



Contents lists available at ScienceDirect

Schizophrenia Research

journal homepage: www.elsevier.com/locate/schres

Letter to the Editor

Separating hearing sensitivity from auditory perceptual abnormalities in clinical high risk (CHR) youth



Attenuated auditory distortions, illusions or hallucinations are often observed in those meeting criteria for a prodromal syndrome (clinical high-risk CHR individuals). For example, CHR individuals might report hearing distinct and indistinct sounds or words in the absence of an external stimulus, such as hearing one's name being called, only to then discover that no one is around. Given the costs associated with false-positive CHR diagnoses (e.g., stigma, unnecessary and expensive treatment), it is important to accurately understand and categorize these types of experiences. Indeed, over the course of the past several years, our team has discovered that when evaluating prodromal syndromes, assessors may mistake normative experiences or other unrelated medical issues for clinically relevant phenomena (Mittal et al., 2008; Dean and Mittal, 2013). These types of mistakes are likely to become even more common as prodromal syndromes are being assessed in an increasingly diverse number of settings (Kline and Schiffman, 2014), often by individuals without formal medical training. Thus, it is critically important to be aware of normative and medical factors that may contribute to common psychosis-risk symptoms such as auditory perceptual abnormalities. In the interest of improving valid assessment in this population, we wanted to share a discovery from an interesting case.

Recently a young man presented to our clinic with an apparent perceptual disturbance, having endorsed a special talent of being able to hear his television even when it was not turned on, while others (his family) could not hear it. In the process of doing background work for the case conceptualization, we came upon information that suggests this experience may in fact not represent an emerging psychosis symptom. Specifically, we learned that older televisions are equipped with high-frequency sound emitting parts that may in fact be audible to some individuals (Dixon, 2001; Ong et al., 1988). Transformers, which are widely used to generate high voltage signals in monitors and televisions, emit high frequencies, with some variants (named “flyback transformers”) reaching the 15 kHz range. This is noteworthy as the threshold of human hearing is from 0.02 to 20 kHz (Dixon, 2001; Rodriguez Valiente et al., 2014). Thus, some individuals are indeed able to hear the high-pitched sound (Ong et al., 1988), and this may have been the case for this individual.

Sound sensitivity overlaps in an interesting way with the prototypic CHR period, which occurs in the adolescent and young-adult stages. Normatively, this is a period where hearing sensitivity is greater on average compared to that of older individuals (Rodriguez Valiente et al., 2014); this population would therefore on average be more sensitive to hearing high-frequency (high-pitch) sounds. This is an increasingly recognized phenomenon, so much so that companies are beginning to capitalize on it. For example, in recent years ultrasound deterrents have gained popularity in emitting high-frequency sounds in order to deter younger individuals (for which the sound is audible) from frequenting certain locations (Scientific American, 2013). Further, high frequency cell

phone ringtones have also been developed with the purpose of being inaudible to older adults so that they may, for example, go undetected in classrooms where phone use is not allowed (Scientific American, 2013). So how then do we differentiate individuals with high sensitivity from those experiencing emerging auditory perceptual aberrations related to psychosis?

Fortunately, there are several simple methods for distinguishing hearing sensitivity from genuine auditory disturbances related to emerging positive symptoms. Given that it is older models of monitors and televisions that have flyback transformers audible for certain individuals (Dixon, 2001; Ong et al., 1988), inquiring about whether the sound hearing applies to all monitors, including newer models built within the past decade, could be greatly informative. In addition, questioning regarding the apparent source and generalizability of sounds heard is necessary in a variety of other contexts. Relatedly, it is important to be knowledgeable about other sources of high-frequency sounds (e.g., ultrasound deterrents and ringtones noted earlier). Given that auditory hallucinations in CHR individuals often occur frequently and in a variety of settings (Marshall et al., 2014), it is especially important to inquire regarding the frequency and ubiquity of the auditory perceptual abnormality (i.e. is it specific to one place, or generalizable to many locations/settings?). When ruling out hearing sensitivity, it will be critical to also consider presence of distress and impairment around the possible symptom, as well as exposure to other risk factors (i.e. family history, drug use). Finally, in ambiguous cases, freely available online hearing sensitivity tests could serve as preliminary assessment of hearing sensitivity (for example, <http://newt.phys.unsw.edu.au/jw/hearing.html>), and there are also freely available smartphone app options for this purpose (Amlani, 2014). In less straightforward cases, it could also be beneficial to refer the case to an audiologist for a formal screening.

Contributors

Dr. Vijay Mittal, K. Juston Osborne, and Teresa Vargas conducted the literature review and drafted the manuscript. Emily Cibelli helped edit the manuscript and was consulted with regards to the literature and conceptualization of the letter.

Conflicts of interest

V.A.M. is a consultant to Takeda Pharmaceuticals. No other authors have any disclosures.

Acknowledgments

This work was supported by a Northwestern University Society Biology and Health Cluster fellowship (T.V.), and by grants R01MH112545, R21/R33MH103231 and R21MH110374 (V.A.M.).

References

- Amlani, A.M., 2014. Apps for the ears: tablet and smartphone users can choose from a growing number of apps that test hearing sensitivity and amplify sound. *ASHA Leader* 19 (7), 34.
- Dean, D.J., Mittal, V.A., 2013. Tinnitus: a potential confound when assessing perceptual abnormalities in ultra-high risk youth. *Schizophr. Res.* 147 (2–3), 410–411.
- Dixon, L.H., 2001. *Magnetics Design Handbook*, Section 5, Inductor and Flyback Transformer Design. Texas Instruments.

- Kline, E., Schiffman, J., 2014. Psychosis risk screening: a systematic review. *Schizophr. Res.* 158 (1–3), 11–18.
- Marshall, C., et al., 2014. The content of attenuated psychotic symptoms in those at clinical high risk for psychosis. *Psychiatry Res.* 219 (3), 506–512.
- Mittal, V.A., et al., 2008. Floaters: a potential confound in the assessment of perceptual abnormalities. *Schizophr. Res.* 104 (1–3), 305–306.
- Ong, C.N., et al., 1988. Review and reappraisal of health hazards of display terminals. *Displays* 9 (1), 2–13.
- Rodriguez Valiente, A., et al., 2014. Extended high-frequency (9–20 kHz) audiometry reference thresholds in 645 healthy subjects. *Int. J. Audiol.* 53 (8), 531–545.
- Scientific American, B.S.H., 2013. Sonic Science: The High-Frequency Hearing Test, Bring Science Home. Education.com Scientific American.

Teresa Vargas*

K. Juston Osborne

Northwestern University Department of Psychology, USA

*Corresponding author at: Northwestern University, Swift Hall 102,
2029 Sheridan Road, Evanston, IL 60201, USA.

E-mail address: teresavargas@u.northwestern.edu.

Emily S. Cibelli

Northwestern University Department of Linguistics, USA

Vijay A. Mittal

*Northwestern University Department of Psychology, Department of
Psychiatry, Department of Medical Social Sciences, Institute for Policy
Research and Institute for Innovations in Developmental Sciences, USA*

13 August 2018