



The *misunderstood* Misophonia

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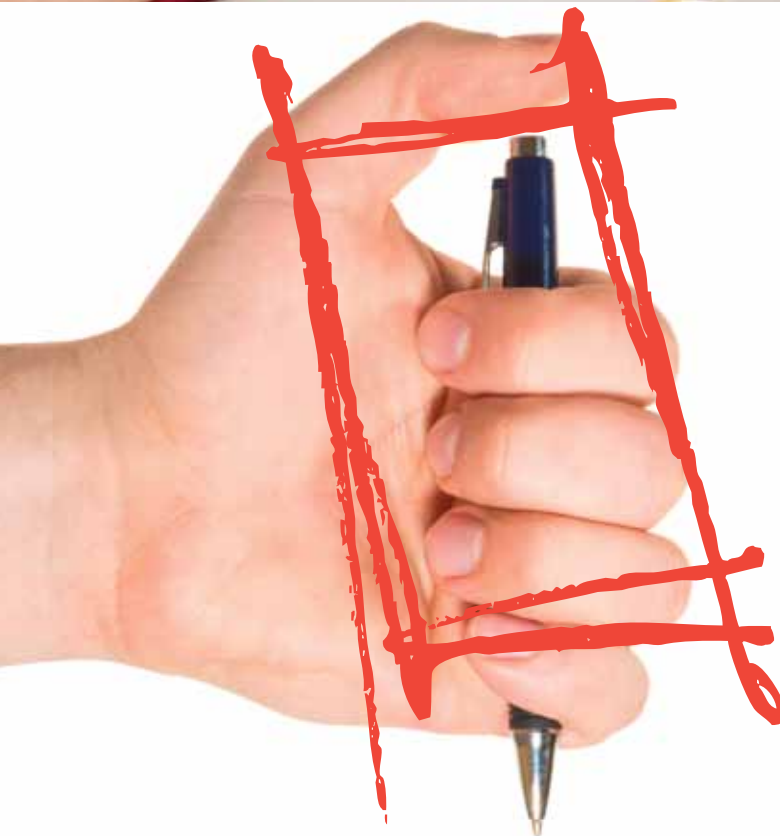
In misophonia, or hatred of sound, the extreme reaction to sound is quite often limited to specific sounds, referred to as “trigger sounds.” Reported trigger sounds include chewing, breathing, and repetitive sounds like a pen clicking. The most common reaction is irritation followed by disgust or anger and can include physical effects such as pressure in the chest and arms, clenched teeth, and tightened muscles. Research is needed to further describe and understand misophonia, but options exist for audiologists, as part of a team of providers, to aid in the diagnosis and management of this disorder.

What is your response when you hear someone smacking on a piece of gum, crunching on chips with her mouth open, slurping on noodles? Cringe, throw a death stare, think someone did not teach that person proper etiquette, or simply ignore? Then again, maybe you are the culprit!

Misophonia, or hatred of sound, is a term coined by Margaret M. Jastreboff and Pawel J. Jastreboff in an article about hyperacusis on June 18, 2001. Jastreboff and Jastreboff further describe the term as “abnormally strong reactions of the autonomic and limbic systems resulting from enhanced connections between the auditory and limbic systems. Importantly, misophonia ... [does] not involve a significant activation of the auditory system. At the behavioral level, patients have negative attitudes to sound.... In cases of misophonia ..., the strength of the patient’s reaction is only partially determined by the physical characteristics of the upsetting sound and is dependent as well on the patient’s previous evaluation and recollection of the sound ..., the patient’s psychological profile and the context in which the sound is presented” (2001).

