1. This document is created for accessibility and is intended to be a supplemental resource. If you would like to print a hard copy of this document, please follow the general instructions below to print multiple slides on a single page or in black and white.
2. This handout is for reference only. Non-essential images have been removed for your convenience. Any links included in the handout are current at the time of the live webinar but are subject to change and may not be current at a later date.
3. Copyright: Images used in this course are used in compliance with copyright laws and where required, permission has been secured to use the images in this course. All use of these images outside of this course may be in violation of copyright laws and is strictly prohibited.
4. Social Workers: For additional information regarding standards and indicators for cultural competence, please review the NASW resource: Standards and Indicators for **Cultural Competence in Social Work Practice**
5. Need Help? Select the "Help" option in the member dashboard to access FAQs or contact us.

How to print Handouts

On a Mac

- Open PDF in Preview
- Click File
- Click Print
- Click dropdown menu on the right "preview"
- Click layout
- Choose # of pages per sheet from dropdown menu
- Checkmark Black & White if wanted.

How to print Handouts

On a PC

- Open PDF
- Click Print
- Choose # of pages per sheet from dropdown menu
- Choose Black and White from "Color" dropdown

Audiological Treatment of Hyperacusis, in partnership with the American Academy of Audiology

Ali A. Danesh, PhD, FAAA

Board Certified, American Board of Audiology
Professor, Department of Communication Sciences and Disorders
Clinical Affiliate Professor (Secondary), Biomedical Sciences, College of Medicine, Florida Atlantic University
Affiliate Faculty, Department of Psychology, College of Science & Affiliate Professor, Department of Electrical Engineering and Computer Science, College of Engineering and Computer Science
Voluntary Associate Professor, Department of Otolaryngology, Miller School of Medicine, University of Miami
Consultant, Labyrinth Audiology, Boca Raton, FL

Disclosures

- Presenter Disclosure: Financial: Ali Danesh received an honorarium for presenting this course. Non-financial: Ali Danesh has no relevant non-financial relationships to disclose.
- Content Disclosure: This learning event does not focus exclusively on any specific product or service.
- Sponsor Disclosure: This course is presented in partnership with the American Academy of Audiology.

Limitations/Risks

- The applicability and accuracy of the course content may vary by the clinical, geographical, and cultural context; you should evaluate the course accordingly.
- As healthcare is rapidly evolving, new findings may change the validity of the information presented in this course. Providers should always consult the latest research and guidelines from professional associations.
- The interventions discussed in this course may be limited in generalizability, requiring practitioners to consider specific individual and population factors.
- The course may not cover all possible risk factors, diagnostic methods, or treatment options, and complex cases may require additional considerations.
- Healthcare providers should apply cultural competence and sensitivity to ensure effective and respectful care based on their patients' diverse needs.
- Providers should always evaluate the limitations of diagnostic and screening tools, considering their potential for false results as well as any ethical implications.
- It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.

Learning Outcomes

After this course, participants will be able to:

- Identify underlying etiologies of hyperacusis.
- Discuss evaluation methods for hyperacusis.
- Describe management strategies for hyperacusis.

Hyperacusis Hero

- Professor Chuck Berlin was a pioneering audiologist whose innovative approaches to hyperacusis management have significantly advanced the understanding and treatment of sound sensitivity, helping countless individuals find relief through personalized therapeutic strategies.

Presentation Outlines

- Definition of Hyperacusis
- Classification of Decreased Sound Tolerance Disorders
- Pathological Conditions Associated with Hyperacusis
- Assessment of Hyperacusis
- Management of Hyperacusis

Hyperacusis: An increased sensitivity to sound and Abnormal acuteness of the sense of hearing.

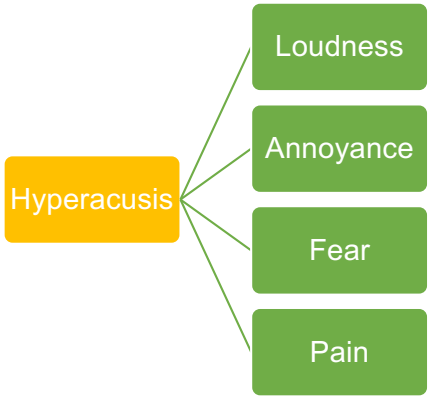
- Hyperacusis is a decreased sound tolerance disorder in which normal everyday sounds are perceived as exceedingly loud (Salvi et al., 2022).
- “The term “hyperacusis” is used to of everyday sounds being perceived as intense and overwhelming” (Baguely & Hoare, 2018)
- Typically, comfortable sound intensities for most individuals range from 35- and 90-dB SPL and begin to reach an uncomfortable loudness level (ULL) at around 100 dB SPL (Salvi et al., 2022).
- Those with severe hyperacusis have ULLs as low as 50 dB SPL (Sheldrake et al., 2015).
- Hyperacusis is intolerance of certain everyday sounds that causes significant distress and impairment in social, occupational, recreational, and other day-to-day activities. (Aazh et al., 2019)
- May cause depression, anxiety, insomnia, suicidal thoughts (Aazh & Moore, 2017).

Prevalence of Hyperacusis

Hyperacusis and autism spectrum disorder
Danesh AA & Kaplan J
ENT & Audiology News. 2024 Jul/Aug; 33(3).

- In the general population, it is approximately 8-9% (Paulin et al., 2016)
- In children and adolescents, the prevalence of hyperacusis is between 3.2% and 17.1% (Rosing et al., 2016)
- Prevalence increases with age, hearing loss, low-income, poor mental and physical health (Smit et al., 2021)
- 18% in children with autism (N=199) (Rosenhall et.al, 1999)
- 46% in a pediatric otolaryngology clinic (Coelho & Sanchez, 2004)
- 95% in children with Williams syndrome (Borse, Curfs, & Fryns, 1997)
- 69% in individuals with Asperger's Syndrome (Danesh, et al, 2015)

Hyperacusis: Proposed Subtypes

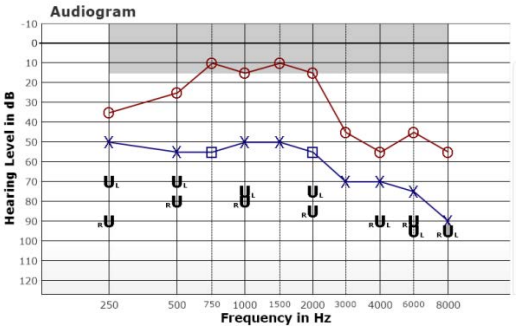


- No agreed-upon definition has been established for hyperacusis, causing debate about whether these subtypes should be considered hyperacusis or separate conditions. (Bigras et al., 2023)
- Loudness hyperacusis is the most common. It can be accompanied by annoyance, fear, and pain, and many can overlap. (Salvi et al., 2022)

(Tyler et al., 2014)

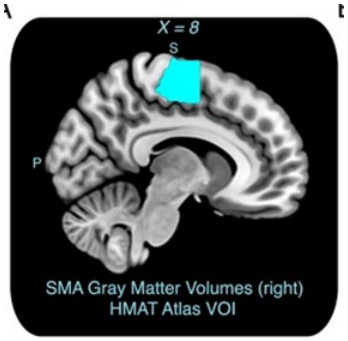
Hyperacusis is not Recruitment!

- Eggermont (2017): “Loudness recruitment is an abnormal relationship between sound intensity and perceived loudness that may accompany NIHL. In this condition, the threshold of hearing is elevated, but a given increase in level above threshold causes significantly greater than normal increase in loudness. ”
- What we believe is that: Hyperacusis is a discomfort of sound loudness and it has a psychological impact on the individual.
- Hyperacusis can be with or without hearing loss!

