**Microtonality**

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Microtonality refers to any use of pitch that departs from twelve equally-spaced tones per octave, the standard tuning established in Europe since the nineteenth century. Twelve-tone equal temperament has come to dominate music internationally through the widespread use of manufactured instruments, such as electronic keyboards with standard tunings.

Modernist microtonal music poses two main alternatives to twelve-tone equal temperament: tunings which divide the octave into a different number of equal steps, called equal tempered tunings, and tunings based on arithmetical ratios, called just intonation tuning.

The number of vibrations per second defines a pitch in terms of physics and acoustics. A pitch vibrating at a regular frequency of 440 Hertz (Hz) is the tone used to tune an orchestra or chamber ensemble before a performance. Just intonation works directly with frequency, and with a specific naturally-occurring sequence of pitches called the overtone series, or harmonic series. The basic pitch of 440 is multiplied by 2, 3, 4, 5, to create frequencies of 880, 1320, 1760, 2200, the first five pitches in an overtone series based on A-440 as the fundamental. In just intonation these multiplications are seen as pitch ratios of 1/1, 2/1, 3/1, 4/1, 5/1 and continue to 7/1, 11/1, 19/1, etc. However they can also be added and subtracted from one another, and transposed into different octaves, creating denominators using other numbers than one. The tonal scale in simple just intonation has been part of the music history of many world cultures. A sequence of ratios might include:

1/1 tonic

10/9 major second

6/5 minor third

5/4 major third

4/3 perfect fourth

3/2 perfect fifth

8/5 minor sixth

5/3 major sixth

9/5 minor seventh

2/1 octave

[NOTE - In the final version I will add cents values for the ratio tunings.]

The pitch set can be expanded by adding and subtracting intervals and by introducing higher prime numbers such as 7, 11, 13, etc. The number of possible pitches quickly expands to an infinity of possibility, and most composers have limited the range of options either by limiting the number of pitches per octave or by limiting the prime numbers used. Because the intervals between pitches are not equal, transposition is done by adding or subtracting the transposition interval to the original sequence, and again the number of different pitches begins to proliferate. The advantage of the system is the coherence provided by the numerical simplicity of the ratios themselves, forming acoustically pure relationships among the different frequencies.

Composers who have pioneered the using of just intonation tunings include Wendy Carlos, Ivor Darreg, Lou Harrison, Ben Johnston, Harry Partch and James Tenney.

These two systems are not as separate as they at first appear, as many composers using equal temperaments look for specific intervals in just intonation within an equal-tempered tuning. Composer Ivor Darreg coined the term xenharmonic as an alternative to microtonal, to avoid the implication that microtonal tunings always use intervals smaller than one hundred cents. The term xenharmonic would include a tuning such as Bohlen-Pierce in which the interval of an octave and a perfect fifth, the third overtone (1900 cents) is divided into thirteen scale steps of 146.3 cents, considerably larger than a semi-tone in twelve tome equal temperament.

Microtonal tunings have also been a central feature of electronic and electroacouastic music, both in music for re-tuned electronic keyboards and in spectralist music which explores pitches within the sounds of instruments or elecotnric sound clusters generated by electronic means.