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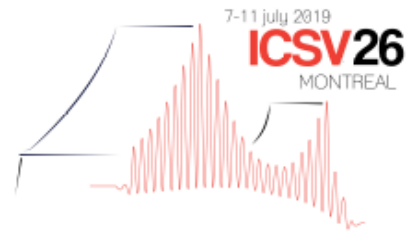
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PLAYER EVALUATION OF PERFORMANCE AND STUDENT VIOLINS

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Several playing experiments have been reported in recent years to assess violin qualities but the results have shown large inter-subject inconsistencies. A new perceptual playing experiment was conducted to examine how violinists might differentiate between “good” and “bad” violins, and to what extent they might agree with each other. A pool of six violins was assembled: three performance violins and three student violins. Nine violinists participated: 3 professional violinists, 1 graduate student, 4 undergraduate students in music performance and 1 had a conservatory degree. The experiment was organized in two phases. During the first phase, subjects were asked to rate and rank the six violins from least preferred to most preferred on a continuous scale. During the second phase, subjects were asked to rate and rank the violins according to five criteria: responsiveness, resonance, clarity, richness, and balance. The results showed that the three performance violins were on average rated significantly higher than the three student violins in terms of preference and all five criteria except responsiveness. We also found that the violinists preferred violins with richer and clearer sound. Three professional violinists rated performance violins much higher than student violins.

Keywords: violin quality evaluation, perceptual experiments

1. Introduction

It has been a long-standing goal for scientists to find correlations between measurable physical properties, acoustic characteristics and the perceived sound qualities of music instruments. The fundamental premise of “goodness” of the violins however had not been investigated scientifically until recent years. In [1] and [2], the researchers designed two perceptual experiments to examine violinists’ preference between old and distinguished Italian violins and new violins made by professional violin makers. The studies found that the violinists could not tell old violins from the new ones at better than chance levels. A general preference for new violins was shown within their studies. To investigate how players evaluate the violins and whether there is agreement between them, Saitis et al. [3] conducted a series of experiments. They found that players were self-consistent evaluating violins in different trials and different days but that there was a significant lack of agreement between different individuals. The participants were also asked to rank the violins according to several specific criteria. It was shown that the violinists

tended to prefer instruments that they judged to have high “richness” and “dynamic range,” though there was no agreement in terms of which instruments were most “rich” or had the largest “dynamic range”.

Before the formal experiments, Saitis et al. conducted a pilot study to select instruments for the experiments. They found that the musicians could easily discriminate the poorly maintained Suzuki instruments. Thus, those violins were omitted from consideration as it was felt they would skew the consistency of the results. On hindsight, we began to wonder why the musicians could consistently distinguish the poorly maintained Suzuki violins from “good” violins. Are there some specific poor qualities of violins agreed upon by most violinists in the Suzuki violins? If the answer is yes, it might be possible to correlate the “bad” qualities to acoustical characteristics and physical measurements of the violins. Thus, this experiment sought to repeat the pilot study of Saitis et al. [3] to assess whether the lower quality Suzuki violins would be consistently distinguished from the better quality violins under more controlled conditions and whether there would be agreement regarding the qualities of those instruments that the subjects found less desirable.

2. Materials and Methods

This section describes the details of this experiment. It includes general design, test violins, characteristics of participants, controls and detailed procedure.

2.1 General Design

The goal of this experiment is to examine whether there is agreement on less desirable features of violins among violinists, and whether they agree on what the less desirable features are. This experiment consisted of two phases. The first phase allowed the violinists to rate all violins on a continuous scale from 0 to 5 based on their own preference. After the preference rating, several open questions were given to the subjects to answer in order to determine how different violinists evaluate violins. During the second phase, the subjects were asked to rate each violin on a continuous scale from 0 to 5 for responsiveness, resonance, clarity, richness, and balance.

2.2 Test violins

A pool of 3 performance violins (labeled P1, P2 and P3) and 3 student violins (labeled S1, S2 and S3) from Schulich School of McGill (SSM) was assembled. The performance violins were from a set of higher quality instruments donated to the SSM over the years while the student violins came from a collection of Suzuki violins used by music education students. They were not played on a regular basis, especially the performance violins. While scientific studies [1,2,4] may suggest that this should not influence the individual evaluations, players may argue that this could lower the perceived quality of these instruments. However, it should certainly not influence inter-individual agreement. Violin P1 was adjusted and setup with new strings before the experiment. The violinists were given the option to either use a provided shoulder rest (Kun Original model), use their own shoulder rest, or not use a shoulder rest at all.