However, Jastreboff and Jastreboff (2001) are quick to point out that hyperacusis and misophonia, though both

forms of decreased sound tolerance (DST), are not the same. Hyperacusis involves an abnormal reactivity of the auditory pathway to sound in general, not necessarily a specific sound, with subsequent limbic and autonomic responses. In contrast, misophonia, according to the Jastreboff and Jastreboff (2001), does not involve abnormal auditory system reactivity. A logical rationale for this assumption is that the reaction is quite often limited to specific sounds, referred to as “trigger sounds,” and even specific persons or things making the sound. The auditory system changes associated with reactivity seen in hyperacusis include abnormal central gain, increased neural activity in the auditory brainstem, midbrain, and cortex, decreased inhibition, and efferent dysfunction (Marriage and Barnes, 1995; Attias et al, 2005; Hickox and Liberman, 2014). Of course none of these physiological changes have been ruled out for misophonia. In addition, misophonia does not usually involve a fear of the trigger sound (aka phonophobia) but, rather, dislike that is sometimes extreme. We should point out that other terms are also sometimes used to describe misophonia including *selective sound sensitivity syndrome*, or 4S, coined by Marsha Johnson in 1999 (www.misophonia-association.org/home.html).



What Do We Really Know about Misophonia?

Unfortunately, we know very little about misophonia. Only a handful of articles have been published on misophonia, primarily case studies or discussions of its place as an independent disorder or symptom of other existing disorders (Jastreboff and Jastreboff, 2006; Collins, 2010; Schwartz et al, 2011; Edelstein et al, 2013; Ferreira et al, 2013; Neal and Cavanna, 2013; Webber et al, 2013; Schröder et al, 2013; Cavanna, 2014; Kluckow et al, 2014; Wu et al, 2014). Only two published studies to date have explored physiological findings in misophonia patients (Edelstein et al, 2013; Schröder et al, 2014).

No animal model exists for misophonia. This is understandable given that the likely method to establish an animal model would be to condition the animal to dislike a specific sound, and in the process you would already be defining the mechanism of the physiological changes, that is, a conditioned/learned response.

Schröder and colleagues (2013) in the Netherlands and Edelstein et al (2013) have published the two most comprehensive reports about misophonia. Schröder et al (2013) recruited 42 Dutch patients who reported misophonia. The patients were clinically assessed by five psychiatrists experienced in obsessive-compulsive spectrum disorders. Hearing testing was only performed in five randomly selected subjects. Four showed normal pure tone threshold sensitivity, speech test findings, and loudness discomfort levels, while one patient had an unexplained conductive hearing loss. The interview revealed some interesting characteristics of the sample. First, all trigger sounds were limited to humans, but none of the 42 patients reported distress when the same sound was self-produced. The average age of onset was 13 years. The most frequently reported trigger sounds were bodily sound related to chewing (81 percent) or breathing (64 percent) and to repetitive sounds like a pen clicking (60 percent). Approximately 12 percent of the sample reported visual triggers.

According to Schröder et al (2013), the most common reaction was irritation, followed by disgust or anger. The reported coping strategy was avoidance, either by active avoidance of social situations or use of headphones, to diminish perception. The remaining portion of the article describes similarities between misophonia and psychiatric disorders such as post-traumatic stress disorder, obsessive-compulsive disorder, social phobia, and others. The authors suggest that misophonia does not neatly fit into current classifications. They propose, rather, that misophonia be considered a variant of obsessive-compulsive spectrum disorder. Proposed diagnostic criteria were

provided for consideration. In addition, a concept scale called the Amsterdam Misophonia Scale was provided.

In the other study, Edelstein et al (2013) conducted interviews with 11 individuals in the San Diego region of the United States reporting misophonia. The characteristics of the subjects were comparable to those described by Schröder et al (2013). However, additional information was noted. Nearly half the subjects (45 percent) reported their misophonia worsening over time. Interestingly, 55 percent indicated that misophonia was a familial trait. In addition, subjects reported physical effects from trigger sounds such as pressure in chest and arms, clenched teeth, and tightened muscles. Other coping mechanisms such as mimicry (e.g., timing own chewing with others) and distraction were also reported.