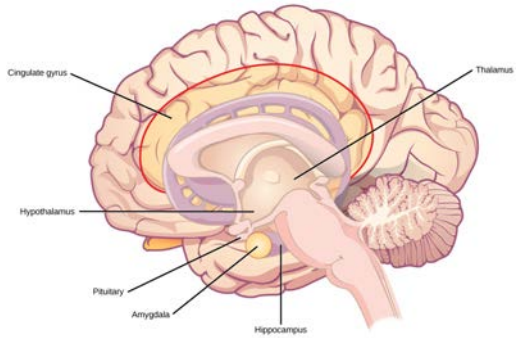


Hyperacusis: Neural mechanisms

- Enhanced central auditory gain from reduced neural input from the cochlea causes amplification of sound-evoked activity at subcortical and cortical levels (Bigras et al., 2021).
- Sound deprivation causes an increase in perceived loudness and a reduction in acoustic reflex thresholds (Formby et al., 2003).
- Non-auditory brain regions are also involved in hyperacusis, impacting emotions, memory, and stress (i.e., the limbic system, particularly activation of the amygdala).
- fMRIs have shown increased sound-evoked activity in subcortical and cortical auditory regions and emotional markers (Koops & van Dijk, 2021).



https://www.sciencedirect.com/science/article/pii/S2213158223001146



Pain and Hyperacusis Nociception

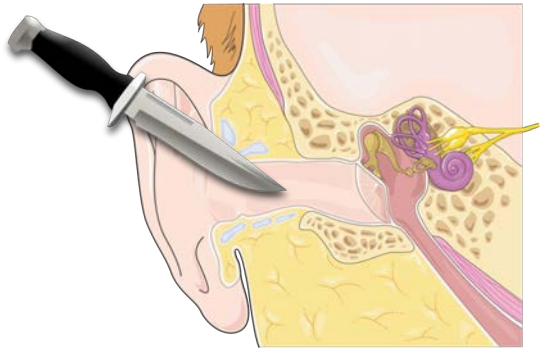
Incorporating nociception (the ability to encode and transmit signals about potentially harmful stimuli from the body to the brain)

Type II neurons innervating OHCs in the cochlea mediate auditory nociception.

A non-canonical pathway from cochlea to brain signals tissue-damaging noise.

Flores EN, Duggan A, Madathany T, Hogan AK, Márquez FG, Kumar G, Seal RP, Edwards RH, Liberman MC, García-Añoveros J.

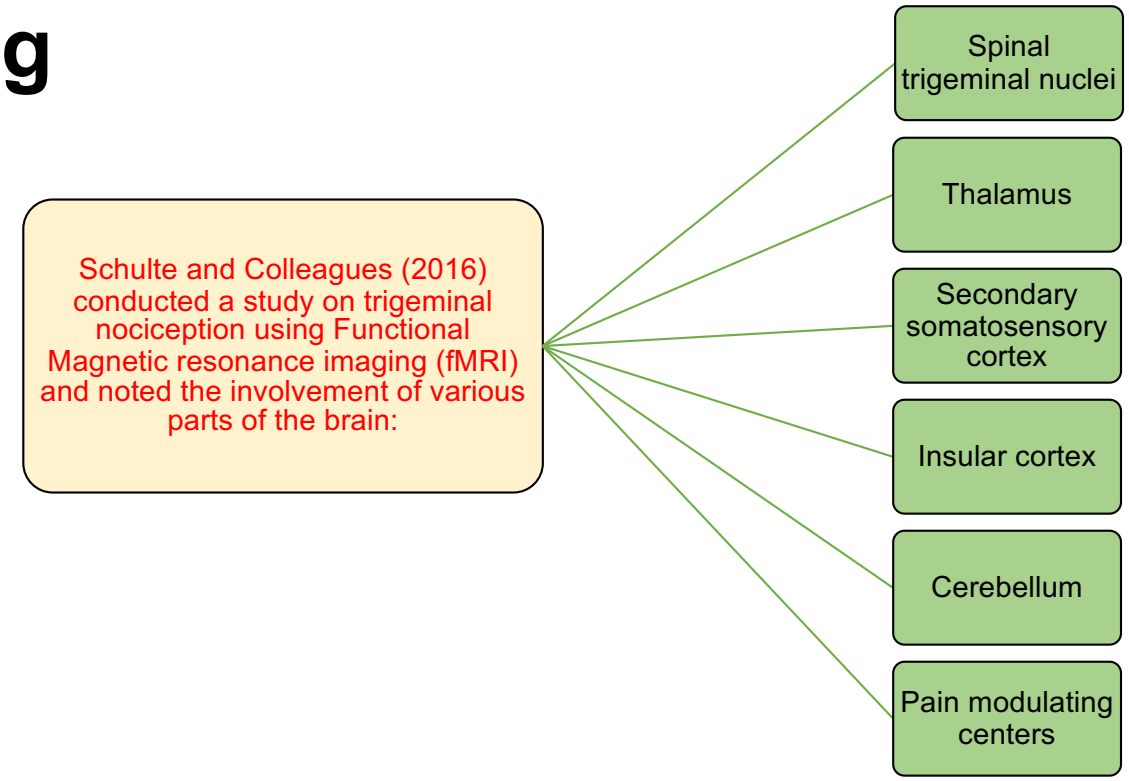
Curr Biol. 2015 Mar 2;25(5):606-12.



Brain Imaging

Salvi et al. (2022) suggested that the pain associated with hyperacusis may involve many brain parts (e.g., Anterior cingulate cortex, insular cortex, somatosensory cortex…).

Brain Imaging



Noxacusis

- Noxacusis, also known as pain hyperacusis, is **“a condition characterized by extreme sensitivity to sound that results in pain.”**

- *Jahn KN, Kashiwagura ST, Yousuf MS. Clinical phenotype and management of sound-induced pain: Insights from adults with pain hyperacusis. medRxiv [Preprint]. 2024 Jun 20:2024.06.19.24309185. doi: 10.1101/2024.06.19.24309185. Update in: J Pain. 2025 Feb;27:104741. doi: 10.1016/j.jpain.2024.104741. PMID: 38946957; PMCID: PMC11213080.*

Jahn, et al 2024 work on:
Noxacusis

.

- Schematic depicting three potential noxacusis mechanisms. In each model, hypothesized components mediating noxacusis are highlighted in red. (A) In the middle ear model, nociceptive signaling is mediated by the mandibular branch of the trigeminal nerve. Trigeminal nerve afferents innervate the tensor tympani and the tensor veli palatini muscles, both proximal to the middle ear space. (B) In the inner ear model, Type II-afferent nerve fibers synapse with outer hair cells and transduce nociceptive signals to the central auditory system. (C) In the central auditory system, maladaptive hyperactivity in the brainstem and brain potentially mediate hyperacusis.
- From: Jahn KN, Kashiwagura ST, Yousuf MS. Clinical phenotype and management of sound-induced pain: Insights from adults with pain hyperacusis. medRxiv [Preprint]. 2024 Jun 20:2024.06.19.24309185. doi: 10.1101/2024.06.19.24309185. Update in: J Pain. 2025 Feb;27:104741. doi: 10.1016/j.jpain.2024.104741. PMID: 38946957; PMCID: PMC11213080.

Common Sounds that Result in Complaints Associated with Hyperacusis

- Loudness is the most commonly reported complaint, particularly sounds such as high-pitched voices, music, whistles, and restaurants (Ke et al., 2020).

