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Why dissonant music strikes the wrong chord in the brain

The common aversion to clashing harmonies seems to be due to mathematical relationships of overtones.

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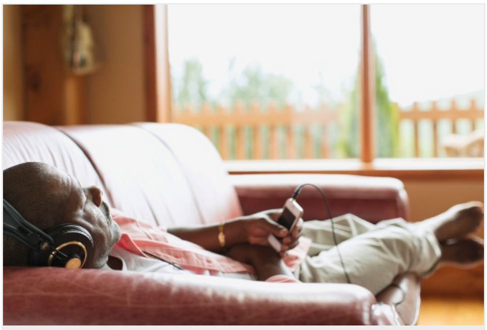
Many people dislike the clashing dissonances of modernist composers such as Arnold Schoenberg. But what's our problem with dissonance? It's long been thought that dissonant musical chords contain acoustic frequencies that interfere with one another to set our nerves on edge. A new study proposes that in fact we prefer consonant chords for a different reason, connected to the mathematical relationship between the many different frequencies that make up the sound[1].



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Whether we find music pleasant for