In a second component of this study, six of the subjects underwent skin conductance response (SCR) testing. Results were compared to matched controls. All subjects in each group had normal hearing sensitivity. SCR measures the electrical conductance of the skin and consequently the amount of sweat produced. SCR is

related to activation of the sympathetic nervous system and autonomic arousal. Stimuli included auditory clips, visual movies, and auditory-visual movies for 15 seconds of birds singing, children laughing, gum chewing, and so forth. The misophonia group had higher SCR measures to auditory stimuli but not visual stimuli compared to controls. Data regarding auditory-visual combination were not discussed. An interesting finding was that the SCR in misophonia and controls was correlated to subjective aversive rating. In other words, both groups found similar stimuli to be aversive, but persons reporting misophonia had more extreme reactions. Edelstein and colleagues (2013) suggested that misophonia may be similar to synesthesia in terms of enhanced connectivity between brain regions of the auditory cortex and limbic structures that could cause a form of sound-emotion synesthesia. The suggestion of a sound-emotion synesthesia is comparable to the enhanced auditory-limbic connections suggested by Jastreboff and Jastreboff. The authors also proposed a possible genetic component given similar experiences

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in family members. However, this could just as well be a learned response from a family member.

Schröder and colleagues (2014) at the University of Amsterdam recently examined auditory late responses (ALRs) in a group of adult patients with misophonia and compared findings to matched controls. ALR components occur within a time period from about 50 to 250 msec after acoustic stimulation. Precise anatomic generators are not known but presumably arise from the auditory cortex and probably other regions of the brain. The typical ALR waveform consists of a positive peak around 50 msec (P1), a negative peak around 100 msec (N1), and a positive peak around 200 msec (P2). P1, equivalent to the P50 component of the auditory middle latency response (AMLR; Hall, 2007), appears to be associated with pre-attention, N1 with early attention, and P2 with early allocation of attention and initial conscious awareness (Hall, 1992). The ALR was evoked with regularly presented 1000 Hz stimuli plus oddball stimuli at 250 and 4000 Hz while subjects watched a silent movie. There was no difference in the ALR between groups for the standard tone but a smaller N1 peak was evoked by the oddball in the misophonia subjects. Reduced N1 responses have been found in various psychological disorders including schizophrenia (Hall, 2007). The study seems to have two major limitations. First, a number of the misophonia subjects were taking psychotropic medications at the time of data collection. Also, there is the possible influence of hyperarousal on attention. Subjects with hyperarousal may find it more difficult to attend to specific stimuli when they are hyperresponsive to the entire task. Differences in ALR data were limited to group mean findings. This finding does not translate directly to clinically significant findings for individual subjects. In addition, no differences were observed for the P1 or P2 of the ALR.

The literature and our clinical experience suggest that the majority of patients with misophonia have normal hearing sensitivity.

Clues from Aversive Sound Research

Long before the term *misophonia* was coined, psychophysical researchers examined the nature of aversive sounds. Why do people cringe when fingernails scrape across a chalkboard? It is actually a fairly universal response. Boyd (1959) and Ely (1975) reported that high frequen-

cies as well as prior knowledge of the sound source were responsible for the unpleasantness or aversive nature of jarring sounds. In 1986, Halpren et al published an aptly titled article, "Psychoacoustics of a Chilling Sound." These researchers performed a series of studies to examine the acoustic properties of sound responsible for subjective aversive ratings. They first created a sequence of 16 different stimuli, among them chimes, white noise, running water, pure tones, blender, rubbing Styrofoam, and a

three-pronged garden tool scraped over a slate surface (a True Value "Pacemaker" model). Subjects rated the pleasantness to unpleasantness of the sound. The highest unpleasant rating was for the Pacemaker garden tool and Styrofoam. Next, the stimuli were filtered to remove energy from different frequency regions while controlling for energy level. Low-pass filtering had essentially no effect on rating; however, high-pass filtering above 2000 Hz decreased the unpleasantness. In other words, high frequencies were not responsible for the subjective aversive nature of the sound.

