Supporting Information

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SI Text

Subject Demographics. All subjects were trained as classical players and play predominantly classical music. Demographic details are given in Table S1, which uses information from the questionnaires completed by each subject. We did not verify this information independently.

Most of the subjects were involved with the International Violin Competition of Indianapolis (IVCI), as shown by Table S2.

Instructions. Each subject was given an instructions sheet containing the following information to read before the experimental session.

How do musicians evaluate violins?
Indianapolis, September 2010
Instructions to Read by the Player

Thank you for taking part in this study! Our goal is to better understand how violinists evaluate violins. There are no wrong answers to any of the questions! We are simply asking for your personal preferences, based on your expertise as a player. We hope you will feel free to express yourself!

To prevent you from identifying instruments by visual clues, we ask that you wear darkened goggles for the entire experiment.

For the well-being of the instruments, please wash your hands before playing and please hold the instruments by the neck and chinrest only!

The first part of the experiment involves a series of 10 pairs of violins. The violins will be presented to you one pair at a time, laid out in front of you on the bed.

Although you are free to play anything you like on them, we ask that you play them in a specific order and for a specific amount of time.

First play the instrument marked "1" for one minute (after which a bell will ring), then play the instrument marked "2" for one minute. The minute starts with the first note you play on an instrument and includes any tuning.

When you have finished, please answer the following question: "Based on this brief trial, which of the two instruments do you prefer: 1 or 2?"

When all 10 pairs have been played, you will be asked to evaluate a number of instruments in a manner that will be described to you at the time.

Before starting the experiment, could you please read and sign the Informed Consent Form?

The instructions of part 2 were not written on this sheet so as to not introduce any bias. They were therefore read to each subject at the end of part 1:

We now move on to the second part of the experiment. Six violins are laid out on the bed. You have 20 min to play them in any manner you wish, to answer the following questions:

* If you could go home with one of these violins, which one would you choose? Why?
* Which are the best and the worst instruments in terms of projection?
* Which are the best and the worst instruments in terms of playability?
* Which are the best and the worst instruments in terms of range of tonal colors?
* Which are the best and the worst instruments in terms of response?
If a term lacks clear meaning for you, do not choose in that category.

Please feel free to talk out loud about what you think, make any comment about your feelings, express your reactions to instruments while doing this.

Detailed Analyses and Results of Part 1. *General information.* Unless otherwise stated, the analysis is based on the primary set of nine pairs (i.e., with the retests omitted), in which each instrument was played just once by each subject (because 21 is not a multiple of 9, some violins were played more often than others in the retests).

All confidence intervals (CI) and P values presented here are two-sided.

Preference. In testing the nine pairs, each violin was presented three times to each subject. Table S3 shows the number of times (NoT) each violin was preferred by each subject. The last column shows the total number of times (NoTOV) each subject preferred an old violin. Statistics for the total number of times are presented in Fig. S1.

The mean and the SD are 3.7 and 1.9, respectively. The observed mean is thus markedly below the equal preference point (4.5). The 95% CI for the population mean is [2.9; 4.5], and thus the test of the null hypothesis 4.5 is nonsignificant at a 5% level ($P = 0.053$).

Age of a subject's violin as a covariate. We looked at the approximate age of each subject's violin (ASV) as a possible covariate. The correlation of ASV with NoTOV is 0.31, 95% CI = [−0.1; 0.6], $P = 0.170$. Thus, there is no evidence that ASV affected the subjects' preference decisions. However, when ASV is used as a covariate, it increases the significance of the result: the adjusted mean for NoTOV becomes 2.8, 95% CI = [1.4; 4.3] and $P = 0.030$ for the null hypothesis 4.5.

Effect of presentation order within a pair. For each subject, we computed the mean of NoTV when the presentation order of the pairwise comparisons is new/old (NO) and then old/new (ON). The analysis of the difference between these two means (NO–ON) gives a mean difference of 0.04, SD = 0.27, t (20 df) = 0.64, 95% CI = [0.09; 0.16], $P = 0.531$. There is therefore no evidence of a presentation-order effect. Moreover, if an absolute value of 0.150 is considered the limit of a small effect, it can be concluded (with a 5% type I error) that the effect is, at most, small, the limit of the Westlake interval being 0.141.

Retested pairs. Considering now the retested pairs, just 11 of 21 subjects (52%) made the same choice twice. The 95% CI is [30%; 74%], meaning no firm conclusions about player consistency can be drawn. Note, however, that if subjects perform no better than chance in such a test, two possible conclusions might be drawn: (*i*) as suggested in Table 1 for five of the violins, the instruments are about equal in overall quality, and so forcing subjects to choose among them (in effect) forces random choices, where consistency cannot be expected, and (*ii*) subjects cannot choose consistently under test conditions, which may therefore be unsuited to studying player preferences. For 9 of the 11 "consistent" subjects, the test and retest were separated by no more than four other pairs, whereas the same was true for only 3 of the 10 "inconsistent" players. Player fatigue may be a factor when judging so many violins in such a short time.

