Violinist, violin, bow: What can we hear and recognize?

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Extended abstract

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Violinist, violin, bow: What can we hear and recognize?

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ABSTRACT

The Science and violin making workshop organized every year by researcher Claudia Fritz and violin maker Paul Noulet in France gathers researchers, instrument makers and musicians to make progress in our understanding of the bowed string instruments. One of the daily sessions consists in critical listening, to train our ears, learn how to express and share what we hear, and search for correlations with construction parameters or study various modifications on the instrument, the bow or the playing technique.

It is generally accepted that the sound of a bowed string instrument depends on three parameters: the player, the instrument and the bow. During the 2021 workshop, formal listening tests were conducted to explore what a group of trained listeners is able to hear and recognize when one of these three parameters varies. Results challenge common ideas among violinists about the sound quality associated to the bow. A large difficulty of comparing instruments when listening was observed, as the musician keeps adapting to the instrument and only few cues are available to the listeners to decouple the player's actions and the instrument behavior with respect to their influence on the resulting sound.

Keywords: Violin, Bow, Perception

1. INTRODUCTION

Many listening tests have been recently designed in violin acoustics to better understand how listeners evaluate violins as well as explore the influence of various parameters (the age (1), the model (2), the soundpost (3), the thickness of the plate (4), the effect of playing (5), etc.) on the perceived sound. While being live or via recordings, they all involved at least one player, playing many times the same short musical excerpt on various instruments. These studies involved a lot of discussions and pilot tests to design experimental conditions and protocols which could counterbalance the influence, on the quality evaluations of the instruments by the listeners, of the player, the reproducibility of the player, the bow that was used, the chosen excerpt, the order of the violins, the types of comparisons, … But to which extent? This study aims at investigating to which extent an instrument has a sound quality per se, independently of the player and the bow, by exploring what can be heard and discriminated within these experimental conditions (beyond the qualitative evaluations for which a large disagreement between listeners has been shown by these studies).

We took advantage of the gathering of violin and bow makers and scientists during a European workshop 'Science and lutherie' organized yearly by the first author and violin maker Paul Noulet. Critical listening sessions are part of the workshop daily routine, which thus make this group of people a relatively well trained audience. These sessions have many goals: ear training, negotiating some common vocabulary, comparing instruments and testing the influence of various modifications which are done during the workshop in order to correlate them with measured acoustical differences. We used these sessions during the 2021 workshop to design a series of listening tests to investigate what, among the three factors that are the player, the bow and the violin, can be recognized and discriminated.

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2. LISTENING TESTS

2.1 General design

All the listening tests were designed as N successive trials, during which one or two violins were played by one or two musicians, behind an acoustically transparent screen, on stage of a 340-seat auditorium. For each test, the participants (between 11 and 12 violin/bow makers and violin acousticians) had to answer the same yes-no question. The probability of a correct answer being 50% for each trial, the distribution of answers for a given participant follows a binomial law with p=1/2. Based on how this law varies with N, we considered that N=8 was an interesting number as the probability of making one or no mistake is below the usual 5% chance threshold. Therefore, we can rule out that a participant did the test by chance if they made no more than one mistake.

The downside of such design is the repetition. Both the audience and the players can get tired over the length of the test. This tiredness can lead the players to be less reproducible. But at the same time, the repetition can make them adapt more and more to obtain the sound that they want, thus smoothing the differences. This will be discussed more later.

2.2 Violin recognition

A first series of tests was conducted to investigate whether a trained audience could reliably distinguish between two violins and could recognize specific characteristics of an instrument across players and trials.

Tests 1a et 1b

For each trial, two violins were played successively. They were chosen randomly among a group of 8 violins. The participants had to tell whether they were two different violins or the same one played twice. In test 1.a, the two violins were played by two professional orchestra players, using their own bow. In test 1.b, they were played by only one of these two players, the same one for all trials. After a few pre-tests, the chosen musical excerpt consisted in only 9 notes, a G Major diatonic scale on the G string with 5 notes up and 4 notes down, to keep the length of the test reasonable and, so we thought, to reduce the difficulty with a short excerpt, which is not too musical.

