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Specific Statistical Analysis of Influence of the Hearing Memory to the Acoustic Quality Evaluation of Multimedia Classroom

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Summary

Assessing the quality of room acoustic is eventually always subjective. The only question is how strict are the criteria which should be met, what is the purpose of space and how important is the quality of listening for the listeners. Subjective tests were made for 18 room acoustic quality parameters of two multimedia classrooms with various acoustics treatment. Tests were conducted with 45 healthy examinees aged 20-25 years. Tests were carried out in two ways, with and without the influence of listening memory, and in two acoustically differently treated multimedia classrooms. Statistical analysis of the results was made, and the impact of listening memory to the obtained results was observed. In addition to subjective tests, objective measurements of both classrooms were made, and compared together. Objective measurements were done in accordance with ISO3352. Reproducing system was calibrated, and it was identical in both classrooms.

Keywords

acoustic quality, subjective rating, objective measuring, statistical analysis

1. Introduction

Subjective evaluation of the acoustic quality of a room is always the most important, as always is the human, the listener, the one who makes a final determination regarding the acoustic quality. The final assessment depends on the social structure of the listeners, their level of education, experience, knowledge of the material to be listened to, education in music and language, performing the speech events, the listeners' age, and other subjective factors (Everest & Pohlmann, 2009). One of the major factors is unquestionably the listening memory, whose influence is observed in all 18 parameters of the subjective assessment of multimedia classroom quality.

The multimedia classroom is a space with very high demands on the acoustic quality, as various events are carried out in them, involving both speech and music, unknown material is presented to the audience (pupils, students), who must be able to hear the presented material of the best possible quality. Influence of the room itself should make no, or at least the smallest possible, impact.

2. Subjective Evaluation of Room Acoustic Quality Parameters

In the process of subjective evaluating of the room acoustic quality, the following parameters were assessed:

1. noise volume
   - External noise level in the room intended for general listening is a measure of acoustic insulation of walls and all openings (doors, window openings and installation);
   - Internal noise level in general is a measure of the acoustic attenuation of internal noise sources (ventilation, forced cooling of lighting devices, device noise in the room).
2. Intimacy, presence
   - the property that the room has a good response to the sound of instruments and that musicians are well able to clearly hear the other musicians in the orchestra
3. Loudness
4. Revereberance
   - non-uniform reverberation time within a certain frequency range directly affects the colour of the tone
5. tonal reproduction, timbre
   - Acoustic characteristics of the room can cause different changes in the spectrum of the signal in each particular part of the audio

process (steady state, the initial and final transient).
6. sound definition; clarity
   - the possibility to distinguish different musical instruments or musical sounds,
   - audibility of the initial transients
7. echo disturbance
   - perceived in the case when isolated sound wave comes to the ears of listeners with a delay of more than 1 / 15 s (67 ms) compared to the arrival of direct sound
8. speech intelligibility
   - it is necessary to ensure the preservation of the natural colour of the speaker's voice or sound in generally, to identify the speaker or sound source, or to enable and provide artistic experience.
9. spectral uniformity, balance
   - the direct impact to the quality is the establishment of standing waves and resonance frequencies of the room
10. sound stage imaging
   - depends on the amount of reflected sound energy compared to direct sound energy during the early decline in sound pressure at the point of receipt,
   - important in stereophonic and multichannel reproduction
11. dynamics
   - determined by the minimum and maximum volume level and the possibility of transferring the original dynamics
12. distortion
   - the consequence of the big mistakes in the design and construction of the room intended for listening to speech and music,
   - reflected in the change of colour and sound enhancement or suppression of certain frequencies or frequency ranges
13. stability of performance
   - determines an equal volume in the whole room (auditorium),
   - directly affects the perception of spatial sound image at frequencies of wavelength in the order of the width of the spacing between the ears,
   - the establishment of standing waves in the room and the resonant frequency directly affect to the achievement of a uniform distribution of sound pressure and to the achievement of distinct areas of minimum and maximum sound pressure level on whose distance the frequency is dependent
14. brilliance
   - representation of high frequencies at the receiving point
15. bass reproduction
   - representation of low frequencies at the receiving point
16. resonance
   - the phenomenon on a certain frequency or frequencies when the room, windows, screens or other parts or structures in the room began to vibrate and thereby produce unwanted sound, i.e. noise,
   - the result of insufficient anchorage or high elasticity of individual parts or structures
17. ambience reproduction, diffusion
   - the possibility of reproducing the original room (space) where the music was recorded in some other enclosed space, or the harmony of the room acoustic parameters with the sort of sound (music or speech)
18. overall acoustic impression

All subjects evaluated parameter values as numeric values in the range from 1 to 5, where 1 is the worst and 5 is the best case (Fajt, Krhen, & Jambrošić, 2010).