Reuter and Oehler (2011) further pursued this topic. They examined the correlation between perception of aversive sounds and physiological reactions as related to spectral content of the signal and knowledge of the stimulus origin. Using aversive sounds like "nails on chalkboard," they had subjects rate the unpleasantness. They found attenuating the frequencies between 2000 and 4000 Hz reduced the aversive nature of the sound. Removal of harmonics also improved the rating. Galvanic skin response measures showed that sounds rated more aversive produced a greater skin response

and attenuating frequencies between 2000 and 4000 Hz reduced the physiological response. Also, the origin of the sound was critical. Half the subjects were told the true source the sound, such as nails on chalkboard, whereas the other half were told the sounds were taken from pieces of contemporary music. Subjects who were informed that the sound was music had reduced aversive ratings and decreased galvanic response. The findings suggest that the acoustic characteristics of sound can contribute to the subjective rating and physiological response, and so can the perceived source of the stimulus.

Analogy: External Tinnitus

Is a misophonia patient's brain response comparable to the brain response of a person with bothersome tinnitus? A study by Mirz et al (2000) may provide a clue. Mirz and colleagues sought to examine the brain's response to aversive sounds, such as a knife scraping on a plate, while performing functional imaging (PET). The rationale of the study was to demonstrate that comparable areas of the brain were activated for tinnitus patients and persons experiencing an aversive sound. The findings highlighted activation of the prefrontal cortex, the insula, and portions of the limbic system in subjects exposed to aversive sounds, which was similar to subjects experiencing tinnitus. The findings of this study support the auditory-limbic response theory suggested by Jastreboff and Jastreboff (2001) and Edelstein et al (2013) and, in addition, the possible application of tinnitus retraining therapy (TRT) elements for reducing responses to trigger stimuli.

Audiologists' Role: How Do We Evaluate and Treat Misophonia?

How should audiologists evaluate misophonia? We suggest that the assessment include a thorough case history and comprehensive audiological evaluation including pure tone audiometry, immittance measures (tympanometry and middle ear muscle reflexes), oto-acoustic emissions, and loudness discomfort levels to rule out peripheral hearing deficit. The evaluation may also include central auditory processing testing, tinnitus evaluation, and auditory evoked responses if indicated.

Case history is critical. Someone who presents with misophonialike symptoms may, in fact, have other more appropriate diagnoses. A common example is a child who experiences sensitivity to sudden unexpected sounds or specific objects like a vacuum. Some children with apparent misophonia may have suspected or diagnosed autism spectrum disorder. Children with autism spectrum disorder are more likely to have global sensory processing disorders than true misophonia. These children should

be referred to occupational therapy for further evaluation and therapy.

The literature and our clinical experience suggest that the majority of patients with misophonia have normal hearing sensitivity. The findings of Schröder et al (2014) reviewed earlier offer limited data on hearing status in misophonia as only five of 42 subjects underwent formal hearing audiological assessment. Group-based statistical differences in a specific auditory measure such as the ALR does not mean there are individual clinically significant differences. In our experience audiological findings are usually normal in persons with misophonia who do not have other decreased sound tolerance issues or central auditory processing concerns.

A multidisciplinary team approach including audiology, psychology, medicine, and occupational therapy is most effective in establishing a differential diagnosis and in developing reasonable therapeutic options. Communication among providers is important in establishing an individual treatment plan for each patient. This may also require peer-provider education on misophonia, as colleagues in your area may not have experience with this population.

At least six management options are suggested for patients with misophonia. However, the effectiveness of these approaches is based mostly on anecdotal reports, not formal research published in the peer-reviewed literature.



1 COUNSELING: It is helpful to review in understandable terms for the patient with misophonia how the auditory system and nonauditory regions of the brain are involved in sound processing in persons with tinnitus and hyperacusis. The reaction the person with misophonia is experiencing is not necessarily a reflection of an underlying psychiatric disorder but, rather, an enhanced version of the reaction many people experience. Though the mechanism is not understood, the auditory-limbic theory provides a starting point. In addition, educating the patient about potential therapeutic options helps to reduce the patient's response. It is generally beneficial to include the patient's family in the counseling process. The family should understand that the patient is not consciously producing misophonia. Family-centered counseling also offers an opportunity to address misinformation on misophonia. Whether this is a preexisting genetic distortion of sound-stress response or a conditioned response or a manifestation of other psychological-based disorders, the treatment options at this time are likely similar. Most importantly counseling should give the patient hope.