2.3 Participants

Nine violinists took part in this experiment (6 females, 3 males; 6 native English speakers, 2 native Chinese speakers and 1 native Catalan speaker; average age=30 yrs, SD=14 yrs, range= 20-55 yrs). They had at least 12 years of violin experience (average years of violin playing = 22 yrs, SD=11 yrs, range = 12-40 years; average years of violin training = 14 years, SD=4 yrs, range = 8 – 23 yrs; average hours of violin practice per week = 19 hrs, SD= 13 hrs, range= 0 – 35 hrs). The estimated prices of their own violins range from \$10K to \$20K, and they were paid for their participation. Three violinists described themselves as professional violinists, and 1 had a master’s degree in music performance (MMus), 3 had bachelor degrees (BMus, B.A.), 1 had a conservatory degree, and 4 were undergraduate students in music

performance. They reported playing various musical styles [classical (100%), folk (22%), baroque (22%), jazz/pop (44%), contemporary (22%) and electronic (11%)], and in various types of ensembles [chamber music (67%), symphonic orchestra (89%), solo (67%), private violin teacher (11%), electronic (11%), indie (11%), and R&B (11%)].

2.4 Controls

The possible effect of visual information, such as the style of the violin, the colour of the varnish, identifying marks of the violin, may cause preference biases in the evaluation process. In order to eliminate this possible influence and also ensure the safety of the players and instruments, the subjects were provided dark sunglasses and the light level in the room was significantly reduced.

Considering, like in previous studies [e.g. 1-3] the bow as an extension of the player, we asked violinists to use their own bow. The violinists were also asked to bring their own violins with them, in case they wanted to use it as a reference during the tests.

This experiment took place in a diffusive sound space (walls treated with diffusive panels) in order to minimize the effects of room reflections on the direct sound from the instruments. The area of the room was approximately 27 m², and the reverberation time was approximately 0.18s.

2.5 Detailed procedure

This experiment was organized in two phases and lasted around 1 hour. Subjects were scheduled individually. The experimenter was constantly present in the room for instructing and taking notes for the subjects. Before the experiment, the subjects answered a questionnaire and signed the consent form. Then they were given instructions about the experiment. Before the experiment, the six violins were assigned a letter from A to F randomly, to avoid presentation order effects; the letter was written on a small piece of paper, which was then stuck on the scroll of each violin. The violins were ordered from A to F and placed on a table along with the subject's own violin. During the first phase, the subjects were given up to 25 minutes to play all six violins, and compare and rate the violins from least preferred to most preferred on a continuous scale from 0 to 5. Subjects were free to play the instruments in any manner and any order. They were also encouraged to comment out loud when assessing the violins, and the experimenter took notes of the subjects' comments. They were instructed to follow their own strategy imagining that they were choosing violins for themselves at a violin shop. They were allowed to play their own violins whenever it seemed useful. Upon completing the first phase of the experiment, subjects were asked to provide written responses to a set of very general open-ended (in order to avoid confining the answers into pre-existing categories) questions as follows:

A1. *How and based on which criteria did you make your rankings/ratings?*

A2. *Why did you choose the violin ranked as the most-preferred?*

A3. *Why did you choose the violin ranked as the least-preferred?*

A4. *In general, what distinguished the less-preferred violins from the more-preferred violins?*

A5. *Do you have any comments or remarks about the task you were involved in? To what extent was wearing sunglasses disturbing?*

After finishing the first phase of this experiment, subjects were given five criteria for assessment of each violin: responsiveness, resonance, clarity, richness and balance. The criteria were carefully chosen from previous publications [1, 2, 3]. Subjects were given 5 minutes to evaluate each criterion and rate the six violins on a continuous scale from 0 to 5. To ensure all subjects had a common interpretation of the rating scales, each criterion was presented with a descriptive phrase and an explanatory text.

After the rating of each criterion, subjects were given a question to answer in written form:

B1. *Do you have specific comments or remarks about the "balance (each criterion)" of the violins? Was there a particular behavior in the violin rated as least balanced or the one rated as most balanced?*

After rating all five criteria, subjects were asked to answer two optional questions:

- C1. Do you have any other further comments or remarks about the violins?
- C2. Would you like to change the preference ranking after rating these criteria?

3. Detailed analyses and results of phase 1

This section provides the subjects’ preference ratings of the violins and verbal responses from phase 1. This section also studies the rating difference between performance violins and student violins. The relationship between the rating difference and subject characteristics are also analyzed.

