LISTENING EXPERIENCE SURVEY IN CONCERT HALLS, CASE STUDY OF PHILHARMONIE 2 IN PARIS.

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1 INTRODUCTION

Assessing the acoustic quality of concert halls is made by questioning listeners in laboratory conditions or through *in-situ* surveys. Each method provides a different type of knowledge. Despite continuous improvement in auralization systems to exactly reproduce concert hall acoustics, laboratory conditions still deprive acoustic stimulations of context, inducing their analytic processing, whereas investigations *in-situ* provide a more genuine holistic and multimodal experience. The use of both approaches, laboratory listening tests and surveys, is therefore necessary to better understand how perceptual evaluations are related to acoustic characteristics of concert halls. If, in the first situation, the requirement of the ecological validity of restitutions[1] is now taken into consideration, the design of questionnaires and analysis of field survey data in acoustic research remains quite different from expertise developed in human sciences for exploring sensory experience.

Some of the major studies concerning *in-situ* surveys[2-7] used structured questionnaires with close-ended questions to which subjects answer during or at the end of a concert performance. Two main aspects are worthy to be discussed about these surveys[8]. First, most of these questionnaires have been designed to evaluate the psychological effects of subjects with regard to different conceptualizations (referring to different properties or characteristics of sound or music) established by specific communities of experts. Just one of these surveys[7] introduced wordings from a preliminary investigation among a group of concert-goers in semantic scales (questions). Most survey questions however are derived from scientific knowledge (in acoustics) or expert knowledge (in music and musicology), therefore formulated in specific terminology referring to properties of signal, rather than using common language referring to subjective experience. However, an issue arises. Unlike *shared knowledge* (either in science or other specific expertise), *experiential knowledge* (such as the listening experience of a concert) as a psychological object is individual, seldom worded and negotiated in communication. Hence, subjects' responses are variable from one person to another and problematic for statistical analysis.

The second aspect concerns precisely this, the formulation of the questions themselves, the words or terms used in the questionnaires. These surveys used different methods to rate the questions (bipolar semantic scales, binary scales, ordinal scales, etc.), employing (in part or integrally) specific adjectives or specialized terms whose meaning is supposed to be univocal, known and shared by all subjects. Even though precise definitions are given to minimize polysemy (e.g. in referring to acoustical parameters), there is no guarantee that the meaning of the words expected by the researchers corresponds to subjects' interpretations. This is because there is no simple association between words and concepts, so words (as *signifier*) refer to notions that are incorporated in the subject's knowledge at different levels (according to his expertise and previous experiences). Sometimes, expert listeners (acousticians) are preferred due to their use of consensual terms. Such a specific group of listeners represents, however, a minority amongst concert-goers, not being really representative of the range of preferences and judgments about listening experiences in concert halls (i.e. in general more focused on the acoustic signal).

Our research seeks to study the individual listening experiences of concert-goers in concert halls, and the impact of the hall's acoustics on these experiences from the following perspectives: cognitive psychology of perception and linguistic expertise on how languages cope with subjective experience for different sensory domains[9-10], thus controlling formulation of questions and analysing verbal answers to open ones, in which subjects used their own words. This research is based on a theoretical and methodological framework that have already been developed in different sensory domains[10] and used (among other fields) in musical acoustics[11] and soundscape researches[12]. Our survey differs from previous ones in being explicitly designed to grasp the listeners' sensory experiences and consequently to use common language in avoiding technical or specific terms, as described in the following sections.

Another aspect common to previous surveys is that listeners were able to read the questionnaire before the concert. This procedure focuses listeners' attention on both perceptual and acoustical characteristics. However, orienting attentive listening could prevent the ordinary listening experience, which is more holistic and oriented towards hedonistic assessment (i.e. the pleasure of listening to and enjoying the music). Thus, in order to grasp listeners' ordinary sensory experiences, and prevent such analytic listening, questionnaires were not to be read before the intermission (cf. 3.2).

A preliminary survey was made in three Paris concerts halls (Salle Cortot, Salle Pleyel and Philharmonie 2) where acoustical measurements have been done previously, in order to correlate *a posteriori* physical parameters with psychological descriptions. This paper presents the questionnaire design, the analysis method and some results derived only from the Philharmonie 2 survey concerning listeners' sensory experiences. Comparison between perceptual judgments and acoustical measurements is not covered in this publication but the final purpose of this work is to identify how some physical parameters could account for subjective evaluations.

