

Aspects of Music with Cochlear Implants

-Music Listening Habits and Appreciation in Danish Cochlear Implant Users

Bjørn Petersen^{1,2}, Mads Hansen^{1,3}, Stine Derdau Sørensen⁴, Therese Ovesen⁵, Peter Vuust^{1,2}

¹Center of Functionally Integrative Neuroscience, Aarhus University Hospital, Aarhus, Denmark, ²Royal Academy of Music, Aarhus, Denmark, ³Department of Psychology and Behavioural Sciences, Aarhus University, Aarhus, Denmark, ⁴Department of Aesthetics and Communication, Aarhus University, Aarhus, Denmark, ⁵ENT department, Aarhus University Hospital, Aarhus, Denmark

WHY? - Background & Aims

The Cochlear Implant (CI) restores hearing sensation in deaf individuals and over 250,000 persons use the device worldwide. While the majority of adult CI users achieve good speech perception in quiet, music perception in general is poor [1-2;6]. Because music is an important part of everyday life with great emotional and social aspects, it is reasonable to evaluate the extent of music listening in CI users and identify possible factors that impact music appreciation. With this study, we aimed to gather information about music listening habits and music enjoyment from a large, representative sample of Danish CI users. Furthermore, we aimed to compare this information with self-reported measures of quality of life.

WHO? - Participants

Adult CI recipients (≥ 18 y), implanted at Aarhus University Hospital between January 1st 2000 and December 31st 2010, were invited to take part in the study. Of the 250 patients, 163 responded (101 female; $M_{age} = 56.4$ years; $SD = 15.7$ years; age range: 18 to 86 years; 65% response rate). 117 (72 %) respondents filled out the questionnaire online, while 46 (28%) requested the printed version. Implant experience ranged from 0.4 years to 11.2 years ($M = 4.3$, $SD = 2.65$). 137 (84%) participants used an implant from Cochlear® and 26 (16%) participants used an implant from Advanced Bionics®. The demographic data of the respondents are listed in Table 1.

Respondents (M/F)	Mean age	Duration of profound deafness	Mean CI experience	Unilateral users (R/L)	Bilateral users	Users of hearing aid on non-implanted ear	Able to speak on the phone	Response method (online/paper)
163 (62/101)	56.44 (± 15.7 ; 18-86)	34.5 (± 18.2 ; 1.1-75.3)	4.3 (± 2.6 ; 0.4-11.2)	147 (90 %) (108/39)	16 (10 %)	73 (48 %)	106 (65 %)	117/46 (72/28 %)

Table 1: Demographic data for the 163 respondents in the study

HOW? - Measurements

Three questionnaires were used in the study: 1) a modified, Danish version of the IOWA Musical Background Questionnaire [4]. The questionnaire included multiple-choice, Likert rating scales, visual analog scales, and open-ended questions concerning musical background, listening habits, the quality of musical sound heard through the implant and music enjoyment prior to hearing loss and after cochlear implantation. 2) the Short Form 36 [8] and 3) the Glasgow Benefit Inventory [7] which both required the respondents to answer questions concerning their quality of life (QOL) post-implantation. Here, the QOL data are used for correlational analyses.

WHAT? - Findings

Musical background. 23.9 % of the participants had received singing and/or instrument lessons (in primary school: $M = 3.6$ y; in high school: $M = 1.5$ y). 12.9 % had been a member of a band, choir, or an orchestra. Table 2 sums up the respondents' self-assessed knowledge and experience with music: 77% were involved in music to a lesser or larger extent. This is in agreement with Gfeller [3], and considered representative of the general population.