The material used for evaluation has total duration of 16.5 minutes. In assessing without the impact of auditory memory (Measurements Type A), the subjects evaluated parameters while listening to the test material, and when assessing with the impact of auditory memory, the subjects first listened to the test material, made a pause in a silence for 1 minute, and subsequently after that evaluated all parameters (Measurements Type B).

For testing purposes the audio test CD (Fajt, 2000) is used with content displayed in the Table 1.

Table 1 The content of audio test CD

1	Orrf	Choir (Carmina Burana)	30 s
2	Mozart	Soprano (Cotrubas, Der Hölle Rache – The Magic Flute)	30 s
3	Orrf	Baritone (Carmina Burana, Hakan Hagegard)	30 s
4	Beethoven	Double Bass (9th Symphony, Presto)	30 s
5	Dvorak	Percussion (9th Symphony, Scherzo)	20 s
6	Mozart	Strings (Divertimento KV 251, Andantino)	42 s
7	Chopin	Piano (4th Ballad)	30 s
8	Mussorgsky	Full Orchestra (Night on the bare mountin)	30 s

9	Williams	Return of the Jedi	1 min
10	Rodrigo	Concierto d'Aranjuez, Adiago	1 min
11	Beethoven	9th Symphony, Presto	1 min
12	Rachmaninov	Prelude	1 min
13	Dvorak	9th Symphony, Scherzo	1 min
14	Strauss	Salome	1 min
15	Vivaldi	Winter, arr, for three guitars	1 min
16	Orrf	Carmina Burana	1 min
17	Mozart	Divertimento KV 251, Andantino	1 min
18	Ravel	Bolero	1 min
19	Mussorgsky	Night on the bare Mountin	1 min
20		Speech – male voice	20 s
21		Speech – male voice	20 s
22		Speech – female voice	20 s
23		Speech – female voice	20 s

Classroom Room 1 is acoustically well treated in terms of quality, while the classroom Room 2 is acoustically almost untreated, of almost identical size.

The test results are given in Figures 1 to 4, with their highest, lowest and average value, while the standard deviation (Žužul, Šimović, & Leinert-Novosel, 2008) of the results is shown in Tables 2 to 5.

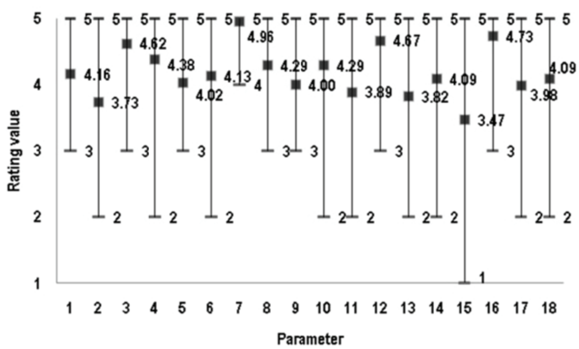

Figure 1 Feedback results for Room 1 / Measurement Type A – Minimum, Maximum and Mean Value

Table 2 StDev for Mean value for Room1 / Measurement Type A

Parametar	1	2	3	4	5	6	7	8	9
StDev	0,67	0,69	0,53	0,89	0,40	0,59	0,21	0,59	0,48
Parameter	10	11	12	13	14	15	16	17	18
StDev	0,66	0,65	0,52	0,68	0,70	0,84	0,50	0,75	0,60

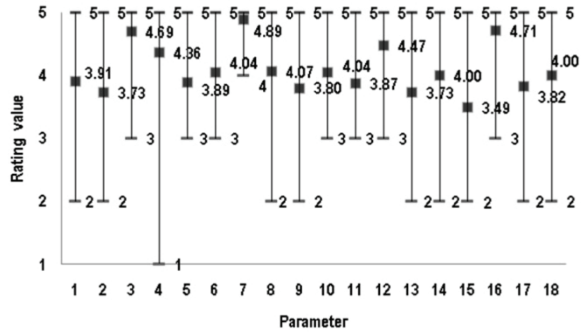

Figure 2 Feedback results for Room 1 / Measurement Type B – Minimum, Maximum and Mean Value