2 QUESTIONNAIRE DESIGN

The questionnaire (in French) was designed to identify listeners' sensory experiences, by including open-ended questions and open response-options for further precisions related to some closed questions. The questionnaire avoided using technical terms whose meaning may not be shared by ordinary concert-goers. Hence, questions and rating scales use common language. The formulation of questions also induced a subject-centred processing of listeners' sensory experience by contrast with object-centred ones. For example, we asked "*did you have the impression…?*" or "*from your seat, did you have the feeling that…?*" the questions are subject-centred, as opposed to "*Is the reverberance of the hall:* ", that is object-centred (i.e. hall parameter). The subject-centred formulation of the questions aims to identify listeners' feelings, regarding their experience, whereas in object-centred statements, the listener is invited to evaluate the "objective/real" value of a parameter with respect to the hall (or the sound). Hence, the statements within our questions are principally subject-centred.

The questionnaire includes open-ended and closed questions ranging from global aspects to specific features of the concert-goer's listening experience. The choice of the questions is based on literature of previous surveys[2-7] and linguistic analysis of previous interviews and structured according to the framework developed with linguists and psychologists in the laboratory to explore sensory experience[10]. Some of the closed questions replicate those borrowed from different questionnaires, published in the literature on the evaluation of concert hall acoustics but with the specificities explained above. Furthermore, the survey was adapted to the musical program of each concert (e.g. questions related to the choir and soloists). Thus, the questionnaire is organized in four parts, and circa, depending on the performance, 30 questions. The first part consists of global open questions concerning the overall concert impression (cf. Table 1 category 1). The second part contains more specific questions, mostly closed, regarding different aspects of the listening experience in concert halls (cf. Table 1. categories 2-8). The third part includes open questions about the overall hall impression (cf. Table 1 category 9) and the fourth part contains factual questions. The questions of the first three parts were grouped in nine semantic categories covering

psychological and acoustic characteristics as shown in Table 1: Overall Impression of Concert (Performance); Location and Envelopment; Proximity; Loudness and Balance; Reverberance; Definition; Timbre; Dynamics; Overall Impression of Hall. The questionnaire uses 3 to 5-point semantic scales (mostly ordinal scales and a few nominal ones), as well as some binary scales for closed questions. Annex A shows an example of the questionnaire (translated into English) without its fourth part.

CATEGORIES	ASPECTS	QUESTIONS
1. Overall Concert Impression	Overall Impression, Positive Concert Impression, Negative Concert Impression, Emotions	1, 2a, 2b, 2c, 3
2. Location and Envelopment	Music Location, Listener Envelopment, Location of Musical Instruments Sound	5a, 5b, 5c, 16c
3. Proximity	Orchestra Proximity, Choir Proximity, Singer Soloists (soprano, mezzo, tenor, baritone) Proximity, Quartet Proximity	6a, 6b, 6c, 6d, 6e, etc.
4. Overall Loudness and Balance (Level)	Orchestra Loudness, Balance of Choir to Orchestra, Balance of Solo voices (soprano, mezzo, tenor, baritone) to Orchestra	7, 8a, 8b, 8c, 8d, etc.
5. Reverberance	Persistence of musical sound, Sudden stop of musical sound	9a, 9b, 10a, 10b
6. Definition	Clarity of Musical Execution, Clarity of Soloist Voices	11a, 11b, 12, 16b
7. Timbre	Frequency Balance, Bass Loudness, Treble Loudness, Overall Bass Impression, Overall Treble Impression	13, 14a, 14b, 15a, 15b, 16a
8. Dynamics	Orchestra Dynamics	17a, 17b
9. Overall Hall Impression	Hall/Program Adequacy, Positive Hall Impression, Negative Hall Impression	18, 19, 20, 21

Table 1. Questionnaire Categories

3 THE PRESENT SURVEY

The Philharmonie 2 concert hall is particularly interesting because of its architecture, the variety of musical programs and its public. In fact, the typical audience of Philharmonie 2 attends concerts regularly either in this hall or elsewhere, which is desirable for assessing the listening experience of concert performances, and the acoustic quality of the hall, by a self-recruiting audience. The survey was of two concerts and during their intermissions, subjects were invited to respond. The program, prior to the intermission, was the “Coronation Mass” (Mozart) for the first concert, String Quartet No 15 (Schubert) and Chamber Symphony No 2 (Schoenberg) for the second concert.

