## A study of ageing and playing effects on violins: the first three years

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# Is a Violin like Wine?

### Physics and Music?





Musicians will go to extraordinary lengths to improve their instruments!

# A common question asked by violinists



Giovanni Francesco Barbieri (Guercino): "St Francis with an Angel Playing Violin"

#### Do violins 'play in'?

Hutchins, C.M.: "A Measurable Effect of Long-Term Playing on Violin Family Instruments," *Catgut Acoustical Society Journal*, **3** (series II), (May 1998)

Turner, R: "Instant Vintage: Can a Vibration Machine Make a New Guitar Sound Like an Old Guitar?" *Acoustic Guitar Magazine*, 36-41 (Feb. 1997)

# Another common question asked by violinists



Do violins improve with age?

#### Lack an ideal reference or control violin

(Image from fotservis.typepad.com/.../ 2004/08/)

### The 'Powerhouse Twins'









### Project Goals

Attempt to address possible ageing and playing effects by measuring:

- •Material properties of wood used
- •Vibro-acoustic parameters at various construction phases
- •Responses of listening/playing tests (psychoacoustics)

### Wood Characterisation



High quality violin wood

The finest *Picea excelsa* (top-plate) and *Acer pseudoplatanus* (back-plate)
From the same wood block
Seasoned for 80 years

(Image from www.violin.ch/work\_a.htm)

But, even so...









$$\overline{E_L} = 12.67 \pm 0.53(5) \quad GPa \qquad \overline{E_L} = 11.54 \pm 0.41(5) \quad GPa 
\overline{E_R} = 1.89 \pm 0.96(3) \quad GPa \qquad \overline{E_R} = 0.70 \pm 0.05(2) \quad GPa 
\overline{\rho} = 465 \pm 8(24) \qquad kg \cdot m^{-3} \qquad \overline{\rho} = 451 \pm 11(14) \qquad kg \cdot m^{-3}$$

(Moisture content: 11.6%)

Phase	Description
P1	Properties of raw wood



Phase	Description
P2	Plates carved to shape



Phase	Description
P3	<i>f</i> -holes and bass-bar installed



Phase	Description
P4	Finished violins



Phase	Description
P5	Three years after finishing



Phase	Description
P6	Three years after finishing: played instrument altered



(3 days after P5)

### Vibro-acoustic tests

Are there any physically measurable differences between the two instruments?





























### Impact Measurements





#### **Comparison of Violin Pressure Spectrograms**



**One year later** 



### Listening/Playing tests

Are competent humans able to distinguish between the two instruments?

#### **Venue:** Large concert hall (Clancy Auditorium, UNSW)

Subjects: Most proficient violinists from UNSW Orchestra (7<sup>th</sup> grade-Licentiate)



### Procedure



•Live players

•Each played 3 trials of a set piece

•Violins presented in pseudorandom order from behind a screen

•Participants were left unaware of the nature of the test

## Responses

Players	Listeners	Data type
Warmth	Evenness	Ordinal(1-10)
Evenness	Clarity	Ordinal(1-10)
Brightness	Projection	Ordinal(1-10)
Speaking ability	Character	Ordinal(1-10)
Playability	Warmth	Ordinal(1-10)
Responsiveness		Ordinal(1-10)
Character		Ordinal(1-10)
Dynamic range		Ordinal(1-10)
Preference (sound)	Preference	Ranking
Preference (playing)		Ranking



- P4: Violins newly finished
- P5: Three years after P4
- P6: Three days after P5 (with adjustments to the played violin)



P4: Violins newly finishedP5: Three years after P4P6: Three days after P5 (with adjustments to the played violin)

### **Statistics (or just a lie?)**

Probability of no false positives in all 48 comparisons at the 95% confidence level:  $(0.95)^{48} = 0.085$ 

Probability of no false positives in all 48 comparisons at the 98% confidence level:  $(0.98)^{48} = 0.379$ 

Therefore these results are not inconsistent with the hypothesis that the violins are indistinguishable

### A Notable Exception

Romano Crivici: owner (and player) of the played violin



Blindfold test, pseudorandom order: 20 correct guesses from 24 trials

Significant at the 99% level

### Conclusion

•Some measurable differences in properties of wood and free plates

•Some measurable differences in the physical responses of the instruments

•A panel of expert listeners *did not* distinguish between the two, directly after finishing the instruments or three years later

•A panel of expert players *did not* distinguish between the two, directly after finishing the instruments or three years later

•The owner of the played violin *could* distinguish between the two, well above chance levels

### BBC radio's conclusion



### Future Work

- •A long-term study (decades?)
- •May be able to separate potential effects due to playing and ageing
- •May be able to establish a relationship between changes in wood and changes in the instrument

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### Thank you, Adelaide!



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#### Comparison of Violin Spectrograms: V1 and V2









#### Comparison of Violin Spectrograms: Lark Comparison









### Results: Listening/Playing

#### (95% level)

Players: P4			Players: P5			Players: P6		
Category	P(T<=t)	df	Category	P(T<=t)	df	Category	P(T<=t)	df
Warmth	78.8	40	Warmth	54.6	43	Warmth	46.1	37
Evenness	10.8	37	Evenness	72.9	43	Evenness	65.1	37
Brightness	8.5	40	Brightness	49.9	43	Brightness	68.0	37
Speaking Ability	4.1	20	Speaking Ability	51.3	43	Speaking Ability	32.4	37
Playability	61.5	40	Playing	42.0	43	Playing	80.0	37
Responsiveness	22.7	40	Responsiveness	96.9	43	Responsiveness	92.6	37
Character	52.2	40	Character	92.4	43	Character	54.3	37
Dynamic Range	12.4	40	Dynamic Range	77.4	43	Dynamic Range	84.5	37
Preference (Sound)	22.9	34	Preference (Sound)	7.0	43	Preference (Sound)	44.2	37
Preference (Playing)	69.2	34	Preference (Playing)	15.1	43	Preference (Playing)	44.2	37
Listeners: P4			Listeners: P5			Listeners: P6		
Category	P(T<=t)	df	Category	P(T<=t)	df	Category	P(T<=t)	df
Evenness	36.2	232	Evenness	73.6	106	Evenness	78.4	175
Clarity	73.9	230	Clarity	77.2	106	Clarity	82.0	175
Projection	82.1	232	Projection	45.5	106	Projection	45.5	175
Character	98.8	229	Character	95.3	106	Character	75.3	176
Warmth	37.8	231	Warmth	76.1	106	Warmth	57.5	175
Preference	29.4	223	Preference	41.7	106	Preference	5.8	166