2 MISOPHONIA RETRAINING THERAPY: Retraining therapy refers to use of pleasant sounds to reduce perception of the trigger stimulus and their reaction. The goal is comparable to TRT; that is, the reliance on pleasant sound is reduced as the patient's reaction diminishes. For example, initially the patient is permitted to wear an mp3 player while listening to his or her favorite music at the dinner table to diminish perception of the offending sounds. This differs slightly from TRT because we want the patient to attend to the pleasant sound not simply try to ignore it. Over time reliance on the retraining signal is no longer necessary.

3 POSITIVE ASSOCIATION AND DESENSITIZATION: With desensitization the offending sound is slowly introduced in a controlled manner. The desensitization process needs to be approached carefully. The patient should not be forced or strongly encouraged to try to bear the sound as long as possible as this can potentially exacerbate the response. For example, the offending sound can be mixed with a pleasant sound in a positive environment. There is even a smart phone application that allows the patient to mix offensive sounds with music.

4 PSYCHOLOGICAL OR PSYCHIATRIC EVALUATION AND THERAPY: Some persons with misophonia benefit from professional counseling in an attempt to help explore issues that may be contributing to their experience. For example, a child's strong dislike of chewing sounds that are specifically limited to their mother raises some concern of other underlying factors. Psychological counseling, such as cognitive behavioral therapy, mindfulness-based stress reduction, and dialectical behavior therapy can be helpful in giving the patient tools to improving their misophonia. Some patients may find benefit from pharmacological treatments for stress- and anxiety-related symptoms. In addition, patients may be unaware of a physical response to triggering stimuli, such as tightening of muscles. Recognizing a physical response and then developing a strategy to minimize the response may be of benefit.

5 OTHER APPROACHES: Other potential management approaches include neuro-biofeedback, hypnosis, positive thoughts, relaxation exercises, meditation, healthy diet, and exercise.

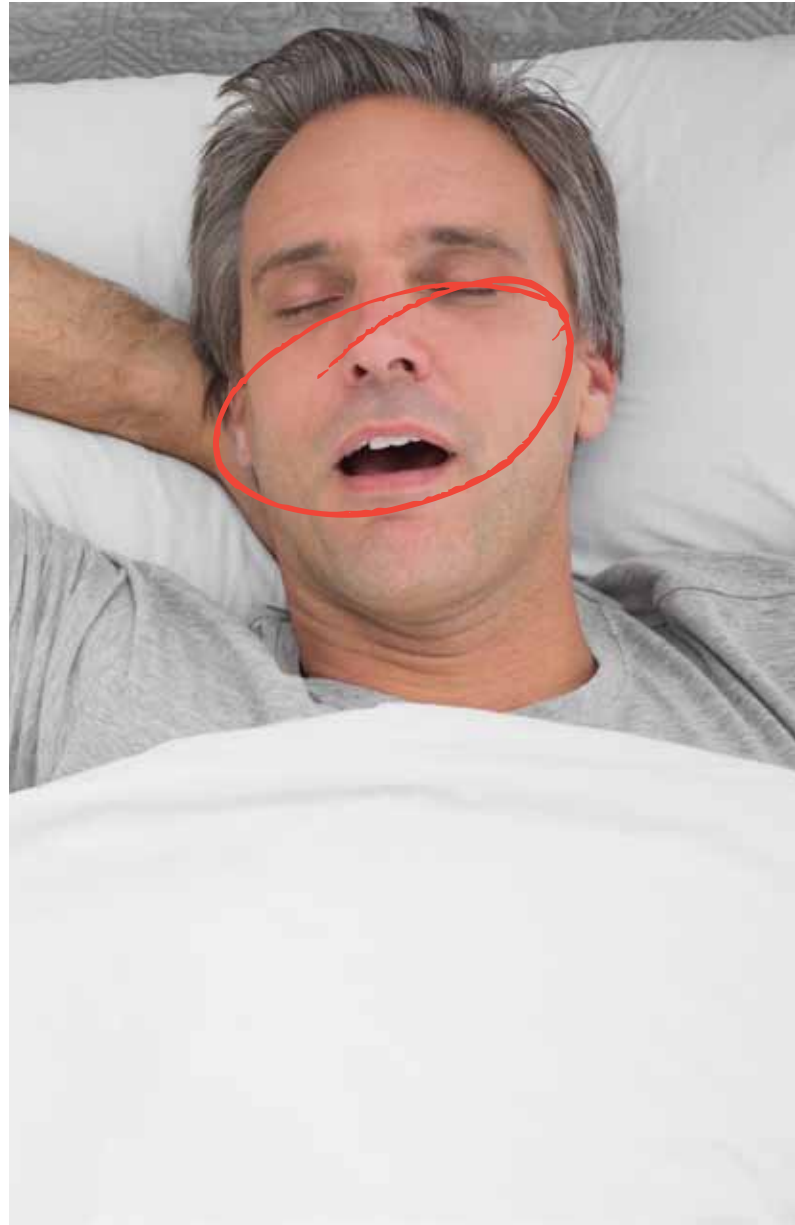
6 HEARING PROTECTION DEVICES: We do not recommend use of hearing protection. We suggest that patients progressively replace hearing protection devices with sound-based therapy. It is not helpful to reinforce the patient's misconception of the need for protection from the aversive sounds. Most patients do not view these sounds as too loud or painful but, rather, as extremely annoying. Use of hearing protection may also lead to altered loudness perception and decreased tolerance to a larger array of sounds.