3.1 Subject Selection

Subjects were selected from six particular positions within the hall where acoustical measurements had been taken previously. The zones are shown in Figure 1. There are 3 zones in the stalls: Front (0-1), Back (5-6) and Front Left (8); and 3 zones in the first balcony: Centre (J-G), Front left (L) and Back Left (J). In each of the zones one assistant with twenty envelopes personally distributed the questionnaires to concert-goers when taking their seats. Subjects were asked to participate in the survey. Assistants gave a brief oral presentation about the survey, and invited subjects to read the instructions written on the envelope but not to open the envelope yet.

3.2 Instructions

As mentioned, listeners were not allowed to read the questions before the intermission in order to collect the impressions and judgments from their ordinary manner of listening to a concert performance (cf. 1). This is why the questionnaire was given to the listeners before the beginning of the concert in a sealed envelope. On the face of the envelope a short presentation explained the objectives of the survey, giving preliminary instructions, but without reference to concert hall acoustics. The following instructions were given on the envelope (in French): *“Please do not open this envelope before the intermission. During the intermission we invite you to open the envelope and we thank you for taking time to answer the questionnaire (only a few seats have been chosen). There is no right or wrong answer; we seek to understand your personal experience of this concert. This survey is anonymous”.*

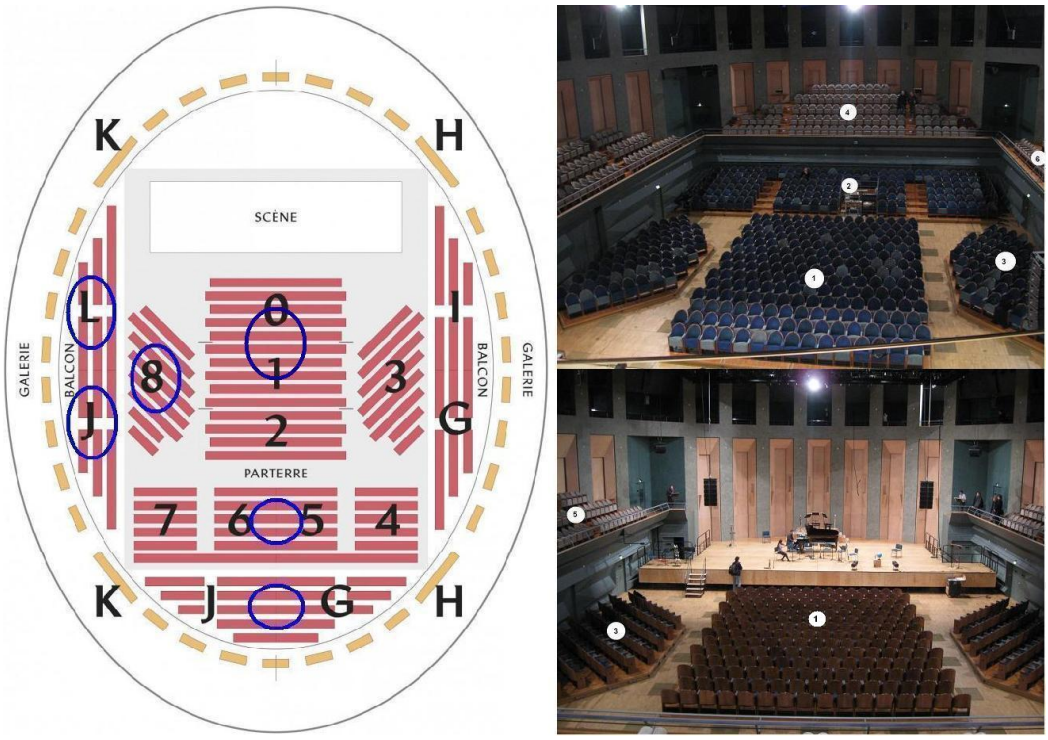

Figure 1. Seating plan of Philharmonie 2 (left). View from the stage (upper right) and from balcony