Table 3 StDev for Mean value for Room1 / Measurement Type B

Parametar	1	2	3	4	5	6	7	8	9
StDev	0,87	0,58	0,51	0,98	0,61	0,56	0,32	0,69	0,63
Parameter	10	11	12	13	14	15	16	17	18
StDev	0,64	0,66	0,69	0,72	0,71	0,89	0,55	0,83	0,60

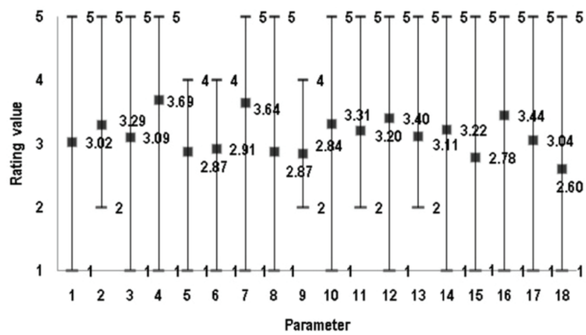

Figure 3 Feedback results for Room 2 / Measurement Type A – Minimum, Maximum and Mean Value

Table 4 StDev for Mean value for Room2 / Measurement Type A

Parametar	1	2	3	4	5	6	7	8	9
StDev	0,99	0,69	1,14	1,02	0,81	0,73	1,09	0,94	0,64
Parameter	10	11	12	13	14	15	16	17	18
StDev	1,00	0,73	1,14	0,78	0,85	0,95	1,32	0,74	0,78

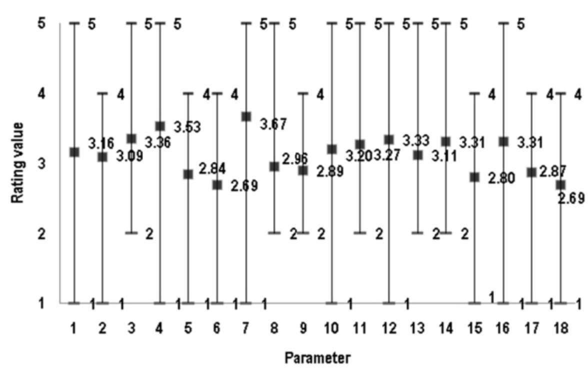

Figure 4 Feedback results for Room 2 / Measurement Type B – Minimum, Maximum and Mean Value

Table 5 StDev for Mean value for Room2 / Measurement Type B

Parametar	1	2	3	4	5	6	7	8	9
StDev	1,02	0,85	1,09	1,06	0,77	0,87	1,15	0,82	0,68
Parameter	10	11	12	13	14	15	16	17	18
StDev	0,99	0,69	1,24	0,75	0,95	0,81	1,22	0,79	0,73

It is interesting to note that at least one respondent gave the best score for acoustically treated classroom Room 1 for each parameter of the subjective assessment, while that is not the case for acoustically untreated classroom Room 2.

By comparing the standard deviation (Žužul et al., 2008) of the mean results of subjective assessment of quality parameters as a measure of the results spread, it can be seen that they were significantly higher in acoustically untreated classroom Room 2. Among other things, it can be concluded based on the above that the evaluation of acoustical quality parameters depends on their absolute values, or that there will be less results spread in acoustically better treated rooms. Since the value of standard deviation for each parameter is approximately equal in the case with and without influence of listening memory to the valuation, it can be concluded that the listening memory has no effect on the statistical spread of results. Comparison of the values of standard deviation is given in graphical form in Figure 5.

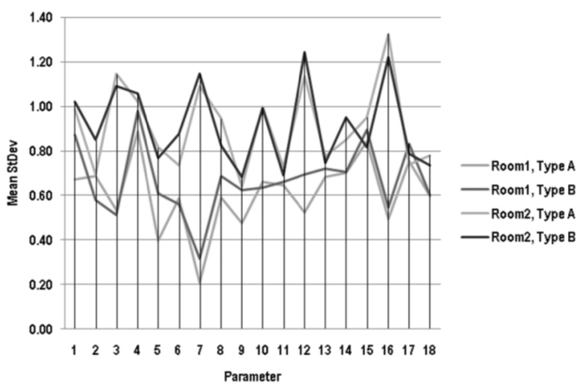

Figure 5 Standard deviation of the mean value

Furthermore, a comparison of the absolute value of rating the acoustic quality of the room with and without influence of listening memory is given. Differences of mean values are given in Figure 6. It can be noted that better results of the evaluation are obtained in the acoustically treated classroom Room 1 for 15/18 (83.3%) of parameters in the case without affecting listening memory, worse results is obtained for 2/18 (11.2%) of parameters, while the same result is obtained for the 1/18 (5.5%) parameter.