Detailed Analyses and Results of Part 2. *Take-home choice.* Table S4 gives the distribution of the responses for the six violins.

Link between take-home choice and the four criteria. What drives the subjects' choices? There is evidently some link between the take-home choice and the four criteria because the take-home violin for each subject was selected as best for at least one criterion (Table S5). Moreover, the take-home choice was the highest-scored violin

for all but four subjects, for whom there was clearly a tradeoff among the four qualities.

Comparing the six violins. *Overall comparison of the six violins by the four criteria.* Table S6 shows that the null hypothesis that all six violins have the same population mean can be rejected for the four criteria.

Comparison between new and old violins. In Table S7, we compare the mean of the new violins (N1, N2, and N3) to that of the old ones (O1, O2, and O3). The effect is the difference between the means for new and old, so that a positive value indicates that new violins score better.

At a descriptive level, we can see there is a marked effect for playability and a notable one for response. Both are significant at a 0.05 level. More uncertainty remains for projection and tone colors.

Comments of the two jurors. [S12]: *En ce moment, mon violon n'est pas en forme: l'âme a été changée juste avant mon départ pour les US, mais il faut la réajuster. Donc N2 est peut-être meilleur que le mien vu son état actuel. Cependant, de mémoire, le mien a plus de culture sonore, c'est un Strad qui a une énorme personnalité. Il n'est pas facile à jouer mais il a un timbre spécifique sur chaque corde, comme N2. Mais N2 est plus ouvert que le mien. Il faudrait essayer N2 dans une grande salle. Je sais que le mien pénètre jusqu'au fond de la salle alors que de près, il n'est pas forcément super.*

Translation: At the moment, my violin is not in great shape: the soundpost was changed just before I left for the US, but it needs to be adjusted again. So N2 is maybe better than my own violin in its current state. However, from memory, mine has a more cultivated sound; it's a Strad with an enormous personality. It's not easy to play but it has a specific timbre on each string, like N2. However, N2 is more open than mine. N2 should be tried in a large room. I know that mine penetrates to the back of a hall, although from close up it's not necessarily great.

[S21]: [About N3] *I don't know if it's old or new. It's similar to mine in terms of response and quality.*

Comments of the participants about the age of the violins. [S2]: *I have a bias to modern instruments. My guess is that N3 is a modern instrument. O2 is older.*

[S3]: [O1] *French school, which is not appealing to me*

[S4]: *I think that O2 is maybe a Guarneri because of the dark color. However, I don't know for sure, it's just a guess.*

[S7]: [N2] *I hope it's an Italian!*

[S8] – [S10] – [S11] – [S14] – [S15] – [S18]: *No clue.*

[S9]: *No idea because I can't see!*

[S12]: [N2] *Something from a Guarnerius. However, I can't say its age . . .* [a few min later] *To my mind, it's nevertheless a modern instrument.*

[S16]: *O2 could be a Strad. And N2 could be a del Gesu.*

[S17]: *N2 is old and O2 feels like a new instrument. O1 sounds like a French instrument, from 1800 to 1840.*

[S19]: *N3, I think it's an old Italian violin, and N2 too.*

[S20]: *O1 definitely sounds like a modern violin because it's very bright, doesn't have a depth, doesn't have a round ring. N1 sounds like an old rare violin. O2 is an old violin and N2 is old too.*

[S21]: *N1 is an old Italian violin, or not?*

Comparison of Parts 1 and 2. *Comparison of the preferred violins from both parts.* For part 1, a subject's general preference is expressed as new (N) or old (O), depending on whether they chose new or old more often from the nine pairs. Table S8 compares this general preference to the type of violin they chose "to take home" in part 2.

Of the 15 who chose new violins more often than old ones in part 1, 7 later chose old violins to take home; against this, five subjects who chose old violins more often in part 1 later chose new violins to take home. By this measure, just 9 of 21 were consistent—although this finding seems unsurprising given the way preferences shifted as time was spent with individual instruments (see comments below).

