'Perfect Pitch' in Humans Far More Prevalent than Expected

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Researchers at the University of Rochester's Eastman School of Music and Department of Brain and Cognitive Sciences have developed a unique test for perfect pitch, and have found surprising results.

Their research shows that perfect pitch—the ability to recognize and remember a tone without a reference—is apparently much more common in non-musicians than scientists had expected. Previous tests have overlooked these people because without extensive musical training it's very difficult for someone to identify a pitch by name, the method traditionally used for identifying those with perfect pitch. The new test can be used on non-musicians, and is based on a technique to discern how infants recognize words in a language they're learning.

The findings will be presented at the International Conference on Music Perception and Cognition in Sapporo, Japan on Aug. 25.

"Tests for perfect pitch have always demanded that subjects already have some musical training or at least familiarity with a particular piece of music, which really limits the pool of candidates you can test," says Elizabeth Marvin, professor of music theory at the world-renowned Eastman School of Music at the University of Rochester. "That means nobody really knew how prevalent perfect pitch is in humans in general."

The findings are part of a larger investigation into perfect pitch at Rochester.

While Marvin has been studying musicians with perfect pitch for many years, her research with Elissa Newport, professor of brain and cognitive sciences, began when Newport looked into research on pitch perception in animals and found that absolute pitch, the scientific name for perfect pitch, is widespread in the animal kingdom even though it's very rare in humans. Humans are unique in that we possess the ability to identify pitches based on their relation to other pitches, an ability called relative pitch. Previous studies had shown that animals such as birds, for instance, can identify a series of repeated notes with ease, but when the notes are transposed up or down even a small amount, the melody becomes completely foreign to the bird. This holds true for almost all animals, but not humans, which suggests that, ironically, common relative pitch hearing may require more brainpower than perfect pitch.

To explore the cognitive basis for perfect pitch, Marvin and Newport wanted to test the basis for pitch perception and memory in people who had never been musically trained in order to get a better idea of exactly how common perfect pitch is in humans. Estimates of how many people have perfect pitch have always been unreliable because non-musicians have no way to identify a note, whether they recognize it or not. Newport has worked for decades to understand how infants come to make sense of the jumble of sounds spoken to them, and one of her former students, Jenny Saffran, had begun to use their experimental materials to study pitch perception in infants. Marvin and Newport, working together, created a pitch-based test similar to these language-based tests.

Both musicians and non-musicians listened to groups of three notes, with the groups played in a continuous stream in random order for 20 minutes.

Just as the human mind quickly begins to identify new sound sequences (words) in a foreign language, the students learned to identify the groups of notes embedded in the stream. Crucially, however, the test made it

very difficult for a student to identify and remember the names of particular notes because the notes were constantly coming in the 20-minute stream.

Marvin and Newport then tested the students. They replayed the note groups, plus new groups the students hadn't heard before, and asked the students if each group of notes was familiar or unfamiliar.

The critical feature of the test was that the team transposed some of the original note groups to a different key without the knowledge of the students.

Students who unconsciously used perfect pitch to indentify notes stumbled over the transpositions. They heard them as a new group of notes they'd never heard before. Students who relied on relative pitch, however, heard the transposed notes and automatically and unconsciously recognized them as familiar—the notes seemed to be of the same group heard before.

The test corresponded well with the results of conventional tests for perfect pitch in musicians, which strongly suggests the new test works. But to the surprise of Marvin and Newport, there were a number of nonmusicians who used perfect pitch to identify groups of notes but did not know they had perfect pitch.

The team is now investigating the other cognitive abilities of this new group of listeners with perfect pitch, to determine what might distinguish them from the more numerous listeners with only relative pitch perception. Marvin and Newport are also planning to investigate a controversial hypothesis that native speakers of tonal languages like Chinese, which utilize pitch to distinguish different words, have their perfect pitch abilities enhanced by their language's necessary attention to pitch.