Patients with misophonia require a multidisciplinary team approach.

Wanted: Research!

Research is needed to further describe and understand misophonia. Some potential questions and research directions include:

- Epidemiological studies to understand demographics, characteristics, and factors associated with misophonia and to define the spectrum of clinical presentations.
- Precise definition of misophonia and differentiation of misophonia from other sensory processing disorders and psychological disorders. Research should answer this question: Is misophonia an independent disorder or a symptom of a disorder involving more complex sensory processing integration attention based distortion?
- What mechanisms underlie misophonia spectrum-based symptomology? Is it a learned/conditioned response that results in enhanced limbic-auditory response? Is it a neurophysiological distortion (e.g., loss of inhibition, gating mechanism) that increases susceptibility to establishing the enhanced response? Is a similar mechanism involved in creating visual triggers or response in anticipation to stimulus? Is it a disorder in itself or a manifestation of other existing neuropsychophysiological conditions? Is there a genetic component?
- What is the role of the classical auditory pathway in misophonia? Are there any clinical abnormalities in cochlear function, in afferent auditory function as




measured with auditory brainstem response (ABR), AMLR, or ALR, in efferent function, or in middle ear muscle reflexes that can be determined?

- Is this even an auditory disorder or a higher level attention-based processing distortion?
- Functional imaging studies would probably be useful to examine areas of the brain involved in misophonia.

There is a clear need for intervention-based studies to examine the validity of various treatments.

Summary

Research efforts to understand misophonia are just beginning. An important first step is to raise awareness of the disorder and to establish a basic understanding of the clinical characteristics. More systematic research is critically needed! Some experts suggest that misophonia is a conditioned response or involves overactive association-building areas of the brain resulting in enhanced connections in the stress response areas to specific stimuli including sound and even visual stimuli. Importantly, the response or association does not require some type of significant traumatic event. Other researchers suggest this is a subcategory or a symptom of other behavioral-based disorders such as obsessive-compulsive disorder.

Despite all the unknowns there are ways audiologists can help patients with the chief complaint of misophonia. Our multiple roles as audiologists are to help in establishing a differential diagnosis, to rule out auditory pathology, to provide counseling on hearing and sound-emotion processing, and to offer sound-based therapy strategies to aid in treatment. However, we should not attempt the diagnosis and management of misophonia in isolation. Patients with misophonia require a multidisciplinary team approach. 

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References

Attias J, Zwecker-Lazar I, Nageris B, Keren O, Groswasser Z. (2005) Dysfunction of the auditory efferent system in patients with traumatic brain injuries with tinnitus and hyperacusis. *J Basic Clin Physiol Pharmacol* 16(2–3):117–126.