Category	Percentage
No formal training and only limited knowledge about music	23 %
No formal training or knowledge about music, but informal listening experience	57 %
Self-taught musician	4 %
Some musical training and have basic knowledge of musical terms	12 %
Several years of musical training, knowledge about music, and involvement in music groups	4 %

Table 2: Self-assessment of musical experience

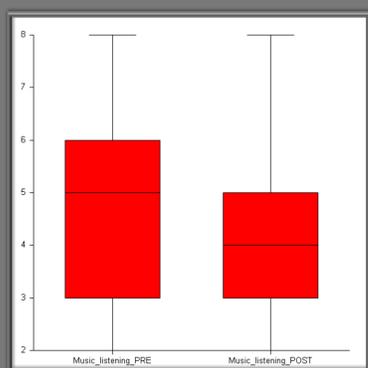


Figure 1: Box plot of composite music listening scores prior to deafness (L) and postimplantation (R)

Quality ratings of musical sound.

Figure 2 shows the mean values for the seven adjective descriptors of music heard through the implant. The average quality rating across all descriptors was 56.1, indicating a positive trend.

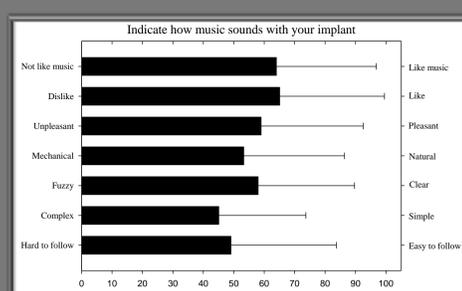


Figure 2: Mean values for adjective descriptors of music heard through the implant

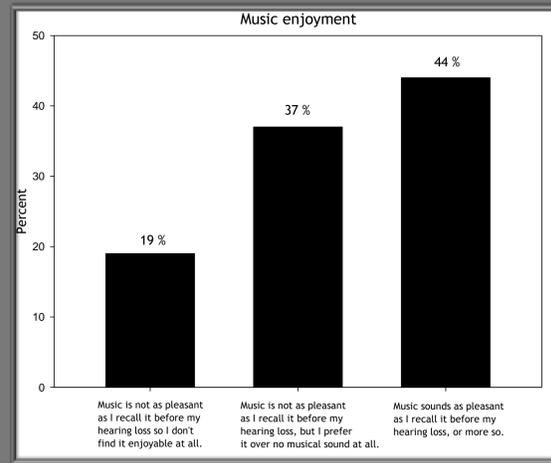


Figure 3: Music enjoyment after implantation

Music enjoyment with a CI.

Figure 3 shows three categories of how the respondents' music enjoyment has changed after receiving their implant: a) 19 % indicated little or no satisfaction in music listening, b) 37% reported that the sound of music is improving over time or preferred it to no musical sound at all and c) 44 % found that music sounds as pleasant as before hearing loss, or more so.

Factors associated with music listening and enjoyment. The ability to talk on the phone showed a positive correlation with both music listening habits, quality ratings and enjoyment (figures 4-6). Furthermore, age showed a negative correlation with all three music listening measurements, indicating that younger CI users enjoy music more than older CI users. No other demographic factors showed any significant correlation with any measures of music listening.

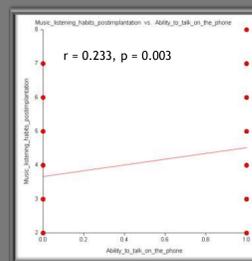


Figure 4: Music listening habits vs ability to talk on the phone

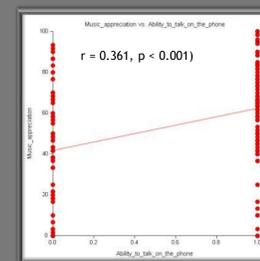


Figure 5: Music quality rating vs ability to talk on the phone

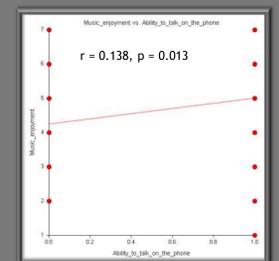


Figure 6: Music enjoyment vs ability to talk on the phone

Music enjoyment and quality of life. The composite scores of the GBI questionnaire showed a significant positive correlation with music listening habits, quality rating (figure 7) and enjoyment. Furthermore, the social functioning subscale of the SF 36 questionnaire data showed correlations of similar strength with the three music listening measurements.