4 ANALYSES AND RESULTS

In total, 93 questionnaires (48 women, 45 men) were completed for the first concert, and 72 questionnaires (35 women, 37 men) for the second. The difference is because attendance to the second concert was lower, and more listeners sat at the center of the hall. This reduced the participation of subjects from the lateral zones. For the first concert, the average age of the audience was 58 years old (*SD* = 15) and 54 years old (*SD* = 18) for the second. Moreover, 47% and 44% of the respondents (first and second concert respectively) declared having musical experience such as playing a musical instrument or singing. Furthermore, 39% and 33% of them (first and second concert respectively) owned a recording of the program (or part of the program) or had listened to it in another hall. Due to the quantity and the richness of data collected from the questionnaires (written comments and ordinal data), analyses are limited in this paper to the responses from categories 2 to 8 (cf. Table 1). Nevertheless, comments from categories 1 and 9 are also used in our analyses of the other categories.

The primary idea of the survey is to describe the impression of listeners' listening experiences in the hall and to account for consensus as well as variability. Hence, observation of the mode, median and frequency of each response category to each closed question is used as global indicator of the degree of consensus or variability in listeners' judgments. A recommended way[13] to visualize, and better understand response distributions obtained from semantic rating scales, is by means of diverging stacked bar-charts. For example, Figure 2 shows the percentage of listeners by response category to the question about the feeling of proximity to the orchestra. Results are organized by zone within the hall and by concert performance. We can see that responses *"close"* and "*very close"* are shown on the right side, and the responses "*far away"* and "*very far way*" are shown on the left side (from the vertical zero reference line). On the other hand, the response category "*neither far away nor close*" ("neutral") is equally distributed in both sides.

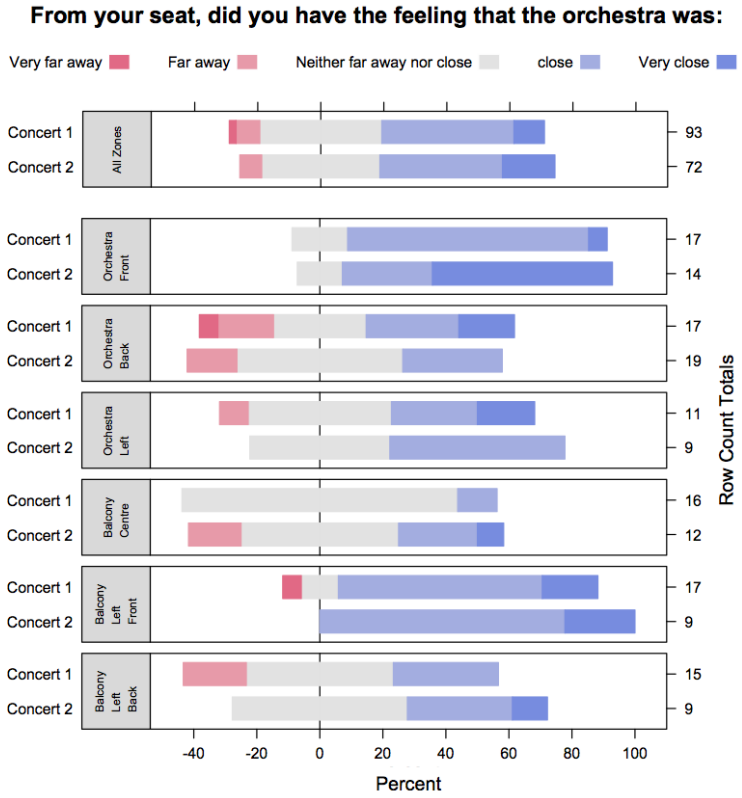

Figure 2. Comparisons concerning "*proximity*" of the orchestra.

