Implicit timbral assessments of recorded and live music with hearing aids

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Aims
- Investigate impact of hearing loss and hearing aid technologies on the experience of listening to music.
- Social-psychological approach, examining almost 1000 responses to an in-depth online survey on music listening. We report a subset of the survey data relating implicitly to timbral aspects of music.
- The survey queries experiences of imbalance between high and low frequencies while listening to recorded and live music with hearing aids.

Background
- 1 in 6 of UK population has a hearing loss.
- Predicted to rise to 1 in 5 by 2031 (Hill et al., 2015).
- "enormous personal, social and economic impact"
- Primacy of speech
  - Ease of defining speech-based listening tasks.
  - Few tasks assessing prosodic cues, music listening, environmental sounds.
  - Benefits of technology restricted to speech-based listening tasks.
  - Surprisingly little research addressing music listening – and hence, timbre perception – with hearing aids.

Method
- Online survey investigating
  - hearing level and use of hearing aid technology,
  - music listening in live and recorded settings,
  - music-related discussions with audiologists.
- Survey questions designed with pilot data from c. 200 hearing aid users
- 179 responses to a waiting-room survey and
- 22 in-depth interviews (Greasley et al., 2015).
- The full survey
  - c. 70 questions
- c. 45 minutes to complete
- advertised via UK and international networks.
- Includes questions on
  - experiencing difficulties with "too much treble" and "too much bass" whilst listening to recorded and live music with hearing aids.

Discussion
- Implicit timbral assessment in real-life listening data – crude, but revealing.
- Same pattern of results across recorded and live music settings.
  - Perception of "too much treble" was widespread across all hearing losses. Perception of 'too much bass' increased with degree of hearing loss.
  - Both individual and contextual factors may contribute to these reports.
    - e.g. Levels of engagement, training, preferences and personality factors influence how people perceive music and tolerate discomfort.
    - People's understanding of terms 'bass' and 'treble' differ with degree of auditory perception, deaf education, computer science and hearing therapy.
- Differences exist among participants in the same audiological category.
  - In their adaption, fitting and use of hearing aid technologies.
  - In their hearing loss itself: many and varied physiological dysfunctions.
  - n.b. Low agreement between self-reported hearing loss level and actual audiological categorization (c. 42% agreement (N=83 submitted audiograms) using 5-band pure tone average hearing threshold, ASA 2011).
- It will be important in the future to
  - Tease out the relative contribution of individual and contextual factors.
  - Investigate link between level of hearing loss and audibility of features (e.g. helpfulness of hearing aids for hearing out individual instruments, following the melody, bassline, ...).
  - Investigate relevancy of vibrotactile sensations.
  - Develop and employ musical listening tasks to assess experiences of specific features of the music.
  - Continue to develop methods for assessing real-life listening situations.

Results
- Online survey results: snapshot of N=981 responses.
  - 451 male (46%); Age range 18–95, average 57.93 years (SD = 17.25).
- Categorisation of participants’ hearing loss:
  - Around 95% responded to a question asking them to remember and report the category of the hearing loss that their audiologist had diagnosed them with (N=928, mild 5.2%, moderate 40.2%, severe 34.4%, profound 13.3%, don’t know: 7.0%).
  - After removing "don't knows", remaining respondents were grouped according to their self-reported level of hearing loss (N=863, mild 5.6%, moderate 43.2%, severe 37.0%, profound 14.3%).

For recorded music
- Approx. two-thirds of people reported difficulties – at least occasionally – of experiencing "too much treble" (N=594, overall 71.9%).
- No significant association with hearing level (N=594, X² (3) = 0.71, p = .871).
- Problems experiencing "too much bass" were significantly associated with level of hearing loss (N=599, X² (3) = 18.83, p < .001).
- The worse the hearing loss, the greater the proportion of participants in the group reported having difficulties with excessive bass (N=599, mild 44.1%, moderate 54.1%, severe 64.8%, profound 76.9%).
- Odds of experiencing excessive bass in recorded music is about 4 times greater (4.22) for people with profound compared to mild losses.

Similar pattern for live music listening
- Experience of "too much treble" were again prevalent (N=529, 72.8%).
- Again, no significant association with loss (N=522, X² (3) = 1.59, p = .661).
- Significant association between hearing loss category and the experience of "too much bass" (N=529, X² (3) = 12.44, p = .006).
- Again, larger proportions reported problems in worse hearing categories (N=529, mild 45.4%, moderate 62.9%, severe 72.4%, profound 80.6%).
- Odds of experiencing excessive bass in live music is more than 3 times greater (3.45) for people with profound compared to mild losses.