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Study of microtuning suggests musical scales may have developed to accommodate vocal limitations

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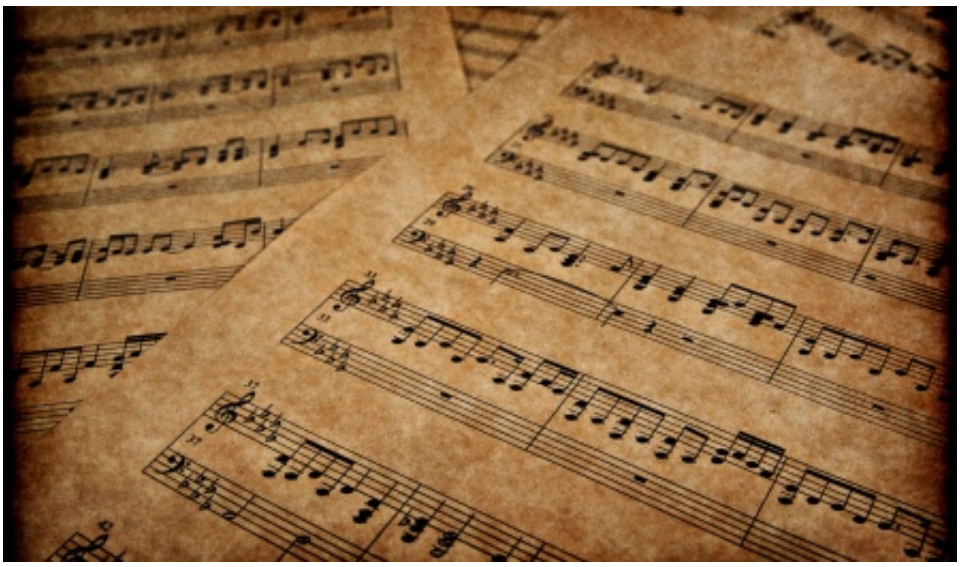

Credit: University at Buffalo

For singers and their audiences, being "in tune" might not be as important as we think. The fact that singers fail to consistently hit the right notes may have implications for the development of musical scales as well.

At issue is not whether singers hit the right or wrong note, but how close are they to any note. It's what researchers call microtuning, according to Peter Pfordresher, a UB psychologist and the paper's lead author of a

new paper with Steven Brown of McMaster University published in the *Journal of Cognitive Psychology*.

The findings not only suggest a different approach to the aesthetics of singing but could have a role in understanding the evolutionary development of the scales, as well as applications to childhood singing development and speech production for tone languages.

There is a long-standing belief that musical scales arose from simple harmonic ratios. The Greek mathematician Pythagoras found that plucking a string at certain points produced pleasing steps similar to the progression heard in musical scales – Do-Re-Mi-Fa-So-La-Ti-Do. Scales came about as a way of getting as close as possible to Pythagoras' pure tuning.

Or maybe not.

Pfordresher says there are at least three problems with trying to match Pythagoras' pure tuning. First, scales are not purely tuned, which has been known for a long time. It's also not clear to what extent all of the world's musical scales tie into the kinds of principles Pythagoras pioneered. Pfordresher cites Indonesian musical scales as an example that does not align itself with Pythagorean pure tones.

The third problems rests with Pythagoras basing his theory on instruments, first strings and later pipes.

"This is where Steve and I came up with our evolutionary idea," says Pfordresher. "Probably the best starting point to think about what we call music is to look at singing, not instruments."

The researchers studied three groups of singers of varying abilities: professionals, untrained singers who tend sing in tune and the untrained

who tend not to sing in tune. They weren't listening for whether the singers were hitting the right notes, but rather how close they were to any note.

Pfordresher and Brown found that the groups did not differ in terms of microtuning, although they were very different aesthetically.

"Our proposal is, maybe scales were designed as a way to accommodate how out of tune, how variable singers are," says Pfordresher. "We suggest that the starting point for scales and tuning for scales was probably not the tuning of musical instruments, but the mistuning of the human voice."

To set up a kind of musical grammar requires rules that allow for songs to be understood, remembered and reproduced. To accomplish these goals, that system needs pitches spaced widely enough to accommodate inconsistencies from person to person.

The space between Do and Re, for instance, is heard by playing two adjacent white keys on a piano keyboard and provides that kind of liberal spacing.

"When you look around the world, you find there are a couple of properties for scales," says Pfordresher. "There's a tendency to have notes that are spaced somewhat broadly, much more broadly than the fine gradations in pitch that our ears can pick up."

This broad spacing helps all kinds of singers, including the nightingale wren, a bird whose virtuosity has been the province of poets since antiquity. Pfordresher says earlier research by Marcelo Araya-Salas found that flexibly tuned instruments like violins and trombones were more in tune that the wren's song.

And though not part of the published study, Pfordresher also analyzed an excerpt of a studio version of Frank Sinatra singing "The Best is Yet to Come."

"It's a wonderful recording and a challenging song to sing, but when acoustically analyzed using several measurements, the pitches are not purely tuned," says Pfordresher. "Although he's close enough for our ears."

Provided by University at Buffalo

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