Keeping Your Temper: A Flutists' Guide to Intonation

by Fenwick Smith

It is the blessing—and the bane—of the flute that it is an easy instrument to play pretty well in tune. A beginner can play a presentable C-major scale in a matter of days just by moving the right fingers, but the beginning string player must discover where the fingers go by *listening*. Because string players' ears must be actively engaged for every note they play, they often end up with a better sense of pitch than wind players, who need only put down the right fingers to get the right notes. Hitting the right notes, however, doesn't necessarily have anything to do with playing them in tune.

This article is about playing in *equal temperament*. Pianos are tuned in equal temperament; tuning machines sound their tones in equal temperament. Equal temperament divides the octave into twelve equal semitones (half-steps). Equal temperament is merely one solution to the problem of dividing the octave; dozens of competing solutions have been in use over the last 2,000 years. In equal temperament, all intervals except the octave are out of tune by various amounts.

The subtle and complicated subject of *just intonation*, or when, why, and by how much it is desirable to alter equal temperament, is not addressed in this article. The ability to play in equal temperament is fundamental to competent musicianship, and is the basis from which we may proceed to just intonation, which is fundamental to artistic musicianship. In other words, you should be able at least to keep your temper. If you eventually go beyond this to seek justice, so much the better!

Before we start, we should agree on a definition or two. We commonly speak of the low, middle, and high register of the flute, or the first, second and third octave. Since the flute is a non-transposing instrument it is referred to as being "in C." Confusingly, however, the flute is acoustically in D. D was originally the lowest note on the instrument. The lower notes added during the last 200 years or so have not altered the fact that the scale of the flute is founded on D. So strictly speaking—which is what I aim to do—the bottom note of the first octave is the D below the staff; the top note of the first octave is the C-sharp in the staff. The second octave begins with the D a half-step higher. I would like to borrow a term from the clarinetists' vocabulary and refer to this interval between the octaves—the semitone between C-sharp and D—as the "break." As we will see, the tuning of intervals that span the break is often problematic. There is a similar break, with a somewhat different set of problems, between the top of the second octave and the bottom of the third.

VARIABLE ONE: YOUR FLUTE

Flute makers aim to make flutes that play in equal temperament. But over the three-octave-plus range of the flute so many mechanical and acoustical compromises intrude that even the best flutes fall short of actually playing in equal temperament—and as I mentioned above, playing in equal temperament gets us only part way toward the ideal of just intonation. A thorough knowledge of the scale of *your* flute is fundamental to improving your intonation.

Most of us have—or think we have—a pretty good grasp of the temperamental problems of flutes, whether we play an old-scale (pre-Cooper) or modern-scale instrument: most of the third octave is sharp, the low register is likely to be flat, the C-sharp at the top of the first octave is probably sharp—perhaps extremely sharp, although the C-sharp an octave higher is less sharp, etc. Since we all become used to the scales of our flutes, and tend over time to accept whatever we are used to hearing as sounding right, it is useful to compare our pitches with a dependable reference, such as an accurately tuned piano—or an electronic tuner, which is especially convenient for the following exercise:

Adjust the tuner to your normal pitch—probably A-440. The room and your flute should be at a normal playing temperature. Set the tuner on a music stand, close your eyes, and noodle around a bit to find your most comfortable playing position and your most beautiful tone. Land on the first-octave A at a moderate dynamic, and open your eyes. If the tuner does not confirm that you are right in tune, adjust the headjoint until this exercise dependably results in an in-tune first-octave A. Then, without further adjustments to the headjoint, pick any other note on the instrument, and repeat the procedure. Remember: our objective is to find out how the *flute* plays, not how *we* play. So it is important not to correct the tuning of the notes we hear; rather we should find the center of the pitch that the *flute* wants to play, and only then look to see exactly what the tuner tells us about the intonation of that note. Play always at a comfortable, moderate dynamic, so your results will not be muddled by variations of pitch caused by variations of dynamic.

Since there are many notes on the instrument, and it may take many attempts over several days to zero in on the results, it might be wise to spend a week or more on this process, investigating just a few notes per day. With luck and a good flute, many notes—perhaps most notes—will be right on the money. If you write out a chromatic scale from low B to high D, you can record your flute's deviations from equal temperament by marking any notes that are *not* right on the money. Use longer or shorter arrows pointing down or up, depending on the size and direction of the correction necessary to bring each note into equal temperament. If, when you are done, you find that a clear majority of the arrows are pointing in the same direction—for instance, that most of the out-of-tune notes are sharp—it may be desirable to pull the headjoint out a bit so the tuning A itself is low, but the errors of intonation are more evenly divided between sharp and flat. I call this "spreading the dirt around"—it's less noticeable, and more easily dealt with, if it is evenly distributed.