On the other hand, in the acoustically untreated classroom Room 2 better assessing results in the case without the impact on the auditory memory are obtained for 8/18 (44.5%) parameters, while worse results are obtained for the 9/18 (50%) parameters. For 1/18 (5.5%) parameter results are the same.

This analysis shows that the valuation of parameters of acoustically untreated rooms is much more dependent on the influence of listening memory. This analysis also shows us another aspect of the complexity of the evaluation of acoustic quality parameters of the rooms, where we can see that acoustic treatment of evaluated facilities has the influence on the impact of listening memory, or that the influence of listening memory is larger in the classroom that is not acoustically treated.

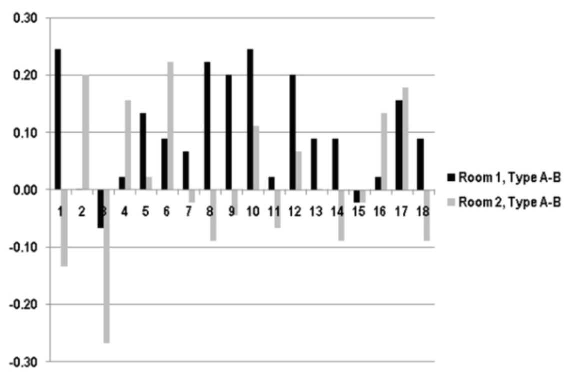

Figure 6 Differences in mean values of the results of evaluated parameters

The last shown statistical analysis is Student's t-test, which is an analysis of statistical significance of differences between arithmetic means obtained with and without the influence of listening memory (Žužul et al., 2008). The analysis results are given in Figure 7.

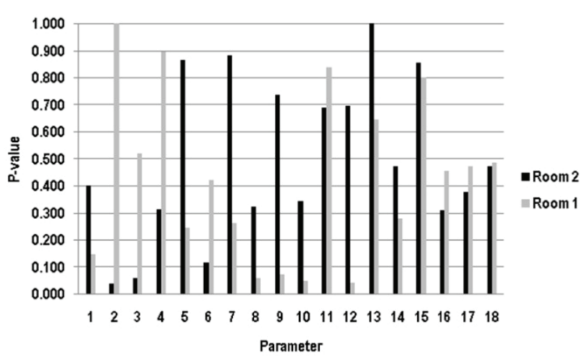

Figure 7 Student's t-test of the results of evaluated parameters

3. Objective Measurements of Room Acoustic Quality Parameters

Objective measurements for Room 1 and Room 2 have been made with acoustical SW "ARTA". The measurements were done with 4 kinds of signal generator: sweep, pink noise, white noise and MLS. The sampling frequency was 48 kHz except for the speech intelligibility measurements, where the sampling frequency was 16 kHz for all signals (Domitrović, Fajt, & Krhen, 2009).

Parameters were measured according to ISO3382, including:

1. Reverberation time

The reverberation time is defined as the time needed to sound pressure level in the room drops by 60 dB after the termination of sound source reproduction (Krhen, 1994).

Since it is often difficult to achieve the dynamic of 60 dB in the room for measurement purposes, reverberation time is estimated based on measured values of sound pressure falls to 10, 20 or 30 dB, where in the ISO3382 it is defined:

- RT30 – time required to sound pressure drops from the value of -5 dB to -35 dB
- RT20 – time required to sound pressure drops from the value of -5 dB to -25 dB
- RT10 – time required to sound pressure drops from the value of -5 dB to -15 dB

2. Early Decay Time - EDT

Early Decay Time (EDT), is defined as the time required for sound pressure level to decrease by 10 dB, and the initial value is 0 dB. In the case of an ideal and perfect exponential decrease of sound pressure level, reverberation time is equal to the value of EDT multiplied by a factor of 6 (Krhen, 1994).