WHAT MAY THE STUDY TELL US?

In line with Gfeller [3], this study indicates that in general adult CI users enjoy music less post-implantation than prior to hearing loss. In addition, the findings show a wide range of success with music. Quite encouraging, a large majority of CI listeners seem to listen to and enjoy music, despite the technical disadvantages of the CI's music presentation. Furthermore, the respondents describe the quality of music slightly more positively than those in the Gfeller study. This difference may suggest a benefit from the technical improvements achieved in the last decade.

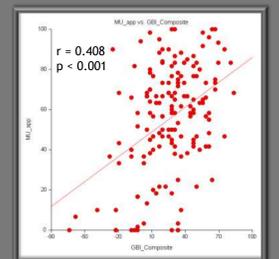


Figure 7: Music appreciation vs GBI over-all health-related QOL scores

Previous studies found that use of contralateral hearing aid and duration of deafness were predictive for music appreciation with a CI [5]. Our findings, however, indicate that particularly the ability to talk on the phone is associated with music listening success. Since phone conversation skills reflect high CI outcome, this implies that music enjoyment is linked to the CI performance level.

In accordance with Lassaletta [4], our findings suggest an association between quality of life and success in music listening. Though the causes for this association may be manifold, this proposes that music exposure or training could be beneficial not only for CI users' perception of music but also for their quality of life.

WHAT DID THE RESPONDENTS SAY?

"After my operation, I enjoy listening to music. There are more notes, the songs sound better."

"I appreciate music more after my CI operation, since I no longer get a headache from going to concerts, etc."

"Music is NOISE to me - I cannot hear music. The exception is Swedish jazz on the stereo in the summer cottage."

"I listen to more music, but it sounds different."

"I didn't think I was going to listen to classical music again. But I have succeeded."

"I hardly ever listen to music anymore. It's exhausting and it all sounds the same."

"I enjoy listening to my wife playing the piano."

"I am convinced that music has contributed to my good CI result."

ACKNOWLEDGEMENTS

This study was supported by the Augustinus Foundation, Ejner Danielsens Foundation and Danaflex A/S.

REFERENCES

- [1] Cooper, W. B., Tobey, E., & Loizou, P. C. (2008). Music perception by cochlear implant and normal hearing listeners as measured by the Montreal Battery for Evaluation of Amusia. *Ear and Hearing*, 29
- [2] Gfeller, K., Turner, C., Oleson, J., Zhang, X., Gantz, B., Froman, R., & Olzowski, C. (2007). Accuracy of Cochlear Implant Recipients on Pitch Perception, Melody Recognition, and Speech Reception in Noise. *Ear and Hearing*, 28
- [3] Gfeller, K., Christ, A., Knutson, J. F., Witt, S., Murray, K. T., & Tyler, R. S. (2000). Musical backgrounds, listening habits, and aesthetic enjoyment of adult cochlear implant recipients. *Journal of the American Academy of Audiology*, 11
- [4] Lassaletta, L., Castro, A., Bastarrica, M., Pérez-Mora, R., Madero, R., De Sarriá, J., & Gavián, J. (2007). Does music perception have an impact on quality of life following cochlear implantation? *Acta Oto-laryngologica*, 127
- [5] Looi, V., McDermott, H., McKay, C., & Hickson, L. (2008). Music Perception of Cochlear Implant Users Compared with that of Hearing Aid Users. *Ear and Hearing*, 29
- [6] Petersen, B., Mortensen, M.V., Hansen, M., Vuust, P. (2012). Singing in the key of life: A study on effects of musical ear training after cochlear implantation. *Psychomusicology*, 22
- [7] Robinson, K., Gatehouse, S., & Browning, G. G. (1996). Measuring patient benefit from otorhinolaryngological surgery and therapy. *The Annals of Otolaryngology, Rhinology, and Laryngology*, 105
- [8] Ware, J. E., Jr. & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Medical Care*, 30