A MEASURABLE EFFECT OF LONG-TERM PLAYING ON VIOLIN FAMILY INSTRUMENTS

Carleen M. Hutchins
112 Essex Avenue
Montclair, N.J. USA

Tests made on violin family instruments over the years show that long-term playing increases the flexibility of the walls of the cavity so that an air-to-air test made inside the instrument cavity gives increased amplitude to many of the response peaks. The changes illustrated are of a viola played in a professional quartet for six years, a cello played by an aspiring soloist at the Curtis Institute for two years, and another played by an amateur intermittently for 3 years, along with a violin and a viola used for experiments and played very little.

String players are well acquainted with the need for 'playing-in' a new instrument to obtain increased ease of playing as welt as overall smoothness of response. Before and after tests of vibrating a violin continuously with electronic music over a long period of time (Hutchins1989) actually decreased the frequency of the main body (B1) mode. Players in controlled tests have confirmed the increased ease of playing resulting from several months of this type of electronic vibration. The tests shown here indicate that the body of the violin itself is more flexible as a result of long-term vigorous playing by the increased amplitude of the cavity resonances in response to a constant input signal.

The Test Method

The instrument is suspended vertically on five rubber bands, one around the heel of the scroll and another at each of the four corners. A tiny microphone (Knowles C *1955)* suspended on the lead wires is inserted through one *f*-hole, and a tiny loudspeaker (Knowles XL 9073) through the other *f*-hole near the lower end of the violin cavity, but not touching each other or the wood of the box. A constant amplitude sine wave from an audiogenerator (Bruel & Kajer 2010) sweeps through the range of 0.1 to 10kHz with the resulting air pressures recorded on a strip chart (B & K 2307). Test results are given in Figures 1 4 and in Chart 1. In each comparison the Helmholtz or AO modes were carefully adjusted to have the same amplitude (plus or minus 1db). All instruments were varnished and well adjusted before playing or testing.

Figure 1 shows the effect of the strenuous hours of practice and performances on Hutchins cello SUS 205 by a young cellist who played the instrument for a period of two years of intensive study. Notice that the Al cavity mode has increased 7db and the peak at 831Hz 10db, while in the range of peaks above that, nearly all show increased amplitudes. The after-hard-play, solid-line test was made two years after the cello was returned to Hutchins, so there is some evidence that this condition will hold. The

