00802

HEARING AIDS FOR ADULTS: IMPACT OF HEARING REHABILITATION ON QUALITY OF LIFE

Hearing aid fitting to listen to music

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Abstract

Studies show that about 50% of musicians who use hearing aids are unsatisfied with their perception of music with the current setting of their devices. The calculation formulas that professionals are using to adjust hearing aids are based on deafness and on the quantitative aspect of the speech signal (LTAS). Unfortunately, the energy of musical sound sources can vary a lot, which prevents using the same method to optimize music listening. On the other hand, musicians are very good at appreciating the quality of musical sound sources. We asked 18 hearing-impaired musicians and music lovers to contribute to the development of a special setting for music listening. We subjected them to a "preference test" that allowed them to indicate their choices in terms of sound quality among a bank of sounds with various filters. These choices provided us with adjustment settings and allowed us to create them a "music" setting. To test the effectiveness of the approach, patients then compared their current setting with the new music setting by rating the quality of different items: loudness, sharpness, fullness, pleasantness and overall impression (3) while listening to a short sequence of music. We obtained an improvement in 15 of the patients interviewed, 2 had no change and 1 reported a deterioration in sound quality with the music program. This first phase of the study is encouraging, a second phase is planned to refine the protocol and maximize the performance of the “music” setting.

Subject	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18
Musicians music lovers	m	M	M	m	m	m	M	M	M	m	M	m	M	M	m	M	m	M
Hearing loss dB HL	65	42	63	50	67	45	57	47	72	58	46	58	47	28	43	67	32	50
Gain Proth	30	10	20	18	30	20	25	20	38	22	14	18	12	6	11	29	7	27
Preferred filtering pattern	1,-2,-1	0,-1,0	0, 0, 0	0,1,0	0, 0, 0	1,-1,1	1,0,1	1, 0, 0	1,-1,0	-1, 1, 1	0,0,0	2,-1,-3	1,0,1	2,0,1	1,0,2	0, 2, 2	0, 0, -1	1, 2, -1
Improvement	0	5	5	14	4	1	4	4	-4	4	0	5	6	9	18	8	6	13

Tab 1 Cohort of 18 Musicians and music lovers:
Audiological data, filtering pattern, improvement

Objectives

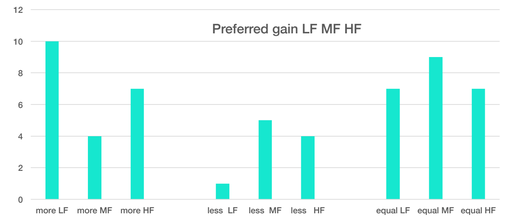
- The aim of our study is building a protocol to improve the setting of hearing aids for a better music listening experience.
- The basic setting, which is automatically implemented when the hearing aids are turned on, was obtained from so-called pre-setting methodologies (Nal2, Dslv5, Cam2). These methodologies propose gains by frequency band depending on the deafness and the physical characteristics of a speech source. Speech is the first source to be impacted by deafness and its management is a priority.
- The impact of deafness on the perception of music is not yet taken into consideration. On the one hand, this request is not expressed because musicians are often in denial. On the other hand, it is very difficult to recommend amplification when the musical sources use acoustic principles as different as a bowed string and the vibration of a clarinet hip. From attack transitions to specific harmonic formants generated by the excitation of the instrument, the variations are too great to extract a single energy spectrum from them.
- If the music setting cannot rely on a generic quantitative model, a patient who is an expert in listening, can accurately define his expectations (1).
- This is why our "Preference Test" developed on the principle of the simplex protocol (2)(4) was proposed to 18 candidates (Tab1), fitted with their hearing aids in the "basic setting" position.
- The results of this test provide us with quantitative information. Our software uses a bank of filtered sounds and manages the chronology of presentation of the sounds until obtaining the patient's preferred filtering model.
- By adding the characteristics of this preferred filtering pattern to the basic setting, we obtain a new setting that we call "music setting".
- The improvement of the new setting is validated by the patients through a rating test to evaluate the quality of the perception of music (3). They will rate the perceived quality of several elements contained in a piece of music such as : loudness, sharpness, fullness, pleasantness and overall impression (3).
- The score obtained with the music setting are compared to the score obtained with the current setting.

