

# Role of timbre memory in evaluating Stradivari violins

Fritz et al. report the inability of violinists to distinguish Stradivari violins from modern ones with regard to timbre (1), but we disagree with their data interpretation.

Fritz et al. fail to grasp a fundamental concept in psychoacoustics research, which is the role of memory in perception. To briefly explain this concept, let us imagine two identical monitors adjusted to different color temperatures (subtle but noticeable) while showing the same picture. If they are shown side by side, it would be easy to tell the color difference. If two monitors are sequentially presented with a 30-min interval, it would be extremely difficult to make the distinction simply because the visual memory has decayed. If the subject fails to distinguish the color temperature of two monitors sequentially presented, it would be erroneous to conclude that the color difference cannot be perceived. It would only prove that visual memory decays too fast for meaningful perceptual comparisons to be made, and a better testing procedure should be devised instead.

During blind playing tests, the violinist has to rely on short-term auditory memory to make perceptual comparisons. Numerous studies have shown that short-term memory for timbre only lasts for seconds, and the memory buffer is probably updated every 10–20 s (2). However, 20 s is too short

for the player to switch violins and play the same passage, and therefore it is unreasonable to expect the player to make meaningful timbre comparisons between different instruments.

Over the last two centuries, many soloists and collectors believe, correctly or incorrectly, that the most distinctive feature of Stradivari violins is timbre quality. To investigate this possibility, it would be more reasonable to record various violins and let subjects perform blind listening tests during which fast A-B switching is allowed. An alternative is to analyze recordings objectively by computer software to look for statistically significant differences. In fact, we have already done the latter, and found that Stradivari violins produced significantly higher formant frequencies compared with a selection of Old Italian violins and new violins of professional quality (3). The magnitude of the observed variation in violins was similar to the formant variation between speakers of different sex.

Based on the reported decay kinetics of timbre memory (<30 s), the blind test adopted by Fritz et al. is expected to consistently produce null results between different violin groups, if their timbre differences are not particularly striking. Unless future research can demonstrate the ability of players or listeners to retain timbre memory long enough to make meaningful comparisons,

blind tests that do not allow for fast switching would appear to be inadequate for assessing timbre qualities associated with Stradivari violins. The fact that one or two instruments seemed to be frequently preferred in blind playing tests may reflect other acoustic properties (loudness, number of wolf notes, dynamic response, etc.) or playability factors (ease of vibrato, transient response, bridge/neck angle, etc.), some of which may induce longer lasting memory than others, and different memory traces may even confound one another.

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**1** Fritz C, et al. (2014) Soloist evaluations of six Old Italian and six new violins. *Proc Natl Acad Sci USA* 111(20):7224–7229.

**2** McKeown D, Wellsted D (2009) Auditory memory for timbre. *J Exp Psychol Hum Percept Perform* 35(3):855–875.

**3** Tai H-C, Chung D-T (2012) Stradivari violins exhibit formant frequencies resembling vowels produced by females. *Savart J* 1(2). Available at <http://savartjournal.org/index.php/sj/article/view/16>. Accessed May 28, 2014.

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