

Sound timbre

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Introduction

"Timbre is that attribute of auditory sensation in terms of which a listener can judge that two sounds similarly presented and having the same loudness and pitch are dissimilar." ["American national standard acoustical terminology" (1994). American National Standards Institute, ANSI S1.1-1994 (R1999)]

The standard definition of timbre is regarded with considerable amusement. You might expect the definition of timbre to tell you something about what timbre is, but all the definition tells you is that there are a few things that timbre is not. It is not pitch, it is not loudness, and it is not duration. It is everything else. Despite the poverty of the definition, it appears in most popular introductory books on hearing and auditory perception, and aside from the definition, these books actually have rather little to say on the topic of timbre. This is somewhat surprising given how important the concept is in music and speech perception. Timbre is what distinguishes a trumpet from a violin when they are playing the same sustained note at the same loudness and for the same duration, and timbre is what distinguishes vowels spoken by a person on the same note at the same loudness and for the same duration. It is a very important concept in hearing and it is, perhaps, time to consider revising the definition of timbre, at least as it pertains to vocal sounds, to make it conform more with what we hear.

Constitution of the timbre



All objects have a natural frequency or set of frequencies at which they vibrate. The quality or timbre of the sound produced by a vibrating object is dependent upon the natural frequencies of the sound waves produced by the objects. Some objects tend to vibrate at a single frequency and they are often said to produce a pure tone. Other objects vibrate and produce more complex waves with a set of frequencies which have a whole number of mathematical relationship between them; these are said to produce a rich sound. Still other objects will vibrate at a set of multiple frequencies which have no simple mathematical relationship between them. These objects are not musical at all and the sounds which they create are best described as noise. When a meter stick or pencil is dropped on the floor, it vibrates with a number of frequencies, producing a complex sound wave which is clanky and noisy. The actual frequency at which an object will vibrate at is determined by a variety of factors. Each of these factors will either effect the wavelength or the speed of the object.

The primary contributors to the quality or timbre of the sound of a musical instrument are harmonic content, attack and decay, and vibrato. For sustained tones, the most important of these is the harmonic content, the number and relative intensity of the upper harmonics present in the sound. Some musical sound sources have overtones which are not harmonics of the fundamental. While there is some efficiency in characterizing such sources in terms of their overtones, it is always possible to characterize a periodic waveform in terms of harmonics - such an analysis is called Fourier analysis. It is common practice to characterize a sound waveform by the spectrum of harmonics necessary to reproduce the observed waveform.

Conclusions

Dealing with tonal sounds that have pronounced resonances like the vowels of speech, it would be useful to distinguish between aspects of timbre associated with the shape of the spectral envelope, on the one hand, and aspects of timbre associated with the acoustic scale variables, on the other hand. This would lead to a distinction between the 'what' and 'who' of timbre, that is, what is being said, and who is saying it. This kind of distinction would at least represent progress towards a more informed use of the term timbre.

References:

1. http://fisicaondemusica.unimore.it/Percezione_del_timbro_en.html
2. <http://hyperphysics.phy-astr.gsu.edu/hbase/sound/timbre.html>
3. <http://en.wikipedia.org/wiki/Timbre>

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