3.1 Overall preference ratings of the violins

The across-subjects average preference score for each violin is shown in Fig. 1. Error bars of two-sided 95% confidence interval (CI; all CIs are two-sided 95% intervals through this chapter) of the means are also displayed. Violin P2 has the highest mean rating in terms of preference, and the 95% CI for the population mean is [2.15,4.78]. The mean rating of violin S2 is markedly below the other violins, and the 95% CI for the population mean is [-0.04, 2.88]. Independent-Samples Kolmogorov-Smirnow test showed that the null hypothesis that all six violins had the same population means could not be rejected, i.e., the overall preference ratings between the six violins were not significantly different.

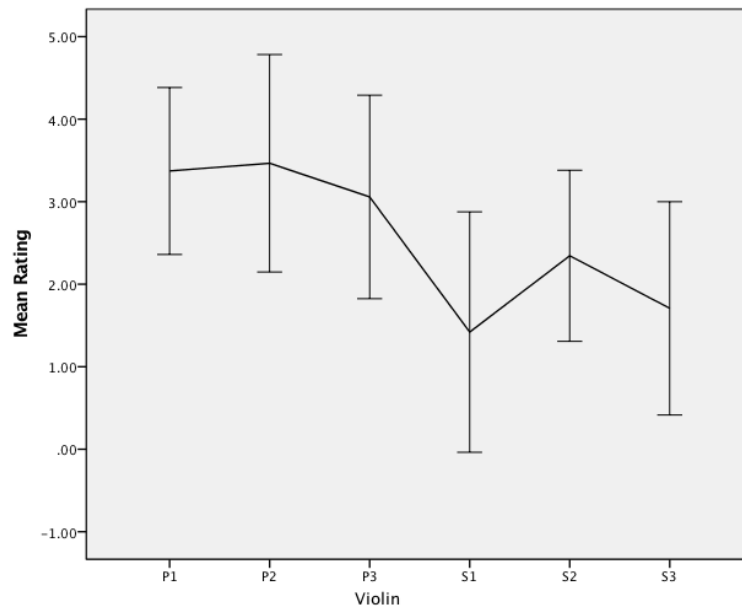


Figure 1: Across-subjects average of the overall preference score for each violin (error-bar = 95% confidence interval of the mean).

3.2 Difference between performance violins and student violins

The ratings of performance violins and student violins were compared in this section. The mean rating of performance violins is 3.30, 95% CI = [2.70; 3.89]; the mean rating of student violins is 1.82, 95% CI = [1.18; 2.47]. An independent-samples Mann-Whitney U test showed that the null hypothesis that the two types of violins had the same population mean could be rejected.

3.3 Influence of participant characteristics

The association between preference rating difference (performance violins and student violins) on the one hand, and the self-reported age, degree in music performance, the years of violin experience, weekly hours of violin practice and price of the owned violin, on the other was assessed. This analysis was carried out by calculating the Spearman rank correlation ρ_s between preference rating difference and

participant characteristics. The correlations between age, degree and rating difference were significant: $\rho_S=0.835$ ($p=0.005$) and $\rho_S=0.766$ ($p=0.016$), respectively. Participants who were older, those who were professional musicians, and/or with a higher educational degree in music performance rated performance violins much higher than student violins.

3.4 Conclusion

The results of phase 1 of this experiment showed that performance violins were on average rated significantly higher than student violins in terms of preference even though there was no significant difference between the ratings of the six violins. And it was found that the subjects who were older, those who were professional musicians, and/or with a higher educational degree in music performance rated the performance violins much higher than the student violins.

4. Detailed analyses and results of phase 2

In this section, the results of phase 2 were analyzed. The analysis was conducted in the following aspects: comparison of the attribute criteria ratings between the six violins, between performance violins and student violins, the relationship between preference and criteria ratings, and the verbal descriptions of each attribute by subjects.

4.1 Criteria ratings

Across-subjects average ratings on specific criterion of each violin are shown in Fig. 2. Violin P2, the violin which had the highest mean preference rating in phase 1, was rated as most rich and most resonant, but the second least responsive and medium clear and balanced. Violin S1, the violin which had the lowest mean preference rating in phase 1 was rated the worst in every criterion. Violin P1 was rated as most clear. Violin P3 was rated as most balanced. The responsiveness of violin P1, P3, S2 and S3 were rated similarly.

