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Feeling the numbers; just intonation as a practical matter

By Paul French, OR-ACDA President

A couple of years ago, I attended a weekend conference of former students of Rod Eichenberger at which Dr. Don Brinegar presented a lecture/demonstration on just intonation which has dramatically changed my perception of harmony and led to the single biggest improvement in my choir's performance in many years. although I had known the term "just intonation" since my undergraduate days at Berkeley, it had always seemed to me to be more of a mathematical, theoretical construct than a real-life musical system, the kind of thing that only heartless academics cared about - a sort of "music for the acoustically inquisitive."

And if my understanding of the theories of the system was, shall we say, hazy, I had absolutely no clue of how to apply them to my own music making. Perhaps a few of you have felt the same way. If so, help has arrived in the form of a wonderfully practical book by W. A. Mathieu, called "Harmonic Experience" (Inner Traditions International, ISBN 0-89281-560-4).

Although Mathieu has obviously done the math, the beauty of the book for me is that it takes an experiential, basically feelings-driven approach to tuning which allows the acoustically challenged of us to develop hard answers to our choir's intonation problems. Mathieu believes that the fastest way to improve intonation is to concentrate on the physical sensation of being in tune, which he refers to as "feeling the numbers." Sing, listen, and feel at the same time.

Begin by singing a unison with a fixed pitch. He recommends using a droning string instrument, but I have found that the piano works just as well. Slip into the sound of the fixed pitch and make it your own. Next. move on to octaves, singing the octave "as if you were the overtone of the fundamental" (this suggestion to my choir produced immediate results). Try to hear and feel the octave's 2:1 ratio. You can hear it in the air if you listen hard enough. So far,

we are on fairly familiar ground, as the octaves on the piano are mostly in tune; in fact, everything else has been sacrificed for this.

Where just intonation begins to dramatically change from the piano's tempered scale is in the tuning of fifths and thirds. Tuning the perfect fifth is the basis of just intonation. Do it by feel; however, it may be useful for you to know that you will be acoustically in tune when you are two cents sharp of the same pitch on the piano (each half-step on the piano is divided into 100 cents, with two cents the smallest perceivable unit). Although two cents would appear to be an almost indistinguishable unit, the difference in feel is immense. When sung correctly, this interval seems quite tall and the resultant sound has a shimmer of energy.

If that is too subjective for you, try going for a perfect 3:2 ratio. It might be worth mentioning here that much of the pre-Baroque repertoire benefits greatly from these taller fifths, as do the many quartal compositions of this century. After tuning unisons, octaves and fifths, tune major thirds. Those of you who have been taught to keep the thirds high are in for a bit of a shock. Major thirds, in relation to the piano, are fourteen cents low! (Minor thirds are sixteen cents sharp.) Resist the temptation to immediately feel that the just intonation third is too low. You have accumulated a considerable amount of tempered intonation memory. Concentrate on feeling the "in-tuneness" of the lower third. When it finally feels right, and it may take some time, juxtapose it with the piano's third and you will be shocked with how harsh and out-of-tune the piano sounds.

Consider the following ramifications in the circle of fifths: G-flat, D-flat, A-flat, B-flat, F, C, G, D, A, E, B, F#. If we take C as our central pitch, every move to the right of C increases by two cents; thus, G is two cents sharp; D, tuned now to G, the note immediately to its left, is four cents sharp. Going the opposite direction, every pitch is two cents flat. Thus, we find that G-flat is twelve cents flat of C, and F# is twelve cents sharp. The accumulated differences between G-flat and F# is twenty-two cents. Now here is where it starts to get really interesting. Let's add a second circle of fifths a third above the first. I'll call this the circle of thirds. As before, movements to the immediate right and left remain movements of two cents sharp and flat respectively, and movements up are fourteen cents flat.

B-flat, F, C, G, D, A, E, B, F#, C#, G#, D#, A# G-flat, D-flat, A-flat, E-flat, B-flat, F, C, G, D, A, E, B, F#

Here is how to use the above chart to tune a C major scale in just intonation: First, tune by fifths (movement to the right) and when necessary, tune to thirds (movement above). When more than one tuning is possible, choose the simplest tuning note within the C major scale. Following this system, the pitch

D is tuned as the second fifth above C and is, therefore, four cents sharp. The E is tuned from the circle of thirds above C and is fourteen cents flat. The F we take from the left of C and is two cents flat. The G is one fifth above C and is therefore two cents sharp. The A is tuned as the third of F and is sixteen cents flat. The B is tuned as the third of G and is fourteen cents flat. Immediately you will notice that the two pitches that most of us were trained to sing high, the major third and the leading tone, should really both be low in relation to the piano! And the resultant scale is full of detail and sensations unknown to the tempered scale, which now seems a bit dull and washed out.

Turning our scale back into chords produces a new surprise. Since perfect fifths ride high and major thirds ride low (relative to the piano), the same individual pitch will tune differently depending on its chord function. For example, the pitch D will be two cents sharp when it is the fifth of a G major chord but fourteen cents flat when it is the third of a B-flat major chord. Knowledge of your individual place in the chord (root, third, or fifth) now becomes an important teaching and tuning tool. What a fun, creative knowledge for our singers to have.

There is much more we can do with this chart of just tunings. We can add other circles of thirds above the C axis, each dropping an additional fourteen cents, or we could add circles of thirds below the C axis, each of these going fourteen cents sharp. Seeing the relationship of pitches on such a chart has been especially helpful to me with compositions in an expanded harmonic vocabulary (Lauridsen's ninth and eleventh chords tune brilliantly in this system). Instead of simply looking for the harmonic root of a chord, I now look for the tuning note, which will be the lowest pitch to the left on the chart.

Try it, it works. Why does it work? The mathematics of acoustics. How does it sound? Beautiful. Which leads me to a final comment. It is not about complexity; rather, it is a return to the often-untapped beauty within simple intervals. A major triad, sung absolutely in tune, is a wondrous and powerful thing. We have all experienced this now and then. Just intonation is a tool towards creating that feeling more consistently.