Test 2a and 2b

Here, only one violin is played per trial, which shortens the test by more than half and thus reduces the tiredness and the problems of reproducibility. The violin played was selected randomly among two violins, labelled A and B, which were chosen collectively before the test as being the most different among the 8 that were available. So for each trial, participants had to tell whether it was violin A or not (i.e. violin B). The violins were played by a semi-professional violinist, who played an ascending and descending A Major scale (covering the register of the violin) followed by the opening of the Tchaikovsky concerto. We thought that the test being reduced, we could afford hearing a bit more and thus have more cues to make our judgment on. In test 2a, the player played with a different bow (selected randomly among a pool of 10 bows) for each trial to limit the adaptation of the player while in test 2b, the player always used his own bow, to reduce the source of variation.

2.3 Bow recognition

Talking about the famous recording by Janine Jansen of 12 Stradivari for which she chose carefully which bow to use among her two bows for each violin, Pauline Harding wrote: “Her two bows had a dramatic effect. It was interesting how everything changed.” (6) This resonates with beliefs in the community of violinists and bow / violin makers who claim that changing bow can completely change the sound of an instrument, and even that a bow has a sound per se. We thus designed two tests to study whether an audience could reliably recognise a bow. As pre-tests made us realise that it may be much harder than expected based on the beliefs, we decided to use two extreme bows: a violin bow made by a renown bow maker and and a middle-range viola bow (about 10g heavier).

Tests 3a and 3b:

For each trial, a violin was played with either the violin or the viola bow, by the same semi-professional violinist as in test 2. The musical material included a Ab Major scale covering the register to the violin, with one bow stroke per note on the way up and with an alternating of six rapid and staccato up and down bows (to illustrate the attacks allowed by the bow) on the way down followed by a very short excerpt from a Bach sonata. Similarly to what was done in test 2, test 3a was done with a different violin for each trial (chosen randomly among the pool of available violins) while test 3b was done on the player's own violin.

3. RESULTS AND DISCUSSION

The number of participants among the total number of participants who did each test at better than chance level is reported in table 1.

Table 1: Proportion of participants who succeeded better than 5% chance level, i.e. who made no more than one mistake for each test.

Test	1a	1b	2a	2b	3a	3b
Number of participants who succeeded better than chance level	1/11	1/11	5/11	5/12	3/12	2/12

Table 1 shows that for each test, only a very limited number of participants were able to succeed at better than chance level. The results of test 1.a seem to indicate that the same violin played by different players can have very different sound qualities which makes it difficult to tell whether it is the same violin or two different ones. Test 1.b's results show that it is not easier when it is the same player. This seems to indicate that the way a violinist play can have as much influence on the timbre than playing different violins. It is difficult for a violinist to play in a strictly reproducible way along the course of the test because of tiredness but more importantly because of adaptation. A good player is always trying to achieve "his/her" sound and so will modify his/her technique to get the sound he/she wants. Therefore, the differences decrease along the test and so it becomes harder for the audience to tell apart the violins. We thought that this adaptation could be limited by playing less the violins, as in test 2 (only one violin per trial instead of 2) and by playing them with different bows (2a) rather than one bow (2b). This seems to be the case, though not to a large extent, with still fewer than half of the participants being able to succeed. The protocol with only one violin in each trial allows a shorter test, but at the same time, may be more difficult because participants need to remember which violin is violin A. If a participant loses track at some point during the experiment, he may well be wrong for the rest of the test. This could be possibly solved in future tests by providing participants with the correct answer after each trial.

The last two tests, about bow recognition, have not been able to show any "bow sound" with only very few people having been able to distinguish two very different bows at better than chance level. Though players claim that the bow can have a large influence on the sound, one can expect, from a mechanical point of view, that this influence will be rather on temporal aspects (like the precision of the attacks or the articulation between notes for instance) rather than on the timbre of the instrument (7). Therefore, one may expect a smaller influence on the resulting sound from the bow than from the violin, and it is thus not surprising that participants could not recognize bows if they were not able to recognize violins.

4. CONCLUSION

These series of listening tests are a first attempt at exploring, beyond any qualitative judgement, what can possibly be recognized in a reliable way by a trained audience when violins are played in similar experimental conditions as previous published studies on violins sound quality, involving the repetition of rather short excerpts on various violins. The results raise interesting questions about the timbre of an instrument: can a violin have some intrinsic sound qualities that can be recognized across players and bows and if yes, how can we access/perceive them in a reliable way? Further work and more listening tests are definitely needed. They could be of significant importance in the current context about the shortage of the Pernambuco wood (traditionally used for bows), which is still used, despite more and more CITES regulations attempts (8), since makers and musicians claim it gives a “better sound”.

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