Figure 1 ▪ Hutchins cello SUS 205

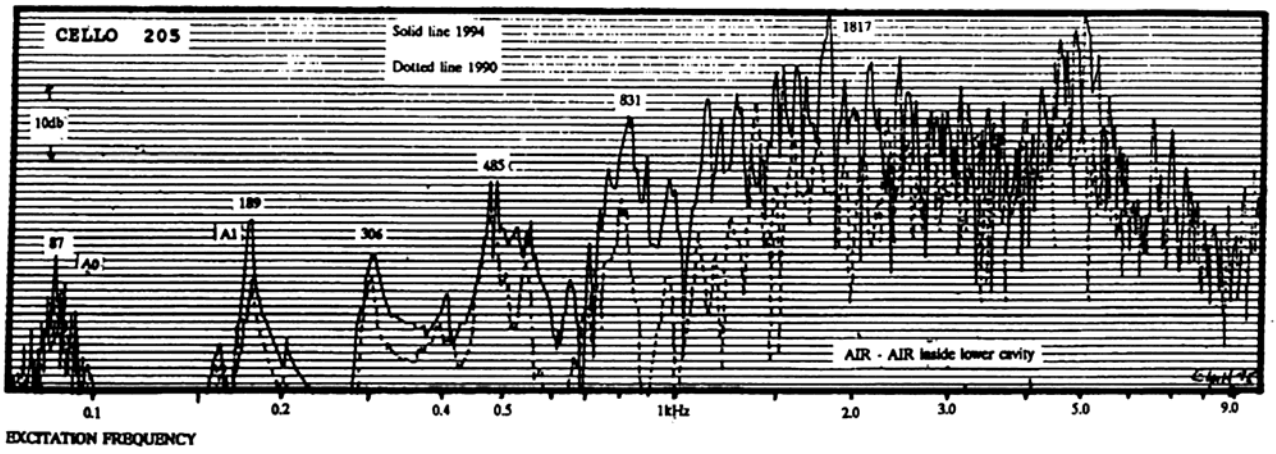
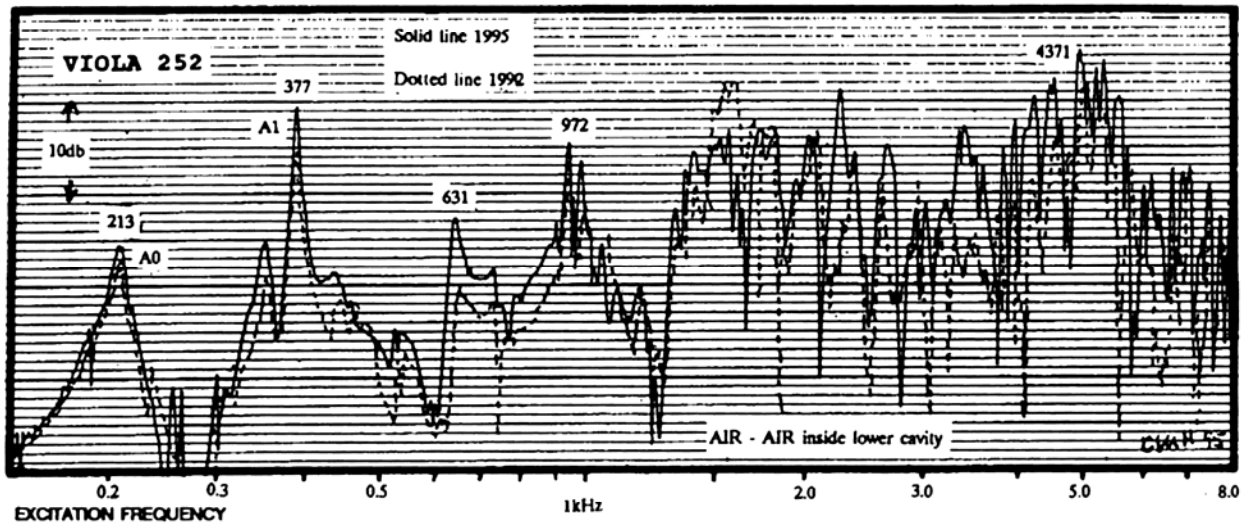


Figure 2 ▪ Hutchins viola SUS 252



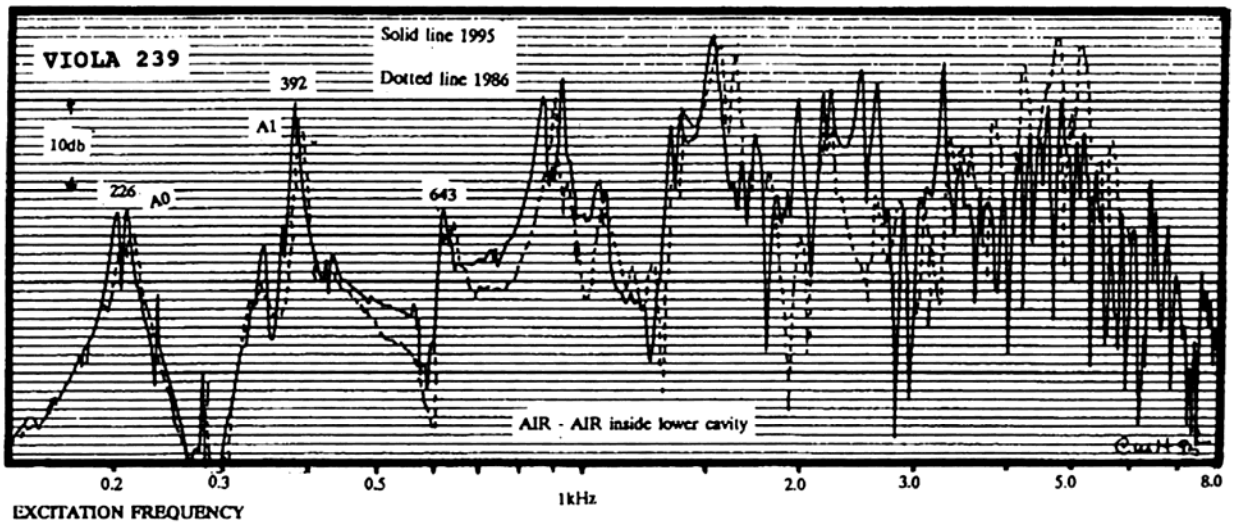
present owner reports that even with intermittent playing, the cello continues to have increased tone production and ease of playing.