In many cases, the median and mode could be used as a consensual description indicating the "global audience impression" within a particular zone and for each question. However, we have observed responses with an important inter-individual variability (see Figure 2, Orchestra Back – Concert 1) and responses with a one-sided tendency, despite an important "*neutral*" position score. In the first case, the description is noted "*variable*". In the second case we evaluate the frequency of "*neutral*" responses and the ratio of "right" to "left" side responses (cf. Figure 2, the ratio on right and left side with respect to the zero reference line) to confirm or reject the possible tendency. Thus, taking the example of orchestra proximity for "Balcony Left Back" (cf. Table 2), the median and mode values in both concerts are "*neither far away nor close*" whilst the right/left ratio is 1.3 for Concert 1, and 2.6 for Concert 2. We established an arbitrary minimum ratio of 2 (or ½ on the opposite side) to infer an important influence upon one side of the judgment. Thus we might infer that for Concert 2, listeners feel rather "*close*" to the orchestra from that zone.

	"*Very Far Away*"	"*Far Away*"	"*Neither far away nor close*"	"*Close*"	"*Very Close*"	Ratio right/left	Description
In French	*très loin*	*loin*	*ni loin ni proche*	*proche*	*très proche*		
Concert 1	0%	20%	46.66%	33.33%	0%	1.3	"*Neither far away nor close*"
Concert 2	0%	0%	55.55%	33.33%	11.11%	2.6	rather "*close*"

Table 2. Orchestra responses to *proximity* for the two concerts at zone "Balcony Left Back". The "*neither far away nor close*" score is split in halves to compute the ratio.

This approach allows us to suggest a description of each zone, regarding the concert performance, for each perceptual category assessed in this survey. Depending on the zone and the question, an important number of "*variable*" responses was observed. Hence, we examine written comments to account for the inter-individual variations of responses (cf. 4.1). Table 3 samples descriptions of the

six zones for the *Proximity* category, concerning the orchestra evaluation regarding the two concert performances. Additionally, in order to evaluate the statistical significance regarding possible differences observed between groupings (zones, programs, listeners' profiles) we have used the non-parametrical statistical tests: the Kruskal-Wallis one-way analysis of variance, the Mann-Whitney-U (MWW) test and the Wilcoxon Signed-Rank (WSR) test (for differences between programs during the same concert performance). These tests are relevant for use with ordinal data instead of classical parametric tests as ANOVA. Also, associations between categories are analyzed by means of Kendall's Tau test. The following sections present the salient results.

Concert	Orchestra Front	Orchestra Back	Orchestra Left	Balcony Centre	Balcony Left Front	Balcony Left Back
Proximity: One feels … to the orchestra / quartet. (neutral = *"neither far away nor close"*)						
Concert 1 (orchestra)	*close*	*variable*	rather *close*	*neutral*	*close*	*neutral*
Concert 2 (orchestra)	*very close*[a]	*neutra*l	*close*	*neutral*	*close*	rather *close*
Concert 2 (quartet)	*very close*[a]	*variable*	rather *close*	*variable*	rather *close*	*variable*

Table 3. Verbal description for *Proximity* category, depending on zone and concert performance

4.1 Perceptual differences between zones for one concert performance

General homogeneity was found amongst the zones evaluated. However, depending on the category, differences in judgments between some zones were observed. For example, in all zones, the direction of musical sound (*direct sound*) is well perceived as coming from the stage, but in zone "Orchestra Left" several listeners declared perceiving sound as coming from the left side. Perceptual differences were mainly found in the *Proximity* category ($p = 0.004$ using Krustal-Wallis test for orchestra proximity among the 6 zones). It was observed that in general the listeners from zones "Orchestra Front" and "Balcony Left Front" felt closer to the sound sources (orchestra, singers, choir, etc.) and listeners from zone "Balcony Left Back" felt more distant from them. That is related to the objective distance between the stage and the seating areas in different zones but also to cross modal correlations with visual cues (which are well known to influence auditory judgments). However, it was found that the feeling of proximity within the same zone varies with the type of source (orchestra, choir, soloist, quartet, etc.). For example, at "Balcony Centre", the orchestra and choir were judged "*neither far away nor close*", whereas the proximity of the soprano was judged "*close*". In a similar way, at "Orchestra Front", the proximity to the soprano was judged "*close*", whereas the mezzo was judged "*neither far away nor close*". One interpretation is that the feeling of proximity could be affected by the perceived loudness of the orchestra (or quartet) and by the balance between singers or choir and orchestra (cf. 4.4).

