How Perfect Does Your Intonation Have to Be?

Description

Whether you sing, play the cello, oboe, or bagpipes, you've probably had one of those days (or weeks or months) where you became obsessed with intonation.

Where you carefully tuned every chord, calibrated every last note with a tuner, and worked diligently with a drone. And maybe even found yourself getting sucked down the Pythagorean vs. just tuning rabbit hole .

All of which is incredibly valuable and important, of course…but is it possible to become a little *too* obsessed with intonation?

I mean, how perfect does our intonation have to be anyway? How much leeway do we have before the average listener notices? Before the average musician notices? 10 cents? 25 cents? 50?[1]

And how much does intonation affect a listener's perception of the quality of a performance anyway? Have we become intonation snobs who put intonation up on a pedestal at the expense of other things that might also affect an audience's experience of a performance?

Believe it or not, there are actually a number of studies out there on intonation! Which is so nerdy, but weirdly exciting, no? Let's take a look…

6 singers

A recent study (Warren & Curtis, 2015) recruited 6 singers at varying levels of experience and training[2] to record 20-second excerpts of three musical theater songs with instrumental accompaniment.[3]

The researchers then used the pitch-correction software Melodyne (BTW, I didn't know this existed, and it's freaking INSANE!!) to create 3 versions of each performance.

1. A **perfect** intonation version, where any note more than 5 cents away from the correct pitch center was adjusted.
2. A **moderately** out-of-tune version where half of the notes (chosen randomly) were perfectly in tune, while the other half were 25 cents flat (for reference, there is about an 8 cents difference between 440Hz and 442Hz).
3. And a **severely** out-of-tune version where half of the notes were 50 cents out of tune (e.g. a full quarter tone flat, which, based on previous research, appears to be the threshold at which even most untrained listeners can tell something isn't quite right).

Pitch discrimination

94 psychology students and 51 music students were then given a pitch discrimination test[4] to see how sensitive they were to small imperfections in pitch.

31 of the music students and 15 of the non-music students[5] passed the test, correctly identifying at least 5 of the 7 out-of-tune notes.

24 of these **intonation sensitive** students and 20 of the **intonation *in*sensitive** students (i.e. those who failed the test) then participated in a listening session, where they heard and rated the intonation accuracy and overall quality of the singers' performances.

So…how much of an effect did mediocre or poor intonation have on the quality ratings of the performances?

Intonation-insensitive listeners

Well, let's start with the listeners who were **less** sensitive to small differences in pitch. The quality ratings they gave to the perfect intonation clips and mediocre intonation clips were pretty much the same. Which suggests that 25 cents was not a big enough gap in pitch for them to hear a meaningful difference in the performances.

It was only when the singers' intonation got *really* bad – where half of the notes were a quarter tone flat – that the performance quality ratings took a hit. But even then, the scores didn't drop by as much as the researchers expected – just 28%.

Ok, but wouldn't a performance where a random half of the notes are a quarter tone flat drive a trained musician nuts?

Intonation-sensitive listeners

Well, yeah, the more discriminating listeners were tougher judges, and the quality ratings took a statistically significant drop when intonation went from perfect to mediocre.

But it wasn't by very much (less than a point on the 1-7 quality scale). And it wasn't until the intonation became blatantly flat that the quality ratings took a really big hit (a 47% drop in quality ratings, to be exact).

So, the results suggest that for the average listener, slight intonation miscues in a performance is not that big a deal, as far as their overall impression of the performance goes. And small intonation issues have a surprisingly modest impact on the perceived quality of a performance even among trained musicians with more discerning ears.

Can that really be?

A follow-up study

The researchers were a little skeptical of their own findings, so they decided to kick things up a notch.

They recruited 18 professional musicians[6] to listen to a few of the same recordings from the previous study and see if they could guess the quality scores listeners gave to the moderate and severely out-of-tune performances.

At the risk of oversimplifying things, essentially the researchers found that the professional musicians consistently overestimated how much of an effect intonation would have on the listeners' ratings of the quality of a performance. Meaning, the professional musicians thought poor intonation would matter more to the listeners than it actually did.

What's the verdict?

So what does this all mean? Are we making a bigger deal about intonation than we ought to?

Well, no, not necessarily. I think it probably depends on the situation.

If your performance is being scrutinized specifically for intonation, or being compared with others' performances – like in auditions, competitions, recordings, or juries – intonation may be pretty darn important, and warrant a healthy amount (but certainly not all!) of your time and energy.

But in most performance settings – like a recital or concert – this study does seem to suggest that intonation matters less to most listeners than we probably think. That most listeners aren't necessarily as sensitive to small deviations in pitch as we might assume. And that while intonation certainly matters, we should make sure to spend plenty of time working on aspects of our performance *other* than intonation too. Because if you've ever heard someone perform a piece where intonation was clearly their one and only concern, you know how painfully uninspiring this can be for everyone involved.

So maybe the take-home message is to work diligently on intonation if it's a moderate-to-severe issue in your playing, but not obsessively at the exclusion of all else, and when it's time to perform, give yourself permission to be a little less neurotic about a few cents here and there?

Bonus question: what about vibrato?

The researchers also explored the impact that vibrato has on the listeners' perception of both intonation accuracy and overall performance quality.

It turns out that vibrato has a couple interesting benefits. For one, performances of a song *with* vibrato

were rated higher than performances of the same song, by the same singer, without vibrato.

Oddly, the perfect intonation performances *with* vibrato were also rated as being more in-tune than perfect intonation performances of the same exact song (performed by the same singer) without vibrato.

And the quality ratings didn't drop by nearly as much in the severely out-of-tune performances *with* vibrato, as they did in those without vibrato.

Which isn't to say that you can (or should) use a wide goopy vibrato to mask your intonation issues. But it does seem, for what it's worth, that a bit of vibrato can widen our margin of error a bit, and make it easier to play in tune…

More fun intonation stuff

Want to test your pitch discrimination abilities? See if you can tell the difference between two notes spaced 50 cents, 25 cents, 12 cents, etc. apart with this simple test:

> Can You Hear Like an Audio Engineer?

Here are some more videos on Pythagorean vs. just intonation on violin (or, why intonation is so squirrely):

> Intonation: Pythagorean Intonation (explained by Kurt Sassmannshaus)

> Intonation: Which System to Use When (explained by Kurt Sassmannshaus)

And a whole page of videos and exercises on intonation at Sassmannshaus's super helpful Violin Masterclass website:

> Intonation @violinmasterclass.com

I wasn't aware of the whole 440 vs. 432 debate, and can't figure out if this is a real controversy, or just one of those internet "mock-conspiracy"-type things, but because it's kind of fun, here's a short history of 440 tuning, with audio comparison samples with 432 to see which bandwagon you want to jump on.

> The Ultimate 432Hz VS 440Hz CONSPIRACY + Comparison

Think you have a clear preference? Alrightie, it's time for a blind listening test to make sure. =) Be sure to keep track of your preferences on a piece of paper. Don't try to listen for pitch and guess which one is 440 and which is 432 – that totally sucks the fun out of it (don't ask how I know…). Just listen for which one you like better, and see how that turns out.

> The Ultimate Test: 440 Hz vs. 432 Hz

References

Warren, R. A., & Curtis, M. E. (2015). The Actual vs. Predicted Effects of Intonation Accuracy on Vocal Performance Quality. *Music Perception: An Interdisciplinary Journal, 33*(2), 135–146.

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