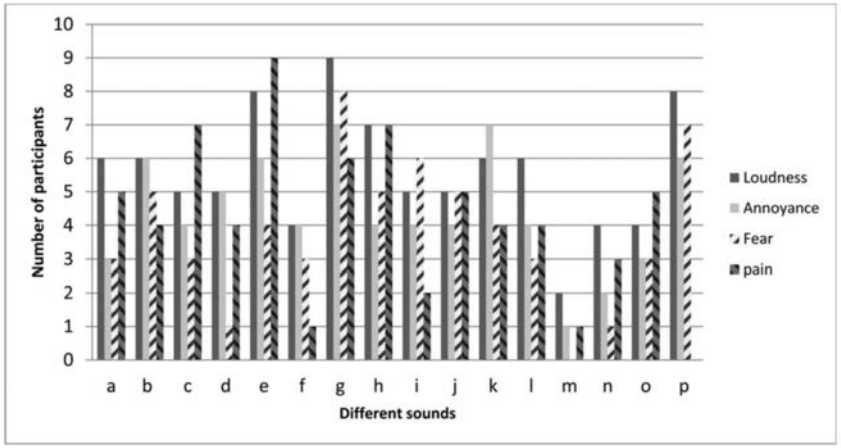
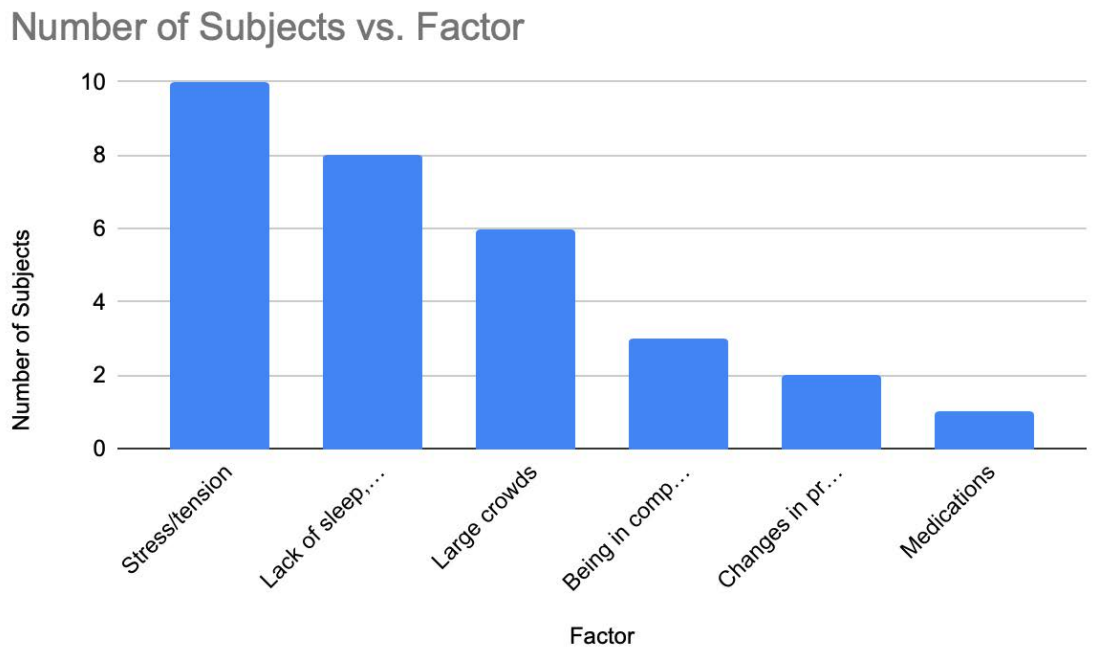


Fig. 1 The frequency of the 16 sounds reported by the participants that cause loudness, annoyance, fear, and pain hyperacusis. (**a**) Baby crying/children squealing. (**b**) Crowds/large gatherings. (**c**) Dishes being stacked. (**d**) Dog barking. (**e**) High pitch voices/screaming. (**f**) Lawnmower. (**g**) Music (loud rock concerts). (**h**) Music (religious service). (**i**) Music (symphony, quartet, etc.). (**j**) Power tools. (**k**) Restaurants. (**l**) Sporting events. (**m**) Telephone ringing. (**n**) TV/radio. (**o**) Vacuum cleaner. (**p**) Whistle/horn/siren. Average category: loudness = 5.6; annoyance = 4.4; fear = 3.8; pain = 4.2.

Hyperacusis: Exacerbating factors

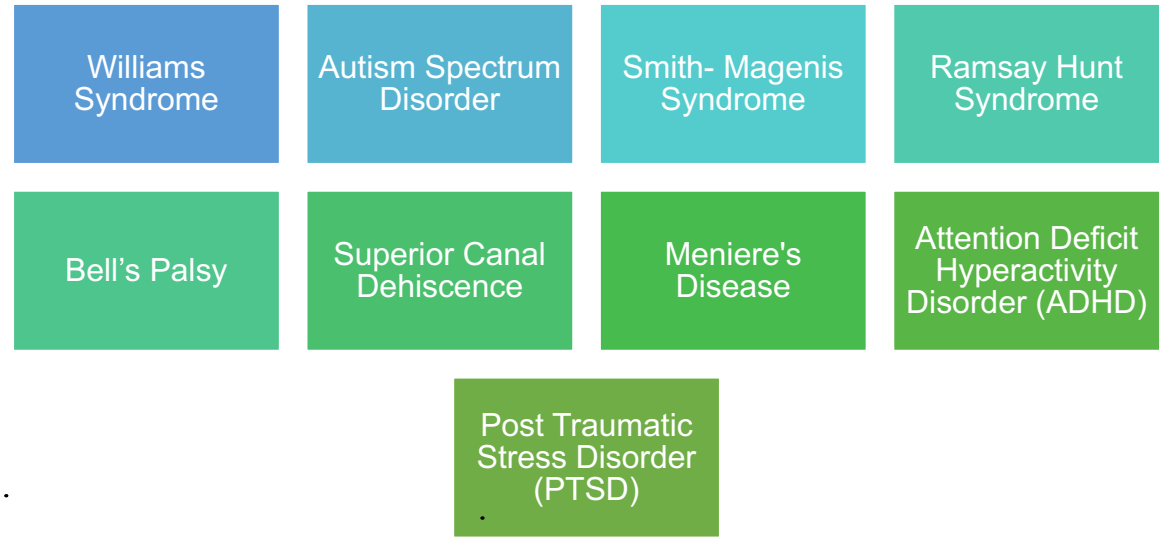


(Ke et al., 2020).

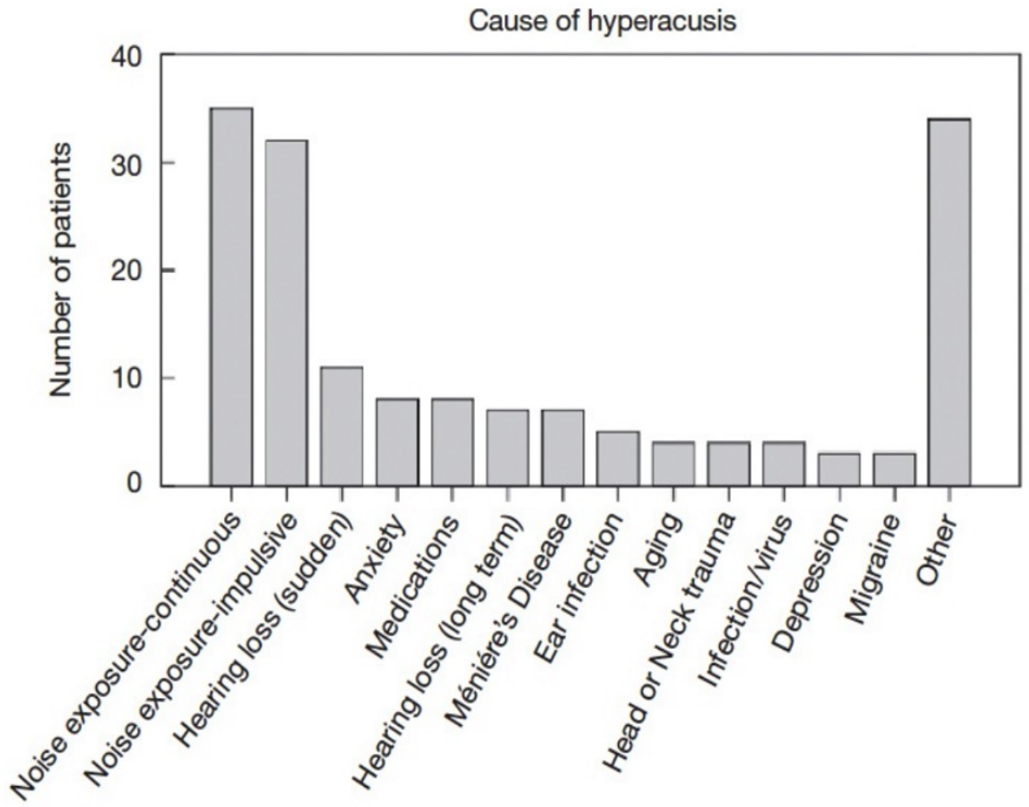
Underlying Pathologies

(A Large Variety of Conditions)

Conditions Often Co-occurring with Hyperacusis



The prevalence of hyperacusis in these neurologic and genetic disorders may be indicative of both central and peripheral nervous system involvement (Salvi et al., 2022).