It was also found that at "Orchestra Back" there were more inter-individual differences in the responses. For example, concerning Choir Proximity, 9 listeners felt "*close*" or "*very close*", 6 listeners felt "*far away*" and "*very far away*" and 2 listeners felt "*neither far away nor close*". Subjects' variations could be interpreted through written comments. In this zone one third of listeners did not find the hall really suitable for performing the "Mass". One listener wrote (in French)[b]: "*Rather satisfied overall. However the hall does not seem entirely appropriate - thereby the work of singers (choir) is not appreciated at its true value*". Another noted: "*the first part was not suitable for this room (Mass) […]. Perhaps my place (the focus of the ellipse) has something to do with the accuracy of the sounds and the predominance of the orchestra.*" It seems that preferential differences (more reverberating as opposed to more precise), are more noticeable in this zone.

[a] We note that in Concert 2 - Orchestra Front most responders were indeed seated closer to the stage than for Concert

[b] All listeners' comments showed in this paper were originally written in French.

4.2 Perceptual differences between musical programs

The second concert had two different musical programs. Regarding *Loudness* and *Definition* categories, listeners felt that the Schubert Quartet was less loud than the Schoenberg Symphony ($p < 0.001$ using WSR test) and distinguished more clearly the musical performance of the Quartet ($p = 0.004$ using WSR). It was also noticed that some listeners observed differences in perception regarding the *Frequency Balance* mainly in the lateral zones and at "Orchestra Back" ($p = 0.045$ using WSR). Perception at "Balcony Centre" and "Orchestra Front" was in general balanced in frequency for both programs. As noted in section 4.1, it was observed that differences about the feeling of *proximity* depend on the zone (cf. Table 3). Regarding Concert 1 (Mozart's "Mass"), listeners were able to distinguish more clearly the performance of soloist voices than of musical instruments ($p < 0.001$ using WSR).

From comparisons between Concert 1 and Concert 2, differences in the *Loudness* and *Definition* categories were found. The Schubert Quartet was rated less loud than Mozart's "Mass" ($p < 0.001$ using MWW test) and the instrumental performance was perceived more clearly in Schoenberg's Symphony than Mozart's "Mass" ($p < 0.001$ using MWW). Also, the Schubert Quartet performance was perceived more clearly than soloist voices in Mozart's "Mass" ($p < 0.001$ using MWW). Differences in rating for *bass frequency loudness* between Mozart and Schoenberg pieces were also found ($p = 0.009$ using MWW); as well as for *Frequency Balance* ($p = 0.043$ using MWW, without including the "Balcony Center" zone). Perception at "Balcony Center" was balanced in frequency during both performances. Finally, the *Reverberance* category was assessed lower (less persistent sound) and more homogeneously in Concert 1 than Concert 2 ($p = 0.036$, MWW)[c]. This result could be made more explicit from analyzing comments since some listeners declared that Mozart's "Mass" is more suitable to performances in more reverberant places such as churches. One listener wrote: " *The music of the Coronation (Mozart's Mass) is a music made for the church. [In this hall] There is too much precision, not enough reverberation, not enough blended* ".

In Concert 2 was noticed a greater variation between zones, concerning *reverberance*. In particular the zones "Orchestra Left" and "Balcony Left Front" were found to be more reverberant than the others. Preliminary analyses indicate that this could be related to the type of music being played; also to the response of the hall at low frequencies, concerning some acoustical parameters[d] in those zones, not noticeable in Concert 1, possibly due to the expectancy to a higher reverberation for a "Mass".

4.3 Perceptual differences between musicians and non musicians

It was noticed that some differences between categories are more emphasized, depending on the program. For example, in Concert 1 (Mozart's "Mass") differences between musicians and non-musicians from all zones were mainly observed in the categories *Envelopment* ($p=0.028$ using MWW) and *Dynamics* of the orchestra ($p=0.013$ using MWW). For *Envelopment*, most of the non-musicians felt surrounded by the music during the whole concert. In contrast, most of the musicians declared not feeling surrounded by the music at any moment. Furthermore, comments allow us to identify moments when listeners felt more surrounded by the music, which were mainly during choral entries, *tutti* and *crescendos*. Some listeners wrote: "*when the music rises in intensity / power", "during polyphonic crescendos - with brass, woodwinds", "when the choir sang*", *"when all the orchestra plays", "when they are all together", "more when the choir sang", "movements* fortes*", "mainly with contrabass". "from pianissimo to forte", "perhaps in the choir + orchestra ensembles".*

Regarding the *Dynamics* category, musicians generally rated higher than non-musicians (this tendency was also observed for Concert 2), showing that musicians are in general more aware of the various movements of the orchestra. It was also observed that musicians were able to distinguish more clearly instrumental performances than non-musicians ($p=0.045$).

