

# Untangling the emotional and physiological aspects of hyperacusis

BY SARAH THEODOROFF

In hyperacusis, the physiological and the emotional aspects can become deeply entwined. **Dr Sarah Theodoroff** draws us into her perspectives on this important aspect of the condition.

## Background

### *Sounds and Emotions*

The basic act of hearing sounds triggers an emotional response – it’s a fundamental aspect of how we sense and interpret the world around us. We are constantly making judgments about what we hear, taking into account both perceptual aspects of these sounds (e.g. pitch, loudness) and our emotional responses (e.g. annoyance, joy) to decide how to respond. Neurologically speaking, we have strong established connections linking our perceptual experience of sound to neural centres that are responsible for evoking emotional reactions and some sounds elicit stronger reactions than others (e.g. music, laughter, crying, screaming, etc).

The sounds we encounter throughout the day make up our acoustic environment and impact us in numerous ways. When there is ‘too much noise’ to hear clearly, communication becomes difficult or impossible and often results in frustration and confusion. To resolve this issue, we adapt – we move away from the source of the noise, or modify our communication style. This reaction is not exclusive to humans and is found in the animal world as well. Because of how ‘noisy’ the world has become, birds have needed to modify their behaviour and adapt to the

human-produced sounds found in their environmental soundscape to survive. When animals are not able to cope with the sounds around them, it has dire consequences. This begs the question, what happens when humans are not able to tolerate aspects of the sounds that make-up their acoustic environment? Take for example hyperacusis, a condition in which the loudness of everyday sounds is perceived to be uncomfortably loud.

### *Hyperacusis*

People with hyperacusis perceive the sounds we encounter throughout our daily lives (e.g. going to the grocery store, a noisy restaurant) as being uncomfortably loud even though these sounds are at low-to-moderate intensity levels. In the general population, prevalence estimates range from 6-22%, suggesting that millions of individuals experience this phenomenon. Many hyperacusis patients change their everyday habits to avoid sounds and often withdraw from social activities [1]. Long-term avoidance and deprivation of sound has been shown to enhance the physiological response of the ear to sounds, increasing one’s sensitivity rather than decreasing it [2].

There are variations of hyperacusis documented in different disciplines, each with their own terminology (e.g. noise sensitivity vs. hyperacusis). There are multiple definitions that have been proposed to describe hyperacusis, none of which are based on physiological markers of the underlying pathology, but instead rely on subjective descriptions of the patient’s experience obtained through case history and clinical interview. Hence, even in the definition of hyperacusis, there is difficulty in untangling the emotional aspects (i.e. reactions) from the physiological dysfunction (i.e. perceptual aspect) that results in this condition. If the underlying mechanism giving rise to hyperacusis was

known, then a definition could be created according to the pathophysiological changes associated with the condition – untangling a bit of the physiological aspect from the emotional aspect. Until such time as scientists are able to answer that question, we must focus on the patient’s subjective experience to address this issue.

### **Clinical considerations: behavioural measures of loudness**

There is no widespread clinical agreement on how best to measure loudness perception and unfortunately, methods that do exist (e.g. loudness discomfort levels) can often exacerbate hyperacusis symptoms, lack agreement with real-world experience of loudness discomfort, and are complicated by psychological considerations (e.g. anxiety). Therefore, there is a critical need to improve the medical evaluation of hyperacusis patients using procedures to evaluate loudness perception that complement the clinical interview and do not expose these patients to high-intensity sounds. Current research efforts are underway to solve this challenge and encouraging new metrics are on the horizon [3].

### *Questionnaires vs. physiological tests.*

One way to separate the emotional from the physiological features of hyperacusis would be to employ a battery of tests to address each of these aspects. Whereas that sounds like a reasonable approach, unfortunately, few validated questionnaires exist measuring the impact of hyperacusis on quality of life, and all have limitations [4]. Another factor to consider when trying to ascertain the emotional aspect of hyperacusis is that various facets of sounds are considered ‘intolerable’ to different people (e.g. overall loudness, annoyance, pain, fear, pitch, timbre, etc.).

In terms of a physiological test, unfortunately, no objective test yet exists

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to diagnose hyperacusis. When considering the possible ways to perform a physiological assessment of hyperacusis patients, an immediate concern that comes to mind is that sounds at high intensity levels (e.g. 100-110dB SPL) used in many objective tests of auditory function, would not be possible to employ because of the risk of exacerbating hyperacusis symptoms. Therefore, it is imperative that testing procedures developed for diagnosing and evaluating hyperacusis don't include exposing this patient population to high-intensity sounds. Even sound levels that would be considered low-to-moderate (i.e. everyday sound levels) can worsen hyperacusis symptoms, such as pain and discomfort, for an indefinite amount of time [5]. Therefore, it is critical for healthcare providers to consider this dilemma and use caution when employing testing procedures that expose hyperacusis patients to sounds that could aggravate their condition.

### Conclusions

There are many unanswered questions pertaining to the clinical manifestation of hyperacusis, associated risk factors, impact on functioning, and relationship to comorbid conditions (e.g. tinnitus). Because it is possible to have a condition and not be bothered by it, it is important

to untangle the emotional reactions from the physiological 'dysfunction'. By parsing out these components of hyperacusis, it would allow for a more precise estimate of the prevalence of the condition to be obtained separately from the severity of the condition. To untangle the emotional and physiological aspects of hyperacusis, future research studies are needed to address this gap in our knowledge and improve our understanding of the perceptual, neurophysiological, and emotional consequences of hyperacusis.

### References

1. Blaesing L, Kroener-Herwig B. Self-reported and Behavioral Sound Avoidance in Tinnitus and Hyperacusis Subjects and Association with Anxiety Ratings. *Int J Audiol* 2012;**51**(8):611-7.
2. Munro KJ, Blount J. Adaptive Plasticity in Brainstem of Auditory Listeners Following Earplug-induced Deprivation. *J Acoust Soc Am* 2009;**126**(2):568-71.
3. Theodoroff SM, Konrad-Martin D, Gallun F, et al. A new approach to diagnosing hyperacusis. Poster presentation at the Association for Research in Otolaryngology 41st MidWinter Meeting, San Diego, CA 9-14 February, 2018.
4. Baguley DM, Hoare DJ. Hyperacusis: Major Research Questions. *HNO* 2018;**66**(5):358-63.
5. Tidball GA, Fagelson M. Audiological Assessment of Decreased Sound Tolerance. In: Fagelson M, Baguley DM, (Eds.). *Hyperacusis and Disorders of Sound Intolerance*, San Diego, USA; Plural Publishing; 2018:15-32.



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Dr Theodoroff is a clinician scientist whose avenue of research is focused on improving the diagnostic, assessment, and treatment of auditory complaints that are not adequately evaluated by the standard test battery. Her work aims to improve patient-centred clinical protocols and increase awareness of the needs of patients with tinnitus, hyperacusis, and other decreased sound tolerance disorders among medical professionals and the general public.

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