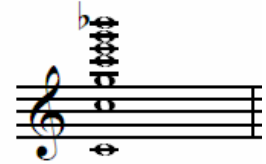


Harmonics & Harmony

Have you ever heard an overtone? The more you hear them, the more you hear them! They are a wonder of natural physics and the foundation of our musical world.

Harmonics

When a note is sung, that “fundamental” is not heard in isolation by the human ear. **A single note ‘sounds a whole chord of pure tones’** hence the rich fullness of a well produced voice.



The harmonic ‘chord’ of middle C, including only the first 6 harmonics.

‘In practice the fundamental tone and the lower harmonics are frequently much stronger than the others... harmonics beyond the sixth or seventh are too weak to affect the ear...’

So what makes one voice sound different to another? Technique is important in providing the power behind our sound, but it is the harmonics which dictate the personal character of our voice.

‘By *timbre* is meant the distinguishing or characteristic quality of a sound... the timbre of a sound is determined by the proportions in which the various natural harmonics are heard in it. ...**the upper harmonics add life, richness and interest** to the foundation tone. And as they are all at least an octave higher in pitch, they will obviously add brilliance...’

The second and fourth harmonics add brilliance only as they are merely octaves of the foundation tone. The third contributes a thickening of the tone, adding a certain hollow, throaty quality. The fifth adds a rich, horn-like quality and the sixth adds a delicate shrillness of nasal quality.’

The human voice is the most complex of all the instruments in its ability to produce overtones. Overtones give the voice a “dimensionality” of sound that gives us goose bumps! In barbershop, we look for a brilliant, “forward” or bright sound – this means we want to sing as many of the higher harmonics as we can.

Tuning, Harmony & Difference Tones

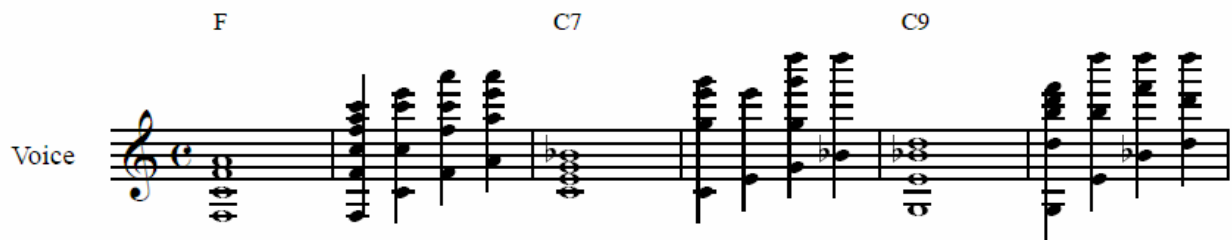
The modern Even Temperament tuning system was designed for keyboards and is only a recent introduction (about 300 years, which is pretty young in the history of music). Musicians of the time described the result as a ‘hellish row’ as everything seemed to be flat and out of tune.

To take advantage of the natural harmonics in our voices, we need to adjust our ears to a combination of Pythagorean and Just intonation. In fact, top violinists (another fretless instrument) also automatically adjust their tuning to this system, and for the same reasons. Put simply, **we must sharpen the intervals** between our octaves in order to match harmonics in our chords.

‘...there is no perfect system of intonation...’

‘Dr Robert Smith, writing in 1759, described equal temperament as “that inharmonious system of 12 hemitones, which produces a harmony extremely coarse and disagreeable”...’

If each voice sings with a full harmonic structure above, and each voice tunes correctly, there will be many harmonics which will double up within the parts. It is these **enhanced harmonics** which are sometimes **strongly audible** and which we barbershoppers strive to achieve on every chord – the elusive Lock & Ring.



The 3 most common Barbershop chords, showing the overlapping harmonics in each part. It is obvious from this why the 'tuning chord' or tonic chord is so strong, and most likely to Lock & Ring.

Not only do we “stack” harmonics when we sing chords in tune, enhancing the sound spectrum above our chord, but due to the structure of the chords most commonly used in barbershop, we also enhance the bass of the spectrum by introducing Difference Tones.

‘...when the fourth, fifth and sixth harmonics are sounded without the fundamental tone, **the ear adds the fundamental and all harmonics** up to the eighteenth. It is in general true that when any two or more pure tones which are sounded simultaneously happen to be harmonics of the same fundamental note, then the ear adds this fundamental note and many of its harmonics, of its own accord... Difference tones... can be heard when voices, particularly treble voices, are singing in harmony, the difference tone providing a dim bass accompaniment.’

Singing Overtones

Hearing your own overtones – try the drone “eeow” exercise. As you can see, it’s almost impossible to create the effect without **lots of space in the mouth**, and a lowered larynx also assists. It follows then that this space is necessary to maximising overtones when we sing.

The human voice is wonderfully flexible and we can choose to a large degree which overtones we produce. For example, vowel shapes affect our harmonic output:

- **“bright” vowels = high harmonics**
- “covered” vowels = only lowest harmonics, if any

Overtones will therefore be clearer when a group matches vowels, with plenty of mouth resonance. It is easier for men’s overtones to be heard as they occur in a more audible range.

The consequences of singing with overtones:

- **Lock & Ring = expanded sound** (singing overtones = singing multiple notes and producing the most acoustically “live” sound possible, therefore most carrying. Head in a bucket vs. in a blanket.)
- Chorus balance is easier, as the BBS cone is transformed into full sound by overtone addition and Difference Tones.