at low levels
 - Hann, D., Searchfield, G., Sanders, M., Wise, K. (2008): Strategies for the selection of music in the short-term management of mild tinnitus. The Australian and New Zealand Journal of Audiology 30: 129-140..

Fitting considerations

- Broadband noise easier to listen to than narrowband noise
- Noise does not have to overlap the tinnitus pitch
- Can mask in contralateral ear in some patients
- Try monaural and binaural fittings
- use low-level stimuli to reduce speech interference, less likely to enhance tinnitus

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Determine who is appropriate for Tinnitus sound Therapy

- Do not use sound therapy
 - If noise makes tinnitus worse
 - try to acclimatize to noise first with very low levels
 - If have hyperacusis
 - treat first with noise at very low levels
 - If do not have troublesome tinnitus

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Long-term benefit

- Masker benefit not just while using the maskers
- relief provided by the masker helps to break the vicious cycle of tinnitus-stress
- Able to attend to other rehab strategies more easily even while the tinnitus masker is not worn
- many can discontinue masker use after few months

TINNITUS HEARING-AID MASKER COMBINATIONS

- fit hearing aid first
- add in just the amount of noise needed
- re-adjust hearing aid or start over again if needed
- inform for patient always to turn on hearing aid first

Non-wearable maskers

- Locations
 - Office/workspace/home
 - Bedroom for sleep
- Device options
 - Specialty instrument
 - Plays ocean waves, rain on leaves, etc
 - Music player
 - RADIO, compact disc player
 - Household appliances
 - E.G. Fan, detuned radio
 - Music from/under pillow

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Noise Generators During Sleep

- Can help getting to sleep
- Provides relief if wake up in the night
- Provides relief when wake up in the morning
- Better NOT with automatic turn-off
- Maybe just have sound as part of bedroom

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