Methods et Tools

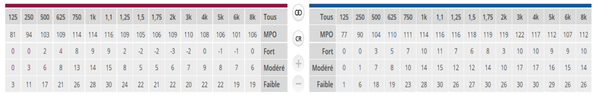
- A bank of filtered sounds or "filtering patterns" is made up of an extract from a work by Mozart that is filtered on three frequency bands: LF (< 800Hz), MF (1 to 2.5KHz), HF (3 to 10KHz) by varying the gain in each of them by +/- 24 dB, in steps of 6 dB.
- Software based on the principle of the simplex protocol allows the patient to be presented with successive sessions of three pairs of filtered sounds. For example, in the first session, the patient must choose between a neutral filtering pattern (0, 0, 0) and a pattern with 6 dB of gain in the low frequencies (1, 0, 0), and so on he next choose between (0, 0, 0) and (0, -1, 0), and finally between (0, 0, 0) and (0, 0, -1). Thanks to the answers from that first session, the software suggests a new comparison session. Thus, step by step, the software leads the patient to provide us with their preferred filtering pattern.
- Participants wear their hearing aids in the "basic setting" position. We ask them to choose their preferred filtering pattern in terms of perceived sound quality.
- Without a measuring instrument, we used the gain tables of the manufacturer's software and through this we applied an "averaged profile" of the patient's preferred pattern. Giving more gain is a risk: highest out put level, feed back effects, patient distrub…(less is more). This averaged profile is a proportion of the gains requested by the patient. For example, patient S18 (Tab 3) preferred a pattern (1, 2, -1) but as it can be seen, we opted for the averaged similar profile: (0, 1, -1). It's because the patient can control the gain to adapt his listening in each particular situation: concert, hi-fi system… so he can easily change (1, 2, -1) in (0, 1, -2).
- To obtain the improvement in quality of music listening, the patient rate the basic fitting quality and the music fitting quality . The difference between the two scores is the implementation (Tab 1 & 4).

Results

- We obtained the preferred filtering patterns for all participants (Tab 1)
- The most frequent request (Tab 2) concerns the increase of low frequencies gains (55%), then comes the preservation of mid frequencies gains for 50% of patients and finally the increase or preservation of high frequencies gains tied with 39% but also 22% of decrease requests.
- If we consider these results to analyse the characteristics of the basic setting, we can conclude that it lacks low frequencies gains for listening to music but that it is consistent with its vocation which is to obtain better speech intelligibility. Regarding to high frequencies, the gains of the basic setting often prove unsatisfactory for the quality of musical listening. And the mid frequencies emerge as having the most consensus as a dosage for intelligibility and for listening to music.



Tab 2: Most frequently asked gain for low, medium and high frequencies for the preferred filtering pattern



S18 Basic setting

S18 Music setting

Tab 3: Adding S18 preferred pattern to get Music fitting

- The use of the Quality Ranking Test (3) (Tab 4) made it possible to know the degree of improvement brought by this new setting and to confirm the superiority of its effectiveness for the exclusive listening of music
- 18 patients were tested, 15 reported an improvement in proportions ranging from 1 to 18 steps (difference basic fitting score and music fitting score), 2 did not feel any improvement (0 no improvement) and 1 reported a deterioration in the quality of their sound perception when using the new music setting that we created for them (Tab 1 & 4)
- It will be interesting to question all these responses when continuing the study. Not only the positive responses to increase them but also the less effective ones to understand the reasons (deafness, types and fitting of hearing aids, others pathologies…) and overall to push back the limits of effectiveness of a hearing aid adjustment protocol for listening to music.

Conclusion

- We have shown that the used of the preferred filtering pattern gives encouraging improvement scores.
- This shows that the preference test is a good way to help adjust hearing aids for listening to music.
- It shows too, that exploiting the expectations of expert listening patients can compensate for the lack of a generic quantitative model.
- The way to transfer the gains from the preferred filtering pattern into the basic setting must be optimized to quickly achieve the ideal musical setting for each patient.
- Using the patients' current setting after checking the binaural balance in free sound field conditions limits its accuracy.
- But one of our goal is to develop a tool that can easily give patient an improvement in their perception of music.
- And our main goal is to lay the foundations of a methodology for pre-setting hearing aids for listening to music. So there we have explored and confirmed the value of several tools and methods, that could be optimised with further research.

Tab 4 : Improvement performance with items : Loudness, sharpness, fullness, pleasantness, overall impression

Références

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