(If you prefer a C foot joint, as I do, but switch to a B foot when the repertoire requires, you may be surprised to find that this causes small but significant changes of intonation throughout the range. Since I spend very little time playing the B foot, I find I have to remind myself of the changes it causes in order to match the results I'm used to getting with the C foot.)

When an intonation problem shows up in a lesson, the first thing I ask the student is "Does this note have a tendency on your flute?" by which I mean a

tendency to be high or low—or right in tune. Knowing the answer to this question, for any note on the flute, greatly increases the odds in your favor.

VARIABLE TWO: HEADJOINT ADJUSTMENT

The above exercise has given you a very accurate assessment of the scale of your flute, as played by you, but only at the base pitch you chose (such as A-440). But in the real world we must often pull out or push in the headjoint to play at lower or higher pitches, or to adjust for other variables discussed below. Unfortunately this alters the scale of the flute that you have just analyzed so diligently, in a way that is a bit tricky to understand. Here is my attempt to make it clear:

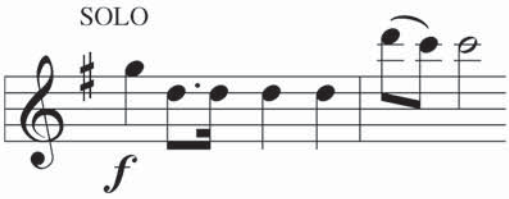
When we pull the headjoint out, all the notes of the scale become flatter. And of course, when we push the headjoint in, all the notes of the scale become sharper. But whether we push in or pull out, the closer a tone hole is to the *bottom* of the flute, the *smaller* the change of pitch; the closer a tone hole is to the *headjoint*, the *larger* the change of pitch. Here's why: If we play low C, the vibrating air column is about 24 inches long; pulling the headjoint out 1/4" lengthens the air column by 1%; the pitch drops 1%. If we play the open C-sharp at the *top* of the first octave, this vibrating air column is about ten inches long. If we pull the head joint out 1/4" this air column is lengthened by 2 1/2%; the pitch of the C-sharp drops 2 1/2%. The open C-sharp moves 2 1/2 times as far as the bottom C!

Have I confused you thoroughly? Here is a less precise, but more practical way of saying the same thing: When we cross the break between the top of the first octave (C-sharp) and the bottom of the second octave (D), the notes are musically close together—a minor second—but mechanically far apart: the D is almost twice as far from the headjoint as the C-sharp. This interval, which on most flutes tends already to be too narrow, can be used to demonstrate what happens to the scale of the flute when we move the headjoint. When we push in, it becomes still narrower; when we pull out, it becomes larger. (If you pull your headjoint *way* out—an inch or more—you can actually turn this minor second into a major second!)

In a nutshell: If you must move the headjoint significantly from its normal setting, you should be careful with the notes under the left hand, especially C-sharp, C, and B in both the first and second octaves, because these notes will be affected most noticeably; and you should be careful with any intervals that span the break between this area and the notes in the next higher octave.

A real-life example: You are about to play the opening of the Mozart *Concerto in G* at an audition.

Since you know the scale of your instrument intimately you know that the third-octave D, as on most flutes, is a bit flat, and that the C immediately below is a bit sharp. So when you arrive at the D-to-C appoggiatura on the downbeat of the second bar, you always push the D a bit higher, and let the C sag just a bit, so it sounds just right. But you just now came out on stage and tuned to the piano. Finding it distinctly higher than the pitch you are used to, you pushed the headjoint in appropriately. Because you understand the principles presented in variable two, you know this will make the interval just discussed still narrower. You lower the C emphatically, and it sounds just right. And since you were the only contestant at the audition savvy enough to bring this off, you have just convinced the committee, before you played two bars, that you are the only flutist around who can play in tune.



VARIABLE THREE: AMBIENT TEMPERATURE

Wind instruments play higher when they are warmer, lower when they are colder. (Regrettably, vibrating strings do just the opposite—but that's another story.) Moreover, flutes are typically designed to be at an even temperature from head to foot when they are in use. But if you are blowing 98.6-degree air into one end of a flute, and the other end is in a chilly church in January, the temperature along the tube will not be even, and there will be progressive flattening effect as you play down the scale toward the cold end of the tube. The English flute-maker Albert Cooper has actually built flutes with the low register tuned intentionally sharp, to help compensate for certain dependably frosty English halls.