Cause of hyperacusis
Number of patients
40
30
20
10
0
Noise exposure-continuous
Noise exposure-impulsive
Hearing loss (sudden)
Anxiety
Medications
Hearing loss (long term)
Ménière's Disease
Ear infection
Aging
Head or Neck trauma
Infection/virus
Depression
Migraine
Other

- Tyler, 2015

Hyperacusis and Tinnitus

30–80% of people with a primary complaint of tinnitus also have hyperacusis and about 85% with hyperacusis also have tinnitus (Pienkowski, 2019)

Treatment for both is often similar as their neural mechanisms and etiology are theorized to be related.

Patients with both hyperacusis and tinnitus have a higher need for psychoeducation (Jacquemin et al., 2022).

Other Underlying factors include:

- Bell's Palsy
- Temporomandibular joint problems
- Central Nervous System damage
- Meniere's Disease
- Hypothyroidism
- Lyme Disease
- Depression
- Migraine Headaches
- Superior Canal Dehiscence (SCD)
- Lateral Canal Dysplasia (LCD)
- …

- Post traumatic stress disorder
- Chronic fatigue syndrome
- Generalized anxiety disorder
- Exhaustion
- Fibromyalgia
- Irritable bowel syndrome
- Hearing impairment
- Tinnitus
- Back/joint/muscle disorders

Paulin, Andersson, Nordin (2016)

Hyperacusis and Autism

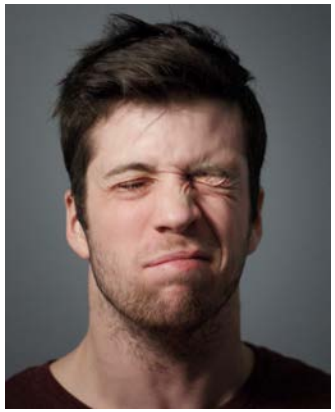
- “Autism may include the symptoms of exaggerated reactions to vision, hearing, touch, smell, or taste. This condition can affect social and communicative development and several studies have linked it to hyperacusis.” Tyler et al. (2014)
- Sound hypersensitivity in the autism group may be due to abnormality of the efferent auditory pathway as shown by lack of sufficient contralateral suppression. Danesh & Kaf (2012)

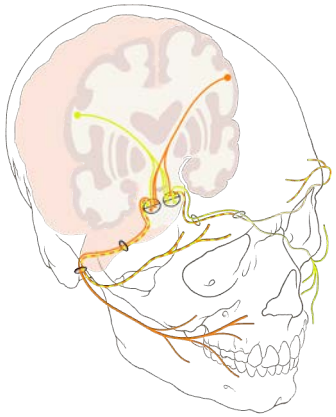
Children Reactions Related to Hyperacusis

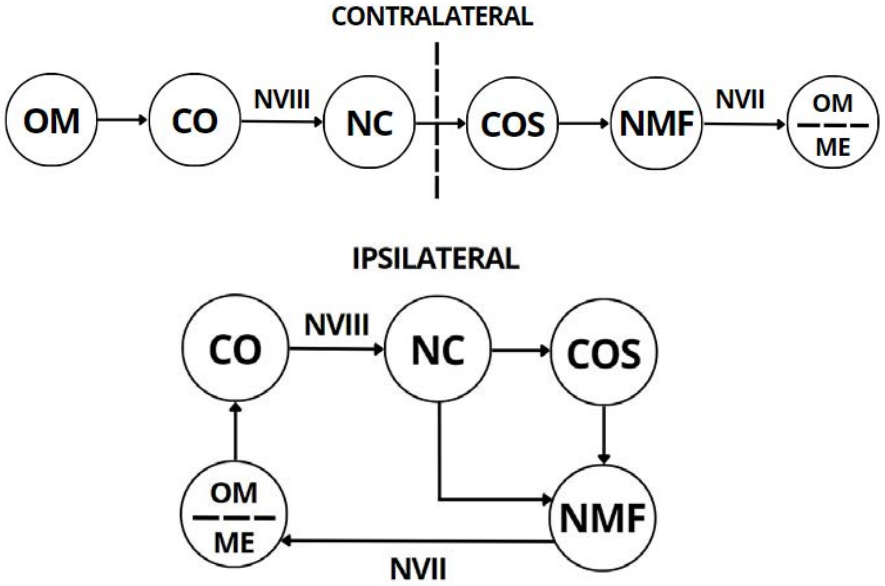
Avoiding or escaping from the sound source	Crying	Covering ears	Making statements of dislike of certain sounds or pain to certain sounds
Screaming or being verbally angry or irritated	Destroying and breaking things	Physically aggressive	Fear or having a panic attack.

(Ke et al. 2020)

Hyperacusis & Bell's Palsy (30%)







Tonic Tensor Tympani Syndrome

- When the tensor tympani contracts without the presence of a loud sound it is referred to as Tonic Tensor Tympani Syndrome (TTTS).

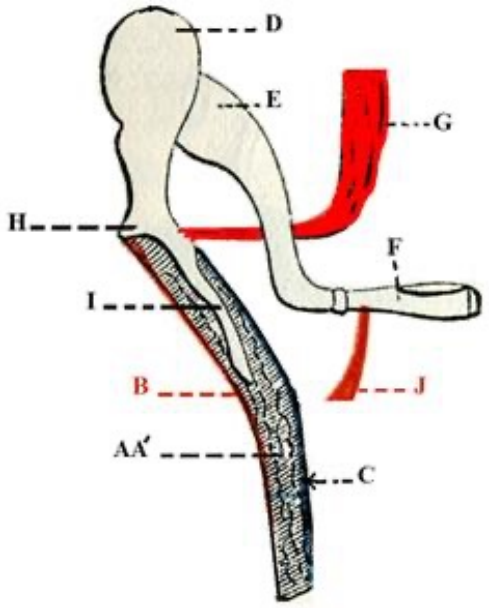


Image by Tillaux Paul Jules (http://en.wikipedia.org/wiki/Paul_Jules_Tillaux => 1834-1904), Public domain, via Wikimedia Commons

Lyme Disease

ERYTHEMA MIGRANS

Flu-like symptoms:

- Headache
- Fatigue
- Fever
- Chills
- Sore throat
- Muscle aches

Insomnia

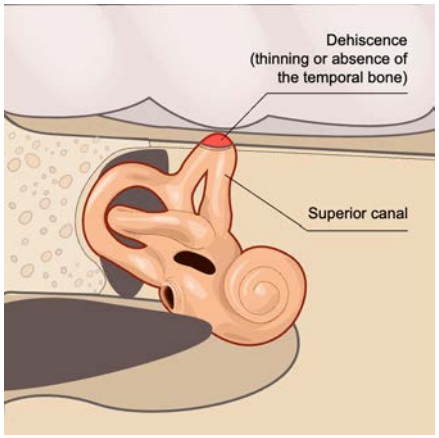
Psychological complications

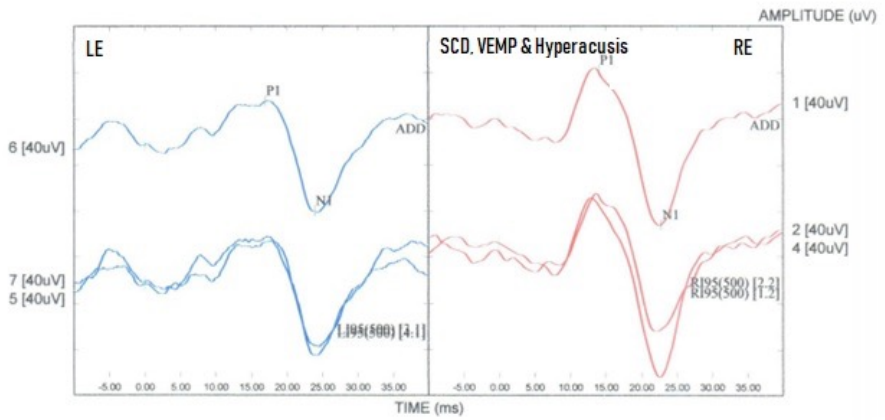
- (long term)
- Depression
- Dementia

- Hearing loss
- Facial paralysis
- Heart complications
  - Rapid heart rate
  - Chest pain
- Syncope, palpitations, Dyspnea
- Hot, swollen, painful joints
- Rash at the site of the tick bite
  - Itching

Photo Credit: James GathanyContent Providers(s): CDC/ James Gathany, Public domain, via Wikimedia Commons

Superior Canal Dehiscence (SCD)





(This patient is a case who faints after hearing loud sounds such as siren which has developed to decreased sound tolerance issues and avoidance).