An individual sample Kruskal-Wallis test was carried out to test the equality of the mean specific criterion ratings of the six violins. The results showed that only richness and balance lead to significantly different ratings between the violins. Further investigation showed that this is due to significant differences in richness between violins P1 and S1 ($p=0.028$) and P2 and S1 ($p=0.006$), and a significant difference in balance between violins P3 and S1 ($p = 0.003$).

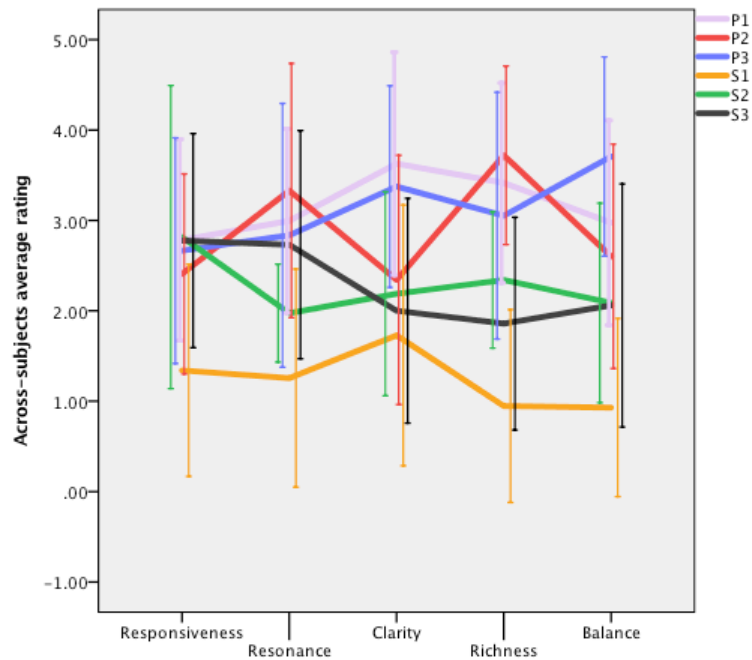


Figure 2: Across-subjects average ratings on specific criterion of each violin (error-bar = 95% confidence interval of the mean).

4.2 Difference between performance violins and student violins

Across-subjects average attributes ratings on performance violins and student violins were also analyzed. Performance violins were on average rated higher than student violins for each criterion except responsiveness. An independent-samples Mann-Whitney U test showed that the null hypothesis that the two types of violins had the same population means could be rejected for all the criteria except responsiveness.

4.3 Relationship between preference and attribute ratings

The violinists may have employed a highly economic strategy in the evaluation process, which might lead to similar ratings to all rating scales. One of the subjects had mentioned at the end of this experiment: “each violin had very different personalities but when broken down into categories it is hard to list them without taking other aspects into account”.

To avoid this interpretation when analyzing the relationship between preference ratings of phase 1 and attribute ratings of phase 2, partial correlation coefficients ρ_p was employed. $\rho_p(A, B \cdot C)$ measures the correlation between A and B removing the effect of variable C. For example, in order to measure the correlation between preference and resonance, the effect of responsiveness, clarity, richness and balance were eliminated by the calculation of $\rho_p(Resonance, Preference \cdot responsiveness, clarity, richness, balance)$.

Partial correlation coefficients ρ_p were computed between each of the attribute scale ratings and the preference ratings of all subjects. The results are shown in Fig. 3. All criteria ratings correlated to preference ratings positively except the responsiveness ratings. Richness and clarity correlated to preference significantly: $\rho_p=0.507$ ($p=0.0002$) and $\rho_p= 0.282$ ($p=0.047$), respectively. The results thus indicated that subjects preferred violins with a richer and clearer sound. None of the other partial correlation coefficients between attributes ratings and preference ratings was significant ($p>0.05$).