Boyd GF. (1959) Auditory irritants and impalpable pain. *J Gen Psych* 60:149–154.

Cavanna AE. (2014) What is misophonia and how can we treat it? *Expert Rev Neurother* 14(4):357–359.

Collins N. (2010) Fear of the yawning mother: a case of misophonia. *Australas Psychiatry* 18(1):71–72.

Edelstein M, Brang D, Rouw R, Ramachandran VS. (2013) Misophonia: physiological investigation and case descriptions. *Front Hum Neurosci* 7:296.

Ely DJ. (1975) Aversiveness without pain: potentiation of imaginal and auditory effects of blackboard screeches. *Bull Psych Soc* 6:295–296.

Ferreira GM, Harrison BJ, Fontenelle LF. (2013) Hatred of sounds: misophonic disorder or just an underreported psychiatric symptom? *Ann Clin Psychiatry* 25(4):271–274.

Hall JW III. (1992) *Handbook of Auditory Evoked Responses*. Needham Heights, MA: Allyn and Bacon.

Hall JW III. (2007) *New Handbook of Auditory-Evoked Responses*. Boston: Pearson.

Halpren DL, Blake R, Hillenbrand J. (1986) Psychoacoustics of a chilling sound. *Percept Psychophys* 39(2):77–80.

Hickox AE, Liberman MC. (2014) Is noise induced cochlear neuropathy key to the generation of hyperacusis or tinnitus? *J Neurophysiol* 111(3):552–564.

Jastreboff MM, Jastreboff PJ. (2001) Hyperacusis. *Audiology Online*. www.audiologyonline.com/articles/hyperacusis-1223.

Jastreboff PJ, Jastreboff MM. (2006) Tinnitus retraining therapy: a different view on tinnitus. *ORL J Otorhinolaryngol Relat Spec* 68(1):23–29.

Kluckow H, Telfer J, Abraham S. (2014) Should we screen for misophonia in patients with eating disorders? A report of three cases. *Int J Eat Disord*. Published electronically January 15. doi:10.1002/eat.22245.

Marriage J, Barnes NM. (1995) Is central hyperacusis a symptom of 5-hydroxytryptamine (5-HT) dysfunction? *J Laryngol Otol* 109(10):915–921.

Mirz F, Gjedde A, Sodkilde-Jrgensen H, Pedersen CB. (2000). Functional brain imaging of tinnitus-like perception induced by aversive auditory stimuli. *Neuroreport* 11(3):633–637.

Neal M, Cavanna AE. (2013) Selective sound sensitivity syndrome (misophonia) in a patient with Tourette syndrome. *J Neuropsychiatry Clin Neurosci* 25(1).

Reuter C, Oehler M. (2011) Psychoacoustics of chalkboard squeaking. Paper presented at the 162nd Meeting of the Acoustical Society of America, San Diego.

Schröder A, van Diepen R, Mazaheri A, Petropoulos-Petalas D, Soto de Amesti V, Vulink N, Denys D. (2014) Diminished n1 auditory evoked potentials to oddball stimuli in misophonia patients. *Front Behav Neurosci*. Published electronically April 9. doi:10.3389/fnbeh.2014.00123.

Schröder A, Vulink N, Denys D. (2013) Misophonia: diagnostic criteria for a new psychiatric disorder. *PLoS One*. Published electronically January 23. doi:10.1371/journal.pone.0054706.

Schwartz P, Leyendecker J, Conlon M. (2011) Hyperacusis and misophonia: the lesser-known siblings of tinnitus. *Minn Med* 94(11):42–43.

Webber TA, Johnson PL, Storch EA. (2013) Pediatric misophonia with comorbid obsessive-compulsive spectrum disorders. *Gen Hosp Psychiatry*. Published online November 4, 2013.

Wu MS, Lewin AB, Murphy TK, Storch EA. (2014) Misophonia: incidence, phenomenology, and clinical correlates in an undergraduate student sample. *J Clin Psychol*. Published online April 17. doi:10.1002/jclp.22098.

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