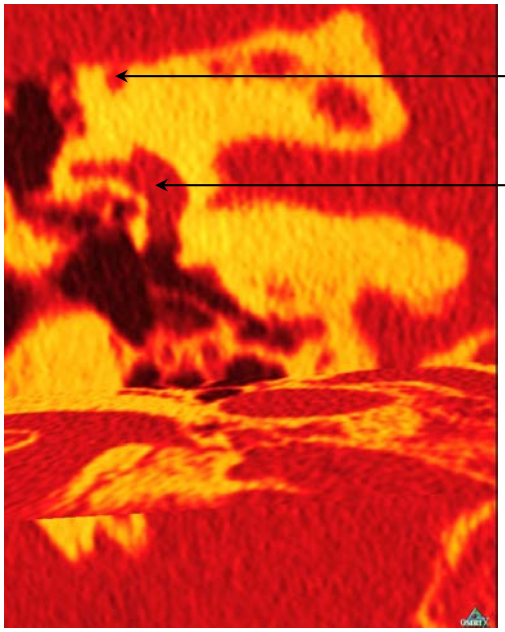
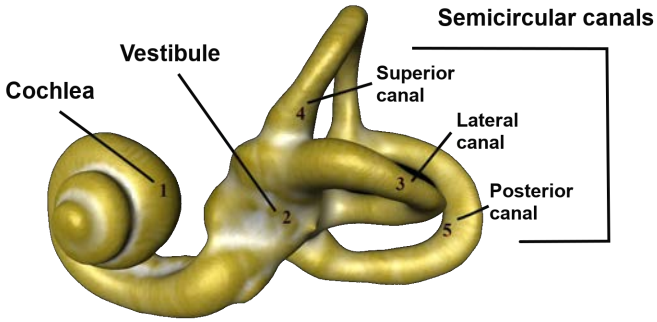


Photo courtesy of Dr. Danesh

(This patient is a case who faints after hearing loud sounds such as siren which has developed to decreased sound tolerance issues and avoidance).

Hyperacusis Due to Lateral Semicircular Canal Involvement

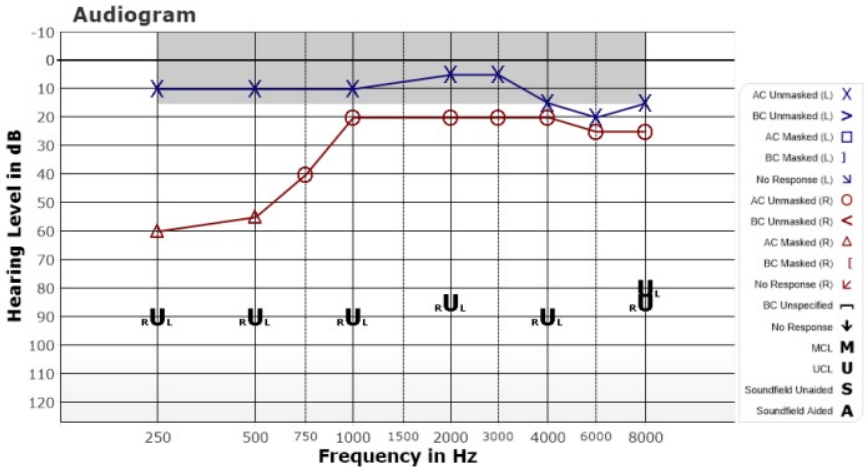
- Modugno & Brandolini (2014), studied three cases that were characterized by disabling hyperacusis in which semicircular canal dehiscence(SSCD) was excluded by temporal bone high-resolution computed tomography (HRCT).
- Their study presented three cases with bilateral lateral canal dysplasia Modugno & Brandolini, (2014).
- (Lateral SCC dysplasia results from disordered embryological development in the sixth week of gestation, https://doi.org/10.53347/rID-51126) .



Hyperacusis and Ménière's Syndrome

- Ménière's syndrome involves severe dizziness, tinnitus and hearing loss. These symptoms primarily result from increased endolymph pressure in the cochlear and vestibular canals. (Tyler, 2014)
- Some studies have reported patients with hyperacusis and Ménière's. In a clinic study of 102 patients with Ménière's, it was reported that a louder tinnitus had a correlation with more severe hyperacusis and hearing loss, but not with vertigo. (quoted from, Tyler, 2014)

Patient with Tinnitus and Hyperacusis (Diagnosed with Meniere's Disease) F, 62yrs



A. Tinnitus Questionnaires Results

Tinnitus Handicap Inventory (THI): 70 (max score 100); Grade 4 (severe handicap)
Tinnitus Reaction Questionnaire (TRQ): 63 (max score 104)
Tinnitus Loudness Scale 1-10: 8 (severely loud)

B. Hyperacusis Questionnaires Results

Hyperacusis Questionnaire: 34 (max score 42); Severe Hyperacusis
Inventory of Hyperacusis Symptoms (IHS): 69 (max score 100): Indication of Hyperacusis

B. Psychoacoustical Tinnitus Evaluation

Tinnitus Pitch Match: 1k Hz Narrow Band Noise (NBN)
Tinnitus Intensity Match: 10 dB SL (Sensation Level)
Minimal masking level: 20 dB SL NBN in both ears at 1k Hz
Residual inhibition: Total (100%) residual inhibition of tinnitus revealed for roughly 30 seconds

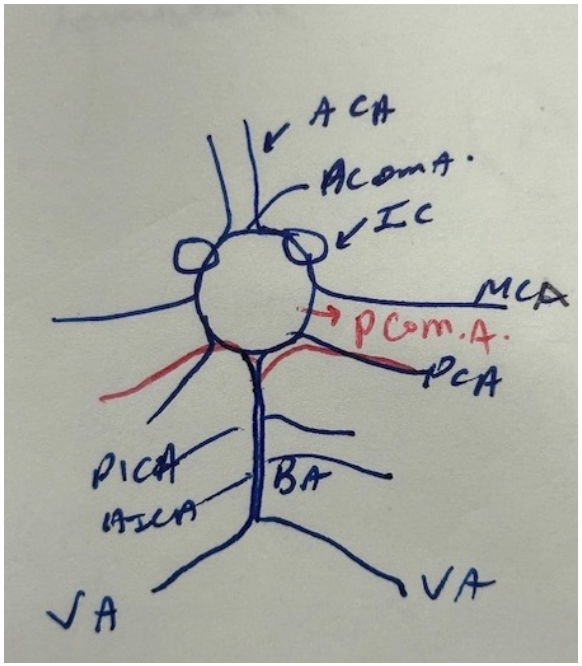
Hyperacusis Following Unilateral Damage to the Insular Cortex: A Three-Case Report

- Boucher et al (2015) reported three cases who developed hyperacusis following insular cortex damage.
- Two patients had had an isolated unilateral insular stroke and a patient with epilepsy who received a right insular resection in order to control seizures.
- All patients, displayed loudness discomfort levels that were lower than typical.

Photo courtesy of Dr. Danesh

MIDDLE CEREBRAL ARTERY

- A group of researchers described a case of middle cerebral aneurysm that presented with brief, intermittent episodes of bilateral hyperacusis. Audiologic and otologic examinations were conducted, however the results were normal and no tinnitus was present.