[c] This test was made using the values from the sum of the ratings of questions 9a and 10a (cf. Annex A).

[d] Strength (G) and Early Decay Time (EDT)

For Concert 2 the main differences were observed in the *Proximity* and *Loudness* categories ($p < 0.001$ and $p=0.003$ respectively for Schubert quartet) where musicians rated lower (less close and less loud) than non-musicians (also observed in Concert 1). Also, it was noted that musicians were more conscious of differences in persistence between the sounds of the different musical instruments within the hall ($p = 0.005$ in Concert 1).

4.4 Correlations

The following correlations were found using Kendall's Tau test: First, the feeling of *proximity* to the orchestra correlates with the feeling of *loudness* (corr. coefficient 0.29, $p = 0.002$). The correlation is higher when orchestra loudness ratings are divided by the distance between the zone and the stage[e] (corr. coefficient 0.36, $p < 0.001$). Second, the feeling of *proximity* to the solo voices (soprano, mezzo, tenor and baritone) correlates with the ratio between volume voices and orchestra loudness (*Balance*), (corr. coefficient 0.25, 0.46, 0,40, 0,42 $p=0.009$, $p<0.001$, $p<0.001$, $p<0.001$). Third, the ability to distinguish the performance of the different musical instruments (*Definition*) correlates with the ability to perceive the various movements (*Dynamics*) of the orchestra (corr. coefficient 0.25, $p=0.014$).

These correlations make sense in the analysis of comments. For example, concerning the correlation between *Proximity* and *Loudness/Balance* one listener wrote: *"Beautiful voices. Good balance instruments / voices"*; and then he expressed: *"we see well, we hear well, we feel close"*. Another listener seated in the zone Balcony Left stated: *"Regarding sound, I felt distanced during the first part (Mozart's Mass), not much power, weak level of music"*. With regard to the correlation between *Definition* and *Dynamics*, one listener wrote that she appreciated in this hall *"the readability of instrumental and vocal (soloists) parts"* and she also described her experience of Mozart's Mass as a *"moment of intense expression (phrasing, dynamics)"*. Finally, another person noted: *"The sound was excellent, even for a seat placed completely sideways along the wall, balanced, distinct and clear. It is a very beautiful concert […]. A beautiful job, a beautiful and nuanced interpretation, in the pure respect of the composer."*

5 CONCLUSIONS

The audience's listening experience was evaluated during two concerts at Philharmonie 2 in six specific seating areas (zones) by means of a questionnaire, explicitly designed to grasp the listeners' sensory experiences, containing open and closed questions. The procedure of questioning was centred on the subject experience and used their common language. Besides, listeners were not allowed to read the questions before the intermission, after which they were invited to fill out the questionnaire. Thus responses (ratings of the scales and comments) correspond *a priori* to their ordinary ways of listening to concerts.

Results were analyzed in order to describe perception of the hall's acoustic response, as related to the seating areas (zones), the music program and listeners' profiles. In this hall the audience assessments corresponding to the categories showed in Table 1 are in general homogenous between zones, for the orchestra's performance and for a given concert. However, depending on the musical sources (quartet, choir, soloist, etc.) perceptual differences between zones emerge for particular categories. Most differences were found in the *Proximity* category, including the *Proximity of the orchestra*. It was noticed that some categories were rated differently, depending on the music program, either comparing different concerts or within the same performance. Perceptual differences were mainly observed in the categories *Definition, Loudness, Reverberance* and *Timbre.* Some differences between musicians and non-musicians were also found concerning *loudness, proximity, the impression of being surrounded* by the music and the perception of *orchestra dynamics*. However, it was noticed that the differences depend on the music program,

[e] A central point in the zone measured to a central point in the stage, with reference to the distance from the stage to the zone 'Orchestra Front'

some cases being more prominent. Finally, correlations between the categories *Proximity* and *Loudness-Balance*, as well as between *Definition* and *Dynamics* were observed.