Figure 2 viola, SUS 252, belongs to a busy amateur who has played it in chamber music sessions several times a month for three years between the tests, and who finds it strong, with balanced tone qualities. as well as fun to play. Notice on the chart that the AO and Al modes have gone up a few db; that the peak at 631Hz increased 7db with then a decrease around 1.5kHz, and an increase in the 2 to 5kHz range. These increases are considerably less than those shown for the cello in Figure 1, which was played much harder and more consistently for only two years.

Figure 3 gives tests of viola SUS 239, the same size and pattern viola as in Figure 2. This instrument was loaned for six years to a research physicist who tested it regularly, but played it very little. There was an increase in the 2-3kHz range and a decrease in the 4-5kHz range. The slight increases below 1kHz are within the limits of experimental error.

Figure 4 shows the changes in violin SUS 271 that was played a little over the years between 1987 and 1995, but was twice put through the 1500 hour vibration test from a classical radio station (Hutchins1989). Before the vibration process the main (B1) body mode was at 560Hz while the Al cavity mode was at 479Hz, making the Al-DELTA-B1 81Hz. After the two vibration tests and

Figure 3 ▪ Hutchins viola SUS 239



a year of rest the A1 mode was at 479Hz, and the B1 mode was at 579Hz, giving an A1-DELTA-B1 of 63Hz. In this condition it has been liked by several soloists. The results of the tests in Figure 4, however, show very little changes in amplitude compared to the vigorously played instruments of Figure 1 and Chart 1.

Chart 1 of viola SUS 251 is given instead of a pair of response curves because the 1985 test was made on earlier test equipment and the curves could not be properly aligned even though the information is comparable. The decibel comparison shows an amazing increase in the height of the response peaks above 600Hz. I heard it several times in concert with the Shanghai Quartet, where it was indeed beautiful and powerful, but almost overwhelming.

(NOTE: All three violas described above were made on the same 17 1/4 Gasparo da Salo pattern.)

Chart 1 ■ Hutchins viola SUS 251

29 January 85—Before hard play
18 February 92—After six years in the Shanghai quartet

Hz	226	262	378	631	946	1137	1562	2035
PLUS	1db	same	7db	9db	21db	7db	14db	8db

Change in amplitude of response peaks with long-term playing, air-to-air inside lower violin cavity

Conclusion

The before and after measurements described here give a preliminary quantitative measure of the effects of long-term playing on several violin family instruments. They show that many of the air modes of the cavity increase in amplitude, particularly with consistently vigorous playing over a period of time. This is particularly true of the modes above 1kHz, especially the high frequency ones with wavelengths short enough to travel between the top and back plates. The tests of violin 271, which was vibrated, but not actually played very much show less overall change than the played instruments. More experimentation needs to be done along these lines. ■ CASJ

REFERENCES

Hutchins, C. M. 1989 and 1990. "A Measurable Controlling Factor in the Tone and Playing Qualities of Violins," *CAS Journal* vol. 1, no. 4 (Series 2) (November): 10-15. Errata added (May 1990): 48.

Editor's Note: This paper was presented originally at the International Symposium on Musical Acoustics, Dourdan, July2-6, 1995, and was included in the conference Proceedings.

Figure 4 ■ Hutchins violin SUS 271