Khalil et al. 2002, Cited in Tyler et al. (2014)

Assessment Protocols

- Extensive History
- Questionnaires
- Audiological Evaluation

Hyperacusis: Assessment

Questionnaires

Sensory Profile

Multiple Activity Scale for Hyperacusis (MASH)

Hyperacusis Questionnaire (HQ)

- A score of 22 or more is indicative of hyperacusis.

Inventory of Hyperacusis Symptoms (IHS). Cut off score 56 instead of 69 (Aazh, Danesh and Moore, 2021).

Semi-structured interviews and observation

Ask the patient if they ever experience over-sensitivity to sounds.

Observe individual behaviors that may indicate discomfort.

Measurements of LDL

LDLs are measured with pure-tone stimuli, which do not reflect everyday natural sounds; therefore, they do not represent the individual's ability to tolerate sound.

It can be a good measure for a follow-up pre-post treatment.

In addition, if the patient has tinnitus, this may exacerbate their symptoms.

Lower at 6 and 8 kHz compared to lower frequencies

Values of 77 dB HL or below suggests hyperacusis.

Questionnaires for Hyperacusis

1. Hyperacusis Questionnaire (Khalfa et.al., 2002)
2. Modified Khalfa Hyperacusis Questionnaire
3. Inventory of Hyperacusis Symptoms (IHS) (Greenberg and Carlos, 2018).
4. Hyperacusis Impact Questionnaire (HIQ) and Sound Sensitivity Symptoms Questionnaire (SSSQ) (Aazh et al., 2022)

Supplementary Questionnaires:

- Generalised Anxiety Disorder (GAD-7)
- Short Health Anxiety Inventory (SHAI)
- Mini-Social Phobia Inventory (Mini-SPIN)
- Obsessive Compulsive Inventory-Revised (OCI-R)
- Panic Disorder Severity Scale-Self Report (PDSS-SR)
- Patient Health Questionnaire (PHQ-9)
- Penn State Worry Questionnaire-Abbreviated version (PSWQ-A)
- Hospital Anxiety and Depression Scale (HADS)

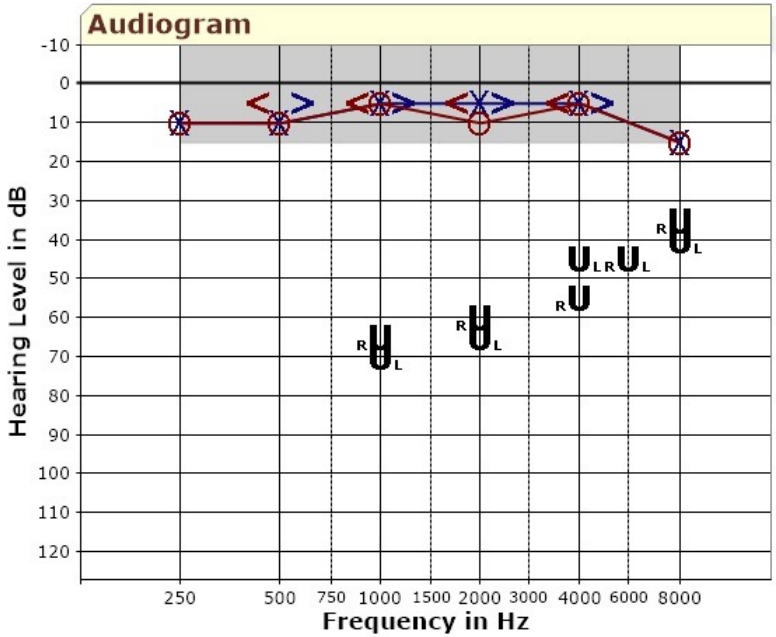
Diagnostic tools

Currently, there is no diagnostic tool or objective measure to assess individuals for hyperacusis, as most involve subjective measures and heterogeneity between studies (Bigras et al., 2023).

Bigras et al. (2023) reviewed studies using electrophysiological measures such as auditory evoked potentials (AEPs) for hyperacusis assessment, revealing that it is a potential tool (short, middle and long latency AEPs).

Aazh and Moore (2017) proposed combined diagnostic criteria and suggested indicators of hyperacusis, including LDL values of 77 dB HL and a score of 22 on the Hyperacusis Questionnaire.

Loudness Discomfort Levels (LDLs)
(not looking to the level that how much you can tolerate!)



Typically LDLs can be assessed using stimuli such as pure tones, warble tones, noise and even speech.

Uncomfortably loud

Loud, but OK

Comfortable, but slightly loud

Comfortable

Comfortable, but slightly soft

Soft

Very soft

Didn't hear it

LDL classifications as suggested by the American Speech-Language-Hearing Association

The impact of Mental Health!

The Importance of Mental Health

- Avicenna (980 – 22 June 1037), put two lambs in separate cages. Lambs were the same age and the same weight, and fed with the same food. All conditions were equal. However, he put a wolf in the third cage. Only one lamb could see the wolf but not the other lamb.
- Months later, the lamb who saw the wolf was cranky, restless, poorly developing, and losing weight. The lamb died whilst the other lamb remained healthy. Although the wolf did nothing to the lamb next to it, the fear and stress that lamb lived in killed it prematurely, while the other lamb that did not see the wolf, was peaceful and developed well with a healthy weight gain.
- **Avicenna (Ibn Sina) demonstrated the importance of mental health.**

Thoughts about Suicide and Self-Harm in Patients with Tinnitus and Hyperacusis (Aazh and Moore, 2018)

- “Audiologists offering tinnitus and hyperacusis rehabilitation should screen for suicidal and self-harm ideations among patients, especially for those with comorbid depression, and make onward referral to appropriate services when needed.”
- A total of 150/402 of patients answered the question about suicidal and self-harm ideations (13% positive ideation).

Suicide Hotline

- Help is available
- ***Speak with someone today***
- 988 Suicide and Crisis Lifeline
- Languages: ***English, Spanish***
- Hours: ***Available 24 hours***
- Call or Text 988
- SUICIDAL IDEATION QUESTIONNAIRE
  https://www.semel.ucla.edu/sites/default/files/pdf/SuicidalIdeationQuestionnaire%28SIQ%29%28Child%29.PDF

Management of Hyperacusis

- Medical
- Surgical
- Psychological
- Audiological

Hyperacusis Treatments: Medications

There is a high interest in using medications to treat hyperacusis, however it has not been investigated in clinical trials. The work published in regard to this is limited to clinical case reports.

- A review by Potgieter et al. (2020) noted a study by that had success using Risperdone.
  - Shuper et al. (2015) utilized Valproic acid 15 mg/kg alone then combined with Risperdone 0.5 mg/day, and it resulted in some improvement
- Sanchez & Pereira (2019) reported a case study where the combination of Counselling and Gingko biloba resulted in gradual and stable improvement.

Pienkowski et al. (2014)

Hyperacusis Treatments: Medications

- A case study in 1993 described the use of Alprazolam (a short-acting anxiolytic) in 5 patients who presented with tinnitus and hyperacusis. After 8 weeks of treatment a complete remission of hyperacusis was observed.
- Another case study focused on the use of Carbamazepine (an anticonvulsant and mood-stabilizing drug) for the relief of hyperacusis in two patients diagnosed with Lyme disease. A third study described the use of selective serotonin receptor inhibitors (fuvloxamine and fluoxetine) for a patient with complete remission of hyperacusis and increase of ULLs.

