

Pupillary Correlates of Auditory Emotion Recognition in Older Hearing-Impaired Listeners

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ABSTRACT

Hearing-impaired (HI) individuals are shown to perform worse in auditory emotion recognition tasks compared to normal hearing individuals. It is still unclear if this is due to processing at low auditory levels or to categorisation of emotions that are involved in an experimental task (1). An index of emotion recognition can be observed in pupil dilations, which have recently been shown to dilate more for emotionally meaningful speech in comparison to emotionally neutral speech (2). We fitted 8 older HI participants, who had moderate to severe sloping high-frequency hearing loss, with frequency lowering enabled hearing aids for an acclimatisation period of 3-6 weeks. We recorded their pupil dilations in response to emotional speech with and without frequency lowering, during a passive-listening condition, both before and after the acclimatisation period. We also recorded their pupil dilations during an active-listening condition, which included a behavioural emotion identification task, after the acclimatisation period. We present here insights into the pupillary correlates of vocal emotion recognition in the HI population and the impact of frequency lowering and the cognitive involvement elicited by the experimental situation on pupil dilation and emotion recognition capabilities in this population.

Keywords: Emotion, Pupillometry, Emotion recognition, Hearing-impaired, Frequency Lowering

1. RESULTS

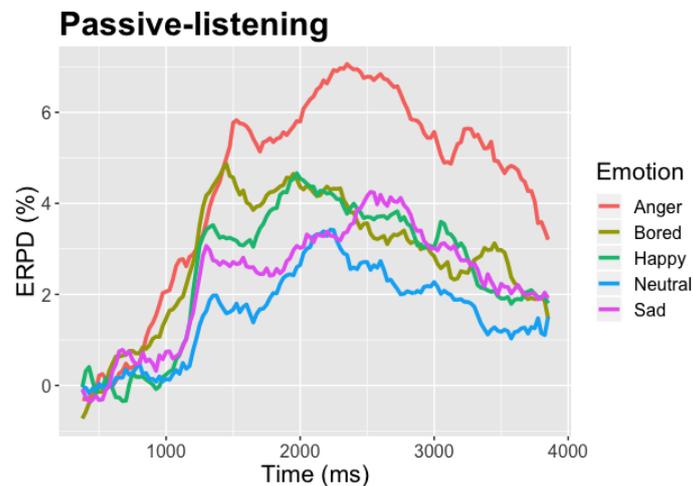


Figure 1 – Aggregated Event-Related-Pupil-Dilation (ERPD) plot for the passive-listening condition. The onset of the stimulus occurs at 0 ms.

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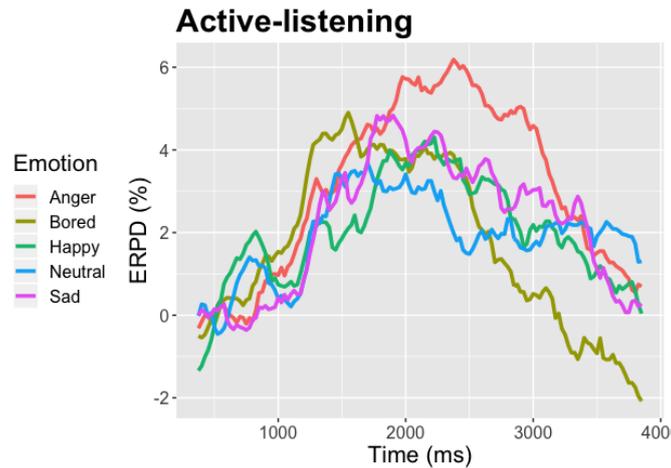


Figure 1 – Aggregated Event-Related-Pupil-Dilation (ERP-D) plot for the active-listening condition. The onset of the stimulus occurs at 0 ms.

DISCUSSION

The communication of emotion is an essential part of our daily interaction, and recognising emotions can elicit a reaction in the observer, such as the well-known fight or flight response. Pupil dilations have been demonstrated to dilate more for emotional in comparison to neutral stimuli across several stimulus types, including pictures, environmental sounds, music, and, more recently, speech (2,3,4,5). The pupillary response has also been shown to illustrate mental effort, attention, and other cognitive processes (6,7,8). Therefore, in order to investigate the nature of the pupillary response in response to emotional speech stimuli, we tested both a passive and active listening condition. The results for the passive-listening condition reflect the appearance of specific pupillary profiles for different emotional stimuli, whereas this appears much less defined in the active-listening condition. This could suggest that both emotional and cognitive processing affect pupil dilation and this can be shown in an older HI population.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Julia Rehmman and Peter Derleth of Sonova AG, Laubisruetistrasse 28, 8712 Staefa, Switzerland.

REFERENCES

- (1) Understanding of Hearing Loss and Emotion Perception and Priorities for Future Research,” *Trends Hear.*, vol. 22, pp. 1–24, 2018.
- (2) R. Jürgens, J. Fischer, and A. Schacht, “Hot speech and exploding bombs: Autonomic arousal during emotion classification of prosodic utterances and affective sounds,” *Open Sci. Framew.*, vol. 9, no. February, pp. 1–13, 2018.
- (3) T. Partala and V. Surakka, “Pupil size variation as an indication of affective processing,” vol. 59, pp. 185–198, 2003.
- (4) M. Codispoti, M. Mazzetti, and M. M. Bradley, “Unmasking emotion: Exposure duration and emotional engagement,” *Psychophysiology*, vol. 46, no. 4, pp. 731–738, 2009.
- (5) B. Gingras, M. M. Marin, E. Puig-Waldmüller, and W. T. Fitch, “The Eye is Listening: Music-Induced Arousal and Individual Differences Predict Pupillary Responses,” *Front. Hum. Neurosci.*, vol. 9, no. November, pp. 1–12, 2015.
- (6) B. Hoeks and W. J. M. Levelt, “Pupillary dilation as a measure of attention: a quantitative system analysis,” *Behav. Res. Methods, Instruments, Comput.*, vol. 25, no. 1, pp. 16–26, 1993.
- (7) Hess Eckhard H and Polt James M, “Pupil size in relation to mental activity during simple problem solving,” *Science (80-)*, vol. 140, pp. 1190–1192, 1964.
- (8) E. Granholm and S. R. Steinhauser, “Pupillometric measures of cognitive and emotional processes,” *Int. J. Psychophysiol.*, vol. 52, no. 1, pp. 1–6, 2004.