Neuroscientists suggest perception of harmonicity, not beating underlies perception of dissonance

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Steinway & Sons Grand Piano Iron Plates and Strings. Credit: David Maiolo / Wikipedia.

(Medical Xpress)—Researchers from the University of Montreal and New York University suggest in a paper they've had published in the *Proceedings of the National Academy of Sciences*, that the perception of harmonicity in humans is more to blame for a dislike of dissonance in musical tones than is beating.

For many years scientists have debated the issue of whether the dislike of dissonant tones by most people in western cultures is due to a physical phenomenon, or a simple preference for more harmonically pleasing sounds. Those arguing for the former suggest that the rattling noise that

occurs when two tones are close in frequency (beating), which results in roughness in the ears, is naturally aversive and thus the answer is that it's a physical condition. Those that argue for the second point out that there are incidences in music, such as rock, where people have learned to enjoy roughness, and thus an aversion to dissonant tones is more likely the result of something in harmonies that are preferred.

In this new research, the team dug a little deeper by enlisting volunteers that suffer from amusia – a condition whereby those who have it have perceive tones differently than most people. They ran several tests comparing the perception of tones in people with amusia with those of a control group that had normal hearing.

In the first test, they asked both groups to rate the pleasantness of a series of intervals (notes at predefined distances between frequencies). The group with amusia rated them all equally, whereas the group with normal hearing rated some intervals as much more pleasant or unpleasant than others.

They followed up the first test by simply asking both groups how they felt about beating – whether they were able to detect it and whether it bothered them. Both groups reported being able to hear it and to have an aversion to it. This, the researchers suggest, indicates that there is some other property at work in causing listeners to report aversion to dissonance.

They suggest that rather than finding dissonance aversive, it's more that people find other tones more pleasant and they claim that it's because of the harmonicity of constant intervals. For pleasant or consonant intervals, they say the overtones that are produced as tones are played coincide rather than collide, producing what most perceive as something pleasant.

Turning back to the volunteers, the researchers found that the control group did indeed report finding consonant intervals with harmonic relationships preferable to those deemed inharmonic. Those with amusia on the other hand, reported no differences in preference. The researchers conclude that their results throw doubt on the idea that an aversion to certain tones when played together is the result of a physical attribute of the human ear or the way they are interpreted in the brain.

More information: The basis of musical consonance as revealed by congenital amusia, *PNAS*, Published online before print November 12, 2012, doi: 10.1073/pnas.1207989109

Abstract
Some combinations of musical notes sound pleasing and are termed "consonant," but others sound unpleasant and are termed "dissonant." The distinction between consonance and dissonance plays a central role in Western music, and its origins have posed one of the oldest and most debated problems in perception. In modern times, dissonance has been widely believed to be the product of "beating": interference between frequency components in the cochlea that has been believed to be more pronounced in dissonant than consonant sounds. However, harmonic frequency relations, a higher-order sound attribute closely related to pitch perception, has also been proposed to account for consonance. To tease apart theories of musical consonance, we tested sound preferences in individuals with congenital amusia, a neurogenetic disorder characterized by abnormal pitch perception. We assessed amusics' preferences for musical chords as well as for the isolated acoustic properties of beating and harmonicity. In contrast to control subjects, amusic listeners showed no preference for consonance, rating the pleasantness of consonant chords no higher than that of dissonant chords. Amusics also failed to exhibit the normally observed preference for harmonic over inharmonic tones, nor could they discriminate such tones from each other. Despite these abnormalities, amusics exhibited normal

preferences and discrimination for stimuli with and without beating. This dissociation indicates that, contrary to classic theories, beating is unlikely to underlie consonance. Our results instead suggest the need to integrate harmonicity as a foundation of music preferences, and illustrate how amusia may be used to investigate normal auditory function.