Pienkowski et al. (2014)

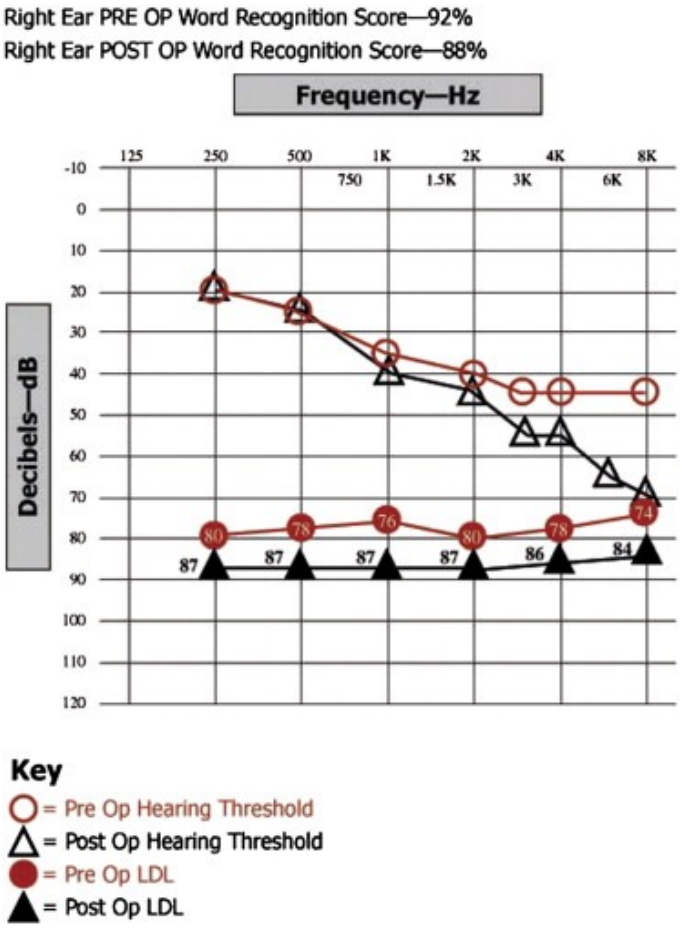
Hyperacusis: Surgical Approach

Round and oval window reinforcement of hyperacusis.

Silverstein H, Wu YH, Hagan S.

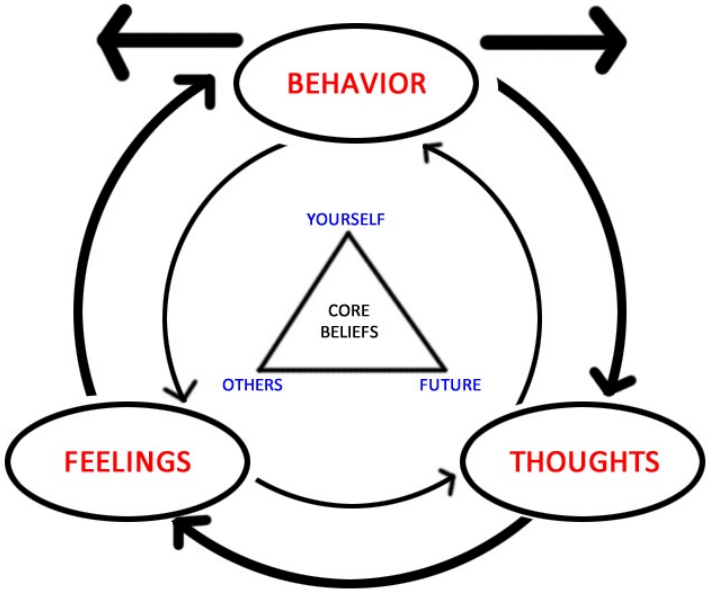
Am J Otolaryngol. 2015 Mar-Apr; 36(2):158-62.

Audiometric and loudness discomfort level (LDL) results for Patient 2, right ear.



Psychological Treatments

- Counseling and Education
- Mindfulness Therapy
- Cognitive Behavioral Therapy
- Dialectical Behavior Therapy



Cognitive Behavioral Therapy (CBT)

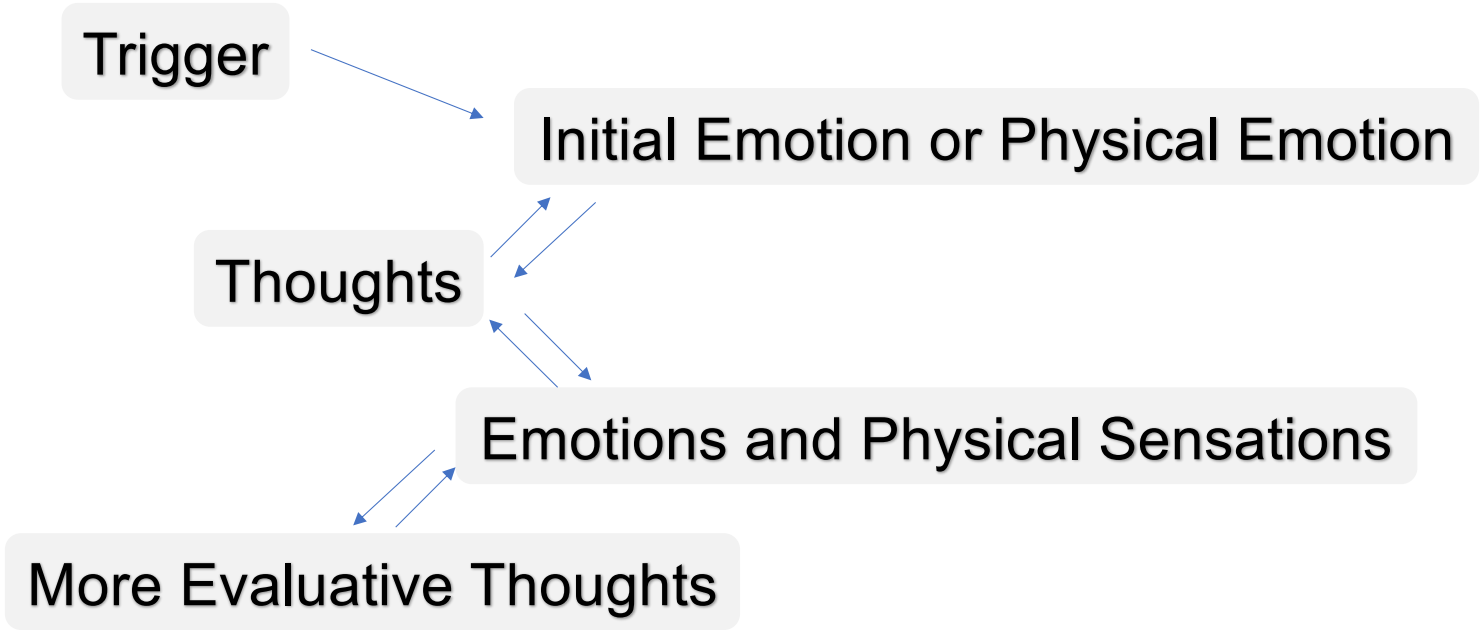
- CBT is a method that can help reduce the secondary emotional reactions such as anxiety and depression that associated with hyperacusis (Henry et al., 2022).
- Kennedy and colleagues treated a 9-year-old boy with CBT.
  - Targeted desensitization daily through graded step-by-step exposure to sounds and rewards
  - Relaxation techniques practicing positive thoughts
  - Improvement was noted after 2 weeks of treatment.

The cognitive behavioral therapy for hyperacusis evolved from the cognitive behavioral therapy for tinnitus and anxiety disorders. Treatment includes education, applied relaxation, graded exposure to sounds, and cognitive therapy for distressing thoughts and beliefs regarding sounds.

Pienkowski et al. (2014)

CBT Model for Hyperacusis

(Aazh et al., 2019)



https://www.dovepress.com/cognitive-behavioral-therapy-for-alleviating-the-distress-caused-by-ti-peer-reviewed-fulltext-article-PRBM Open access and Available free of charge (Authirs: Hashir Aazh, Michael Landgrebe, Ali A Danesh, Brian CJ Moore)

