

Poor pitch singing could be a matter of the tune in your head

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Though it's easy to hear a singer hit a bad note, what's contributing to that inaccuracy might actually be inaudible.

Sub-[vocalization](#), the silent, preparatory muscle movements of the face and larynx that result when singers run a song through their heads prior to vocalizing, could be nudging them out of tune, according to University at Buffalo researchers.

Their study in the journal *Psychophysiology*, made available online in October 2018 ahead of final publication in print in March 2019, for the first time presents evidence suggesting a relationship among sub-vocalization, [auditory](#) imagery and poor pitch singing.

The findings, based on data from electrically monitoring these nearly imperceptible movements, have implications both within and beyond the domains of music and music instruction and provide valuable insights into an area of cognition that is not well understood.

Inaccurate singing is largely a mystery. People who have trouble singing accurately don't appear to have problems hearing pitch relationships or controlling pitch when speaking. So why is finding the correct pitch difficult when singing?

"It would seem like there might be an issue in relating what they perceive musically to the motor planning that's required to sing," says Peter Pfordresher, a professor in UB's Department of Psychology and study's co-author with Tim Pruitt, a UB doctoral candidate, and Andrea Halpern, professor of psychology at Bucknell University. "Basically that means taking the sounds in their head and converting those into the finely tuned muscle movements that we have to engage in to sing."

Enter auditory imagery. Singers create these auditory images when they hear in their heads the tune they're about to sing. This is different from sight singing, where trained singers read notes from a written score.

When creating auditory imagery, singers silently sub-vocalize, like

priming the pump in preparation for song. More than an exclusively mental process, sub-vocalization involves at its periphery specific muscle involvement.

"Sub-vocalization is a mechanism that helps guide thinking and assist in cognitive processing," says Pruitt. "One way to think about sub-vocalization is to think about a child learning to read. They're not overtly vocalizing, but they're engaging in motor movements that are associated with some cognition."

For the participants in this study, the harder the task, the greater the sub-vocalization.

Task difficulty could be contributing to that relationship, but Pfordresher says the sub-vocal movements could be a counterproductive strategy. If the movements are related to task difficulty, he says the goal to improve accuracy would involve getting people to better imagine sound, but if the latter, then the treatment would involve reducing sub-vocalizations.

"Several beneficial things can result by better understanding what going on with poor pitch singing," says Pfordresher. "Singing suppresses levels of stress hormones; it builds community, especially for [older adults](#) experiencing [social isolation](#); and in young children, musical participation does seem to be associated with broader cognitive abilities."

There are benefits to speech as well, especially when learning tonal languages, like Mandarin.

The study involved 46 musically inexperienced participants who were presented with both visual and auditory imagery tasks in order to directly compare the two and determine if sub-vocalization was the general result

of imagination or related exclusively to auditory imagery.

To do this, the researchers presented participants with a melody, gave them time to imagine it and then asked them to imitate. The [visual task](#) proceeded along the same progression, but the image was a novel object, something that doesn't actually exist, which participants had to describe afterward.

Each participant was connected to an electromyography monitor to capture the movements that characterize sub-vocalization. The results validated that auditory [imagery](#) involves sub-vocalization and that the process is not generally a matter of mental activity.

That in itself was a breakthrough, according to the authors

"When we started this it wasn't clear we would find anything," says Pfordresher. "Even a researcher who uses electromyography to study facial [movement](#) during singing was doubtful.

"It was a success that we did find them," he says.

More information: Tim A. Pruitt et al, Covert singing in anticipatory auditory imagery, *Psychophysiology* (2018). [DOI: 10.1111/psyp.13297](https://doi.org/10.1111/psyp.13297)

Provided by University at Buffalo

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