$$RT60(f) = 6 \cdot EDT(f) \tag{1}$$

3. Clarity

Clarity (C50, C80) is defined as the logarithmic ratio of sound energy before and after a certain time limit t, which is defined as 50 ms for good quality of speech, and 80 ms for music.

$$C_{50} = 10\log\frac{\int_{0}^{50ms} p^2(t)dt}{\int_{50ms}^{\infty} p^2(t)dt} \tag{2}$$

$$C_{80} = 10\log\frac{\int_{0}^{80ms} p^2(t)dt}{\int_{80ms}^{\infty} p^2(t)dt} \tag{3}$$

4. Definition

Definition (D50) is defined as the ratio of sound energy to a certain limit t to the total sound energy. The usual value of the limit is 50 ms.

$$D_{50} = 10\log\frac{\int_{0}^{50ms} p^2(t)dt}{\int_{0}^{\infty} p^2(t)dt} \tag{4}$$

5. Centre time

Centre time (ts) is time defined by the formula (5) and its expected value can be determined according to the reverberation time.

$$t_s = \frac{\int_{0}^{\infty} t \cdot p^2(t)dt}{\int_{0}^{\infty} p^2(t)dt}[s] \tag{5}$$

$$t_{s-ocekivano} = \frac{RT_{60}}{13{,}6}[s] \tag{6}$$

Obtained measurement results for acoustically treated classroom Room 1 are given in the tables below:

Table 6 The measuring results for Room 1, excitation with MLS signal

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]
63	0,44	0,44	0,54	0,61	7	4	70
125	0,50	0,53	0,58	0,34	12	6	81
250	0,51	0,51	0,56	0,52	8	4	72
500	0,47	0,50	0,49	0,50	5	3	66
1000	0,45	0,45	0,46	0,51	6	2	63
2000	0,43	0,46	0,42	0,46	6	2	61
4000	0,43	0,46	0,47	0,48	7	3	66
8000	0,40	0,42	0,39	0,43	10	5	78
Mean	0,45	0,47	0,49	0,48			

Table 7 The measuring results for Room 1, excitation with pink noise

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]
63	0,56	0,42	0,51	0,60	8	4	69
125	0,51	0,52	0,62	0,35	11	6	81
250	0,51	0,50	0,56	0,52	8	4	71
500	0,47	0,50	0,48	0,50	5	3	66
1000	0,47	0,46	0,46	0,51	6	2	63
2000	0,47	0,47	0,43	0,46	6	2	61
4000	0,48	0,47	0,48	0,48	7	3	67
8000	0,44	0,43	0,40	0,44	11	6	78
Mean	0,49	0,47	0,49	0,48			

Table 8 The measuring results for Room 1, excitation with sweep signal

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]
63	0,53	0,41	0,51	0,60	8	4	69
125	0,51	0,52	0,61	0,35	12	6	81
250	0,51	0,51	0,55	0,51	10	5	75
500	0,48	0,50	0,49	0,51	8	5	75
1000	0,47	0,46	0,45	0,50	8	3	67
2000	0,47	0,47	0,42	0,46	8	3	67
4000	0,48	0,47	0,46	0,48	8	3	67
8000	0,44	0,43	0,40	0,43	11	6	78
Mean	0,49	0,47	0,49	0,48			

Table 9 The measuring results for Room 1, excitation with white noise

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]
63	0,37	0,39	0,53	0,59	7	3	69
125	0,44	0,50	0,60	0,35	11	6	80
250	0,50	0,50	0,54	0,51	8	4	72
500	0,48	0,50	0,49	0,50	5	3	66
1000	0,47	0,46	0,46	0,50	6	2	63
2000	0,47	0,47	0,42	0,46	6	2	61
4000	0,47	0,47	0,47	0,49	7	3	65
8000	0,44	0,43	0,40	0,43	11	6	78
Mean	0,45	0,46	0,49	0,48			

Differences in measured values depending on the type of excitation signals are clear, and their values are listed in the table below, with a reference measurement signal MLS.