Players' comments about the evolution of their judgment. [S2]: *Liking it* [N1] *more the more I play it.*

[S16]: [O2] *It's quite hard to play* [first impression . . . and then] *there is a solidity to the sound, a core which is sweet, actually sweeter than N1. It plays nicely quickly, it responds well.*

[S19]: [O1] *Good resonance . . .* [and then] *the higher I go on the G-string, the sound doesn't resonate.*

[O3] *D & A are a bit nasal: this is my first impression, but the more I play it, the less I hear this nasality.*
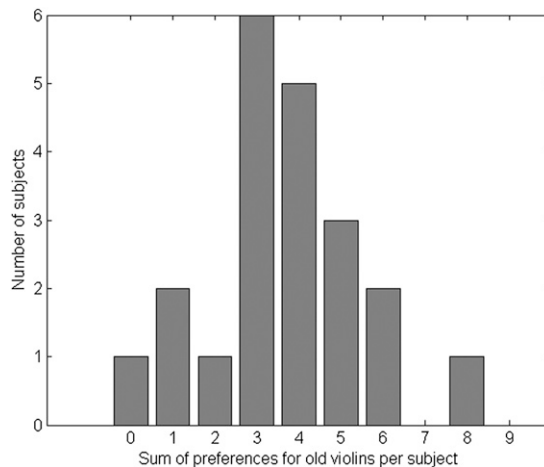

Fig. S1. Histogram for the number of times an old violin was preferred (NoTOV).

Table S1. Details of the 21 subjects

Subjects' age	20–65 y (mean: 40, SD: 14)
Years playing violin	15–61 y (mean: 34 y, SD: 13 y)
Age of the subjects' violins	3–328 y old (mean: 160 y old, SD: 110 y old)
Approximate value of the subjects' violins	$1,800 (US) to $10 million (mean: $850,000, SD: $2.3 million)
Has advanced degree in music (master's or doctorate)	10 subjects
Professional musician	19 subjects
Performs as soloist	11 subjects
Performs chamber music	16 subjects
Plays in orchestra	14 subjects

Table S2. Relation of the subjects with the IVCI

IVCI contestants	4
IVCI jury members	2
Indianapolis Symphony*	8
Others	7

*The Indianapolis Symphony was involved in concerto performances with the contestants.

Table S3. Number of times (NoT) each subject preferred each violin in a pair-wise comparison and then the total number of times (out of nine pair-wise comparisons) that each subject preferred an old violin (NoTOV)

Subject	NoT each violin was preferred						NoTOV
	N1	N2	N3	O1	O2	O3	
1	0	2	1	1	2	3	6
2	3	2	3	0	1	0	1
3	1	2	1	1	2	2	5
4	1	0	0	3	3	2	8
5	1	3	2	0	1	2	3
6	2	2	2	0	3	0	3
7	2	2	0	2	2	1	5
8	3	2	3	0	0	1	1
9	1	2	3	1	1	1	3
10	3	1	2	1	1	1	3
11	2	1	2	0	1	3	4
12	0	1	2	2	2	2	6
13	2	2	1	1	2	1	4
14	1	1	3	0	2	2	4
15	2	2	1	0	1	3	4
16	2	2	2	0	3	0	3
17	1	2	1	1	2	2	5
18	3	3	3	0	0	0	0
19	1	3	3	0	1	1	2
20	3	2	1	1	0	2	3
21	2	2	1	0	2	2	4
Total	36	39	37	14	32	31	77

Table S4. Number of times each violin was chosen to be taken home

Violin	N1	N2	N3	O1	O2	O3
Times taken home	2	8	3	1	5	2

Table S5. Number of subjects for whom the take-home violin was rated as best for a given number of criteria (between 0 and 4)

Number of criteria	4	3	2	1	0
Number of subjects	6	7	4	3	1*

*Subject could not complete the task related to the four criteria.

Table S6. Test for equality of the means of the six violins

Evaluation term	Effect	F (5, 100 df)	P
Playability	0.33	3.95	0.003
Projection	0.37	3.96	0.003
Tone colors	0.30	2.68	0.026
Response	0.37	4.42	0.001

Effect is the quadratic mean of the differences between the sample means of the violins. (Huynh–Feldt adjustment for circularity only changes P from 0.003 to 0.004 for playability.)

Table S7. Test for the equality of the means of the new and old violins

Evaluation term	Effect	t(20 df)	P	95% CI
Playability	0.33	3.62	0.002	[0.14; 0.53]
Projection	0.06	0.51	0.618	[-0.20; 0.33]
Colors	0.19	1.87	0.076	[-0.02; 0.40]
Response	0.27	2.58	0.018	[0.05; 0.49]

Table S8. Preference for old (O) or new (N) violins for each subject in parts 1 and 2

Subject	Part 1	Part 2
1	O	N
2	N	N
3	O	N
4	O	O
5	N	N
6	O	O
7	O	N
8	N	N
9	N	O
10	N	O
11	O	N
12	O	N
13	N	O
14	N	O
15	O	N
16	O	O
17	O	N
18	N	N
19	N	N
20	N	O
21	N	N