Furthermore, important inter-individual variability in responses (within a zone) depending on the zone (especially in "Orchestra Back") and on the question was observed. We have accounted for this variability by processing the ratings of semantic scales as ordinal data, instead of interval data, and by analysing open verbal responses. In addition, written comments allowed us to identify correlations between categories and further psychological aspects, for instance moments when listeners felt more surrounded by the music.

This study presents methods that allow to highlight variability in listeners' judgments as psychological phenomena (the listening experience) that cannot be overlooked when we are concerned with the sensory experience of the audience. Thus, besides an adequate use of semantic scales, we emphasize the importance of linguistic analyses of (open) verbal comments, in their own phrasings, as a means to better understand listeners' preferences and judgments, concerning the acoustic qualities of concert halls. Future work will include comparisons between perceptual judgments and acoustic measurements.

6 ACKNOWLEDGEMENTS

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Annex A. Questionnaire

N	Questions	Type	Semantic Scale
1	You attended this concert or part of it. Overall, what is your impression?	Open	
2a	During the concert did any moments strike you in particular?	Open	
2b	As particularly enjoyable and if so, why?	Open	
2c	As particularly unpleasant and if so, why?	Open	
3	Did you feel any emotions? If so, which, and at what moment?	Open	
5a	Did you have the impression that the music came only from the stage? If sometimes, when?	3-pts Open	during the whole concert, sometimes, never
5b	Did you have the impression of being surrounded by the music? If sometimes, when?	3-pts Open	during the whole concert, sometimes, never
5c	Did you have the impression that the music came to you from other directions?	Open	
6x	From your seat, did you have the feeling that the orchestra (choir/soprano/mezzo, etc.) was:	5-pts	very far away, far away, neither far away nor close, close, very close
7	Did you feel that the orchestra's musical performance (volume) was:	5-pts	too weakly, rather weak, just right, rather loud, too loud
8a	Compared to the orchestral volume, how do you rate the vocal volume of the singers (choir)?	5-pts	too weakly : : : too loud
9a	Is your impression of the hall that the sounds linger?	5-pts	very little, little, neither little nor lengthily, lengthily, a very long time
9b	Is it the same impression for all instruments or voices? Alternatively, for which instruments or voices, and when?	Yes/No Open	
10a	Is your impression of the hall that the sounds cut out?	5-pts	very quickly, quickly, neither quickly nor slowly, slowly, very slowly
10b	Is it the same impression for all instruments or voices? Alternatively, for which instruments or voices, and when?	Yes/No Open	
11a	During the concert were you able to distinguish the musical performance of different instruments?	5-pts	not at all, hardly, a little, clearly, very clearly
11b	During the concert were you able to distinguish the different voices of soloists?	5-pts comments	not at all, hardly, a little, clearly, very clearly
12	Did you have the impression that the sounds were confused?	3-pts	not at all, a little, a lot
13	What is your perception of the relationship between the bass and treble sounds	3 cat	bass and treble are balanced, the treble dominate (are louder), the bass dominate (are louder)
14a	How do you perceive bass sounds?	5-pts	too weakly : : : too loud
14b	Do you consider them?	4 cat	insufficient, pleasant, excessive, bothersome
15a	How do you perceive treble sounds?	5-pts	too weakly : : : too loud
15b	Do you consider them?	4 cat	insufficient, pleasant, excessive, bothersome
16a	From your seat, how did you hear the various instruments and voices of this concert? Did you find their sounds natural? Alternatively, for which instruments or voices, and why?	Yes/No Open	
16b	Could you distinguish them easily?	Open	
16c	Could you locate them individually?	Open	
17a	Was your impression that the orchestra performed various movements (pianissimo, fortissimo)?	Yes/No	
17b	If so, from your place, did you perceive them:	3-pts	a little, clearly, very clearly
18	Do you think this hall is suitable for this repertoire? Why ?	4-pts Open	not at all, not really, rather yes, completely
19	What do you appreciate in this hall?	Open	
20	What do not you appreciate in this hall?	Open	
21	For you, what would be the ideal venue for the type of music you just heard?	Open	

Original wording in `http://www.lam.jussieu.fr/Membres/Espitia/QuestionnaireExample.pdf`