Table 10 The differences in measured results for Room 1 depending on excitation signal

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]	
	-0,12	0,03	0,03	0,01	-0,33	0,06	0,32	MLS - Pink noise
63	-0,09	0,03	0,04	0,02	-0,29	0,06	0,33	MLS - Sweep
	0,07	0,05	0,01	0,02	0,19	0,22	1,09	MLS - White noise
	-0,01	0,01	-0,04	-0,01	0,26	0,01	0,02	MLS - Pink noise
125	-0,01	0,01	-0,03	0,00	-0,24	-0,20	-0,71	MLS - Sweep
	0,07	0,03	-0,03	-0,01	0,54	0,32	1,16	MLS - White noise
	0,00	0,01	0,00	-0,01	0,08	0,18	0,82	MLS - Pink noise
250	0,00	0,01	0,01	0,00	-1,92	-0,71	-3,22	MLS - Sweep
	0,02	0,01	0,02	0,01	-0,04	0,03	0,13	MLS - White noise
	0,00	0,00	0,00	0,01	-0,04	0,00	-0,03	MLS - Pink noise
500	-0,01	0,00	0,00	-0,01	-3,26	-1,97	-9,42	MLS - Sweep
	-0,01	-0,01	0,00	0,00	-0,03	-0,06	-0,33	MLS - White noise
	-0,02	-0,01	-0,01	0,00	-0,15	-0,12	-0,68	MLS - Pink noise
1000	-0,02	-0,01	0,01	0,00	-1,67	-0,90	-4,72	MLS - Sweep
	-0,02	-0,01	0,00	0,00	-0,12	-0,13	-0,71	MLS - White noise
	-0,03	0,00	-0,01	0,00	-0,14	0,04	0,25	MLS - Pink noise
2000	-0,04	-0,01	0,01	0,00	-2,47	-1,10	-5,79	MLS - Sweep
	-0,04	-0,01	0,00	0,00	-0,22	-0,03	-0,17	MLS - White noise
	-0,05	-0,02	-0,01	0,00	-0,22	-0,11	-0,59	MLS - Pink noise
4000	-0,05	-0,01	0,01	0,00	-0,62	-0,10	-0,50	MLS - Sweep
	-0,05	-0,01	0,00	-0,01	0,02	0,13	0,68	MLS - White noise
	-0,04	-0,01	-0,01	-0,01	-0,27	-0,09	-0,37	MLS - Pink noise
8000	-0,04	-0,01	-0,01	-0,01	-0,45	-0,10	-0,37	MLS - Sweep
	-0,04	-0,01	-0,01	-0,01	-0,27	-0,03	-0,13	MLS - White noise
	-0,04	0,00	-0,01	0,00				MLS - Pink noise
Mean	-0,03	0,00	0,00	0,00				MLS - Sweep
	0,00	0,01	0,00	0,00				MLS - White noise

The following results were obtained for acoustically untreated classroom Room 2:

Table 11 The measuring results for Room 2, excitation with MLS signal

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]
63	0,23	0,24	0,10	0,14	-1	-2	40
125	1,80	1,91	2,39	2,67	-3	-6	22
250	1,22	1,30	1,46	1,68	-1	-2	37
500	1,16	1,24	1,38	1,53	-1	-3	32
1000	1,00	1,08	1,06	1,33	2	-1	47
2000	1,02	1,10	1,12	1,17	2	0	50
4000	0,85	0,86	0,83	0,90	5	2	59
8000	0,63	0,67	0,68	0,70	7	3	68
Mean	0,99	1,05	1,13	1,27			

Table 12 The measuring results for Room 2, excitation with pink noise

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]
63	1,21	1,44	1,62	1,48	2	1	56
125	0,88	0,95	0,90	1,33	1	-3	32
250	1,05	1,14	1,29	1,40	1	-2	40
500	1,10	1,22	1,31	1,43	0	-3	33
1000	1,10	1,19	1,11	1,30	2	0	48
2000	1,04	1,12	1,11	1,19	2	0	50
4000	0,84	0,86	0,82	0,92	4	1	58
8000	0,64	0,67	0,67	0,71	6	3	68
Mean	0,98	1,07	1,10	1,22			

Table 13 The measuring results for Room 2, excitation with sweep signal

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]
63	1,32	1,50	0,96	1,62	2	1	56
125	1,12	1,27	1,10	1,48	1	-3	33
250	0,97	1,12	1,27	1,39	1	-2	40
500	1,13	1,20	1,25	1,43	-1	-3	33
1000	1,12	1,21	1,09	1,31	2	-1	47
2000	1,06	1,10	1,11	1,17	2	0	50
4000	0,86	0,85	0,80	0,90	5	2	59
8000	0,66	0,68	0,69	0,70	7	3	68
Mean	1,03	1,12	1,03	1,25			