This all sounds like bad news, but you can make this phenomenon work to your advantage. Even when the ambient temperature is comfortable, if you are about to play a movement that opens with a soft passage in the low register, take a moment to blow a few lungfuls of air through the flute. Finger low B or C, so the warm air travels all the way to the bottom, where it is most needed, and blow *slowly* to give the air time to yield its warmth to the tube. When done most effectively, this procedure is silent—no jet-whistle blasts are wanted. You will be surprised how much this can raise the pitch of the low register—and of the notes under your right hand, regardless of the octave they sound in.

VARIABLE FOUR: DYNAMIC LEVEL

We play loud; we go sharp. We play soft; we go flat. No mystery here, everyone knows the problem. But too often we ignore the problem until we are near the end of a diminuendo, and then we suddenly remember to "lip up." *Any* dynamic change, no matter how small or gradual, whether crescendo or diminuendo, must have a simultaneous correction for pitch.

VARIABLE FIVE: ANGLE OF APPROACH

I sometimes refer to this as the *Bolero* effect, after an incident I once witnessed during an orchestra rehearsal. The famous flute solo that opens Ravel's *Bolero* starts on C, winds around it in a slow arabesque, touching twice on the A a minor third below, then returns to the C. When the first chair player on my left arrived at this point the conductor interrupted to say that the pitch of the this C didn't match the pitch of the opening C. He didn't say which way it was out, and the flutist couldn't tell. The awkward impasse ended when a cellist whispered to the flutist that the C in question—the one approached from a third below, was flat. The tendency, when we approach any note on the flute from below, is for it to sound flat; when we approach any note from above, the tendency is for it to sound sharp. This tendency becomes stronger as the interval becomes larger, and the tendency is stronger in a legato interval than in an articulated one.

Each of the above variables is a given: they all affect our intonation, and once we start a performance we can't alter the scale of our flute, the position of the headjoint, or the temperature of the room. Nor can we magically suspend the tendency of the flute to go sharp when we crescendo, or to go flat if we play straight ahead through a rising interval. We have to correct for all these things all the time—and situations arise constantly where one or more variables tell us to

lower a note, while another tells us to raise it. This may seem terribly complicated—but when you were first learning the instrument, fingering a chromatic scale seemed terribly complicated too.

So far I haven't mentioned the role of the ear in all this, but certainly it is implicit that, as we investigate the five variables on our own flutes, we will be listening actively for the finest gradations of pitch—as string players must. If such active, critical listening becomes habitual, so much the better. It will encourage the player toward an appreciation not only of beautiful tone, but of beautiful intonation.

The flutist who is able accurately to hear and feel the placement of the next note is able to move to it smoothly, confidently, and with good legato, consistent tone, and secure pitch. Playing the flute should look easy. Most of the things we do to temper the pitch happen to be visible: we can *see* what the player is or isn't doing to temper the pitch; too often we can also see extraneous motions in the head, hands, embouchure, throat, etc. that have an unwanted effect on the pitch. What a player does and doesn't know about playing in tune is apparent to the ear *and* to the eye.

Taken singly, the five variables and the corrections they require can all be learned, understood, and *practiced* so they become as smooth and natural as the fingerings for the chromatic scale. The flutist who has these fundamentals of technique and ear training in place, and who can play dependably in equal temperament, has a solid foundation for further progress toward the ideal of just intonation.

ABOUT THE AUTHOR

FENWICK SMITH, Second Flutist of the Boston Symphony Orchestra since l978, has performed on Baroque flute with Boston's leading early-music ensembles, and was for thirteen years a member of the contemporary-music ensemble Boston Musica Viva. After twenty seasons, his annual Jordan Hall recitals are a prominent feature of Boston's concert calendar. He has also been a member of the Boston Chamber Music Society since 1984. Mr. Smith worked as a flute maker for Verne Q. Powell, Inc. for twelve years, and plays a Powell flute he built himself. His adventuresome discography includes world-première recordings of works by such composers as Copland, Foote, Ginastera, Koechlin, Dahl, Schulhoff, Harbison, Cage, Rorem, and Reinecke. Mr. Smith teaches at the New England Conservatory and the Tanglewood Music Center.