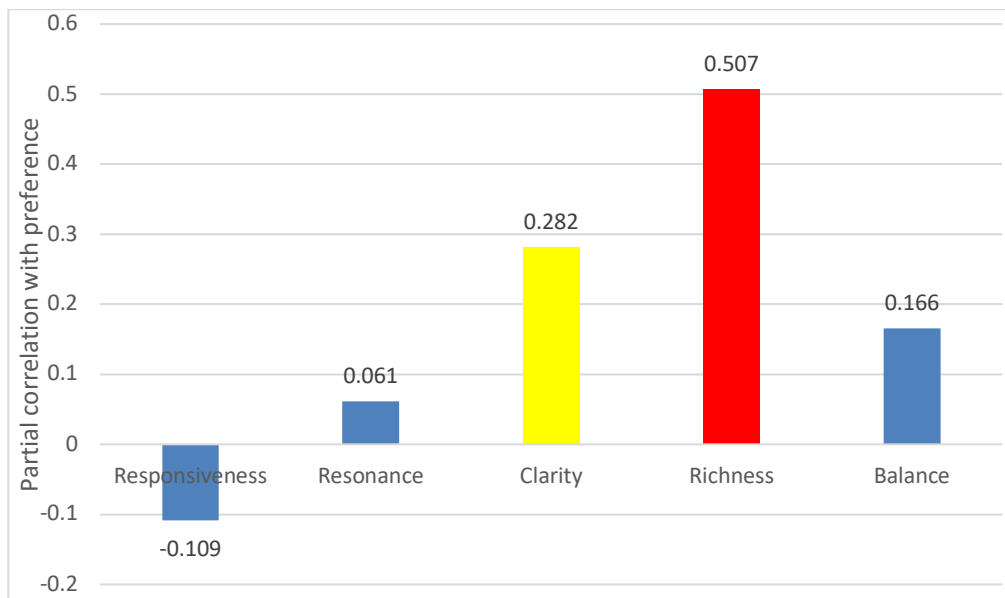


Figure 3: Partial correlation coefficient ρ_p between ratings of each attribute scale and preference.

4.4 Verbal descriptions of violin attributes

The subjects were asked to give comments or remarks about the specific criterion that they had evaluated and describe the particular behavior they noticed of the violin that was rated as best or worst for that criterion.

For responsiveness, some subjects thought the most responsive violin had very clear sound at the attack of string and required less effort to create the sound. Some subjects thought responsiveness meant ringing and sound coming out. Subjects thought the sound of the least responsive violin was small, noisy, and less resonant. One subject mentioned that the violin with a bad and dry sound responded quickly, while the violin with a thick sound needed more time to respond. Another subject commented that the violin with a lower bridge responded fast, but the sound wasn't solid.

For resonance, subjects considered that the most resonant violin had a bright sound and rang very open, overtones came out, and which could be powerful; the least resonant violin had a muted, stiff sound with no ringing/brilliant qualities. Two subjects thought that resonance was different from responsiveness, as not the more resonance the better: good resonance seems to imply ringing very well, but dark sounding instruments usually have less resonance, e.g. muffled, so the challenge is to find a good "dark" violin: "ringing one still dark".

For clarity, three of the subjects considered that clarity was related to responsiveness. They commented that the clearest violin was easy to obtain a brilliant, pure, concentrated and clean sound, which didn't change with bow force. Each note boomed nicely, and the ringing tones around it helped with the transition between notes, making them connect well with each other. The least clear violin had a buzzing, muddy sound that lacked purity, and it became more serious as the bow force increased. There was one subject however who thought the clearest violin was brilliant but lacked flavor. So, his most preferred violin had good flavor, but was not the clearest violin.

For richness, subjects generally thought the richest violin had lots of colour and undertones in the sound and good expression. The sound was deep, dark, sweet, thick, big and fat. Two subjects considered that richness was partly related to resonance. They considered that the least rich violin did not have many colors and lacked depth, the sound was hollow, open, narrow and flat.

For balance, the subjects considered the most balanced violin had an even, consistent sound and stable, balanced playing across strings. The least balanced violin sound was considered either not thick in the lower register, not bright in the higher register or good at one side but bad at the other side. Some subjects

considered the overall bad sounding violins as balanced. Finally, some subjects thought that the bridge mattered a lot. They thought that the most balanced violin resonated and rang well over all strings; the least balanced violin had a sloped bridge that did not allow the strings to resonate separately.

4.5 Conclusion

Performance violins were rated significantly higher than student violins in all attributes rating scales except responsiveness. The analysis of relationship between preference ratings and attributes ratings showed that violinists preferred violins with rich and to a lesser extent clear sound.

From verbal collections, the violinists stated that some rating criteria of the violins were correlated despite that we have given them definitions of each criterion, e.g., resonance and richness, clarity and responsiveness. Resonance and responsiveness were anti-correlated to some extent.

5. Conclusion

This study investigated players evaluation between performance and student violins through a perceptual playing test. The results showed that performance violins were on average rated significantly higher than student violins in terms of performance, and all five attribute criteria except responsiveness. Through the analysis of the relationship between preference ratings and attribute ratings, we found that violinists preferred violins with rich and to a lesser extent clear sound.

And it was found that the subjects who were older, those who were professional musicians, and/or with a higher educational degree in music performance rated the performance violins much higher than the student violins in terms of preference.

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