Table 14 The measuring results for Room 2, excitation with white noise

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]
63	1,45	1,48	1,62	2,60	-3	-6	21
125	0,35	0,38	0,53	1,64	-2	-6	22
250	0,96	1,16	1,47	1,51	0	-2	38
500	1,21	1,31	1,41	1,49	0	-3	35
1000	1,08	1,17	1,16	1,34	2	-1	47
2000	1,02	1,09	1,11	1,17	2	0	50
4000	0,85	0,86	0,80	0,91	4	1	58
8000	0,66	0,68	0,69	0,69	7	3	69
Mean	0,95	1,01	1,10	1,42			

Differences in measured values depending on the type of excitation signals are clear in this case as well, and their values are listed in the table below, with a reference measurement signal MLS.

Table 15 The differences in measured results for Room 2 depending on excitation signal

f [Hz]	T30 [s]	T20 [s]	T10 [s]	EDT [s]	C80 [dB]	C50 [dB]	D50 [%]	
63	-0,99	-1,20	-1,52	-1,34	-2,17	-2,82	-16,07	MLS - Pink noise
	-1,10	-1,26	-0,86	-1,48	-2,29	-2,90	-16,53	MLS - Sweep
	-1,23	-1,24	-1,53	-2,47	2,52	4,06	19,18	MLS - White noise
125	0,92	0,96	1,49	1,34	-4,27	-2,44	-10,93	MLS - Pink noise
	0,68	0,64	1,29	1,19	-3,85	-2,45	-10,98	MLS - Sweep
	1,45	1,53	1,86	1,03	-1,31	-0,11	-0,42	MLS - White noise
250	0,17	0,16	0,17	0,28	-1,05	-0,54	-2,95	MLS - Pink noise
	0,24	0,18	0,20	0,29	-1,11	-0,63	-3,47	MLS - Sweep
	0,26	0,14	0,00	0,18	-0,66	-0,27	-1,45	MLS - White noise
500	0,06	0,02	0,08	0,10	-0,48	-0,28	-1,41	MLS - Pink noise
	0,03	0,04	0,14	0,11	-0,41	-0,21	-1,05	MLS - Sweep
	-0,05	-0,07	-0,03	0,04	-0,56	-0,49	-2,49	MLS - White noise
1000	-0,10	-0,11	-0,05	0,03	-0,15	-0,17	-1,00	MLS - Pink noise
	-0,12	-0,14	-0,03	0,02	-0,08	0,00	-0,02	MLS - Sweep
	-0,08	-0,09	-0,10	0,00	-0,04	-0,01	-0,07	MLS - White noise
2000	-0,02	-0,01	0,02	-0,02	0,03	0,00	-0,02	MLS - Pink noise
	-0,04	0,01	0,01	0,00	0,00	0,02	0,08	MLS - Sweep
	0,00	0,02	0,02	0,00	0,07	0,06	0,31	MLS - White noise

4000	0,00	0,00	0,01	-0,02	0,14	0,13	0,72	MLS - Pink noise
	-0,01	0,01	0,03	0,00	0,01	0,07	0,34	MLS - Sweep
	-0,01	-0,01	0,03	0,00	0,03	0,15	0,82	MLS - White noise
8000	-0,01	0,00	0,01	-0,01	0,23	-0,06	-0,29	MLS - Pink noise
	-0,03	-0,01	-0,01	0,01	-0,12	-0,04	-0,21	MLS - Sweep
	-0,02	-0,01	-0,01	0,01	-0,12	-0,10	-0,53	MLS - White noise
Mean	0,00	-0,02	0,02	0,04				MLS - Pink noise
	-0,04	-0,07	0,09	0,02				MLS - Sweep
	0,04	0,04	0,03	-0,15				MLS - White noise

4. Conclusion

Given that it largely depends on the audience and their real possibilities of making assessments, subjective evaluation of room acoustic quality parameters is always difficult to perform, as well as accurate assessment of subjective room quality. The resulting dispersion of results shows that there are differences even within a group of people from similar socio-economic groups, education levels and technical knowledge. In our work, we especially observed the influence of listening memory to the results, as one of the important parameters which is very often not taken in to account.

However, since there is still a very good correlation between subjective and objective evaluation of the measured parameters, we can say that there is a very high probability that the subjective evaluation of room acoustic quality will be consistent with objectively measured parameters, and that the majority of people agree with that assessment.

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