Audiological Management of Hyperacusis

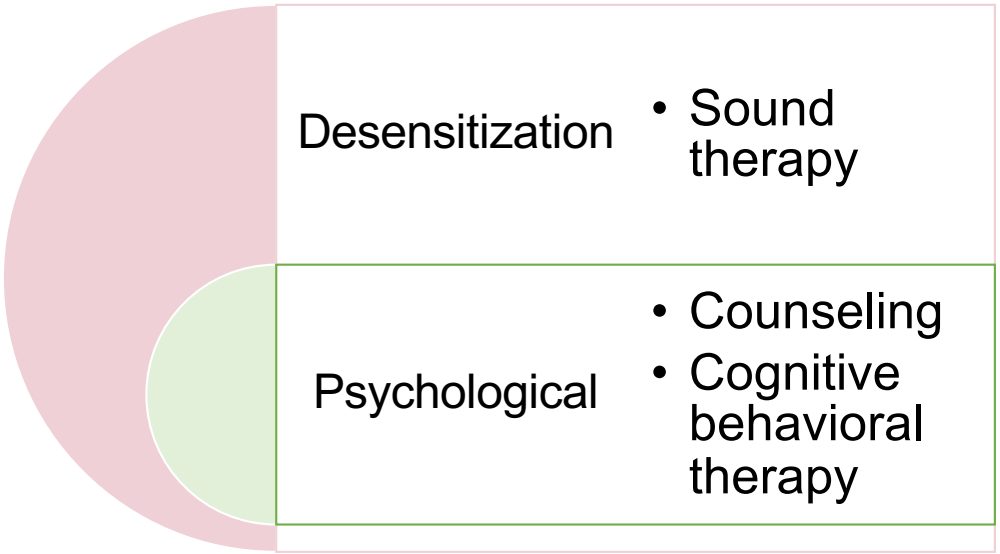
- Patient Education
- Acoustical Enrichment and Exposure
- Say “YES” to Hearing Protection
- Say “NO” to Avoidance Behavior

AND:

- Reduce Fear
- Improve ANS control
- Remove Negative Thoughts

Role of patient education

Hyperacusis: Multifactorial approach (Henry et al., 2022)



The process of desensitization often produces a decrease of hyperacusis relatively fast (Jastreboff and Jastreboff, 2003)

Hyperacusis Treatments: Sound Therapy

- Studies have found that listening to low-level sounds for several months can alleviate tinnitus and hyperacusis.
- Over time there are gradual increases of the level and/or duration of the sound treatment that are implemented with positive reinforcement from the clinician. The association of positive experiences with sound treatment can result in the elimination of hyperacusis symptoms.

Pienkowski et al. (2014)

Sound therapy

- There is evidence that sound therapy can reduce auditory gain and increase loudness tolerance (Henry, 2022).
  - Formby et al. (2003) reported that in a 2-week period participants who used sound generators experienced greater sound tolerance, whereas those who used earplugs experienced decreased sound tolerance.
- Pienkowski et al. (2014) described different sound therapy approaches to increase LDLs:

1.	2.	3.	4.
• Continuous low level broadband noise.	• Slowly increasing the loudness level and duration of the sounds.	• Recording specific bothersome sounds and gradually increasing loudness and duration.	• Decreasing maximum output of hearing aids.

Sound Therapy

- Use of music
- Desensitization with pleasant sounds
- Tinnitus Retraining Therapy (modified) (Jasterboff & Jasterboff, 2000)
- Fractal tone Therapy
- Hearing Aids with BT compatibility and tinnitus features

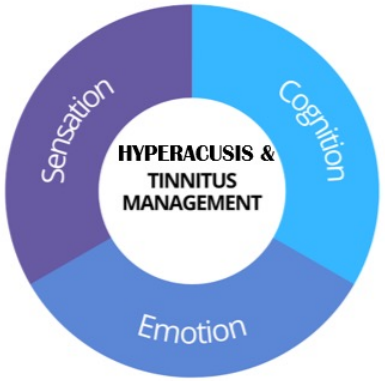
Photo courtesy of Dr. Danesh

Hyperacusis Treatments: Sound Therapy

- Indirect evidence for compensatory processes of the central auditory pathways (and the plasticity of these pathways).
- In terms of hyperacusis, these results (along with other investigations in the research literature; Noreña & Chery-Croze , 2007; Formby et al., 2015) **advocate acoustic environment enrichment** and **sound therapy** to increase loudness tolerance, rather than sound avoidance (via earplug use) which may in fact exacerbate a patient's problems (Formby, Sherlock, & Gold, 2003).

Model of Hyperacusis and Tinnitus Management: Got a SEC!

- Sensation: includes sound therapy, to alleviate impact of hyperacusis.
- Emotion: consists of extensive counseling, relaxation techniques and mindfulness and it reduces reaction to hyperacusis by controlling ANS response.
- Cognition: utilizes direct cognitive behavioral therapy or internet-based CBT to deal with negative thoughts in general.



Overcoming Hearing Loss. From Drug Therapy to Cochlear Implant Surgery.

Adrien A Eshraghi, MD, MSc, FACS (Editor)

World Scientific Publishing Company, 2024.

Neuroplasticity

- "…neural plasticity is the mechanism by which the [normal] brain encodes experience and learns new behaviors" (p. S225).
- "It is also the mechanism by which the damaged brain relearns lost behavior in response to rehabilitation" (p. S225).

Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. J Speech Lang Hear Res. 2008 Feb;51(1):S225-39. doi: 10.1044/1092-4388(2008/018). PMID: 18230848.

Neuroplasticity

- Neuroplasticity: The adaptive capacity of the central nervous system (Kleim & Jones, 2008).
  - "…neurons… possess the remarkable ability to alter their structure and function in response to a variety of internal and external pressures, including behavioral training" (p. S225).

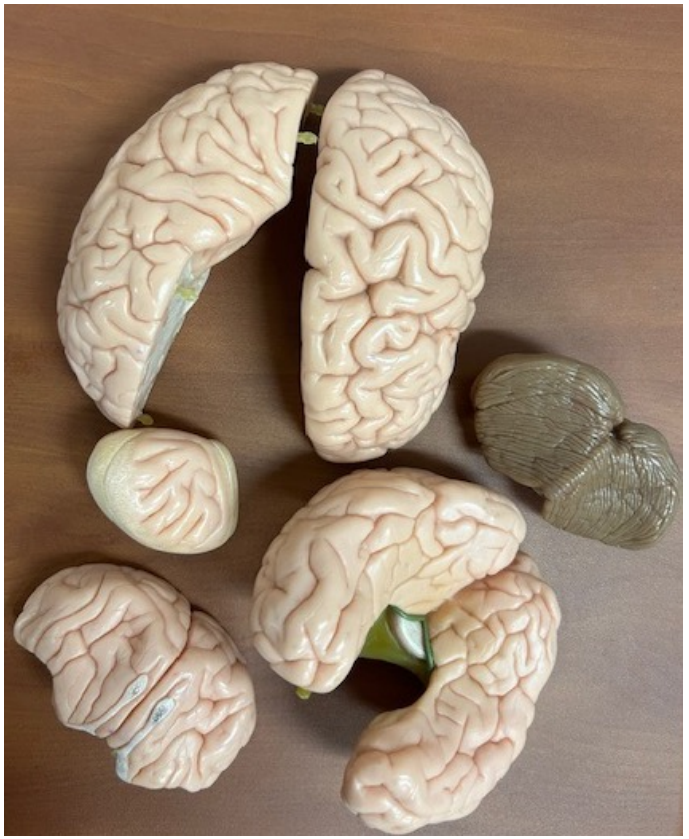


Photo courtesy of Dr. Danesh

Some examples of the Principles of Neuroplasticity

- Use it or lose it (failure to drive certain functions can lead to loss)
- Use it and improve it (training of certain brain functions can lead to improvement)
- Repetition matters (induction of plasticity requires sufficient repetition)
- Time matters (different forms of plasticity occur at different times of training)

Data from Kleim, J. A., & Jones, T. A. (2008). Principles of experience-dependent neural plasticity: Implications for rehabilitation after brain damage. *Journal of Speech, Language, and Hearing Research, 51*, S225–S239.

Our goal is to generate neuroplastic changes for patients with hyperacusis by enhancing their tolerance to the sound, reducing their emotional reaction to it, and providing them with skills to remove negative thoughts associated with their decreased sound tolerance.

Future Research Directions

- Focus on finding an objective measure and a standardized diagnostic criteria for hyperacusis.
- Investigate the neural mechanisms of hyperacusis further.
- More studies exploring treatment efficacy (e.g., sound therapy, SEC, iCBT, and medications).
- More research should be conducted to develop appropriate questionnaires for children experiencing hyperacusis.

Take home message!

- Hyperacusis (a decreased sound tolerance disorder) is a manageable condition!

Congratulations!

- You've completed the course and can move on to the exam!
- From your account:
  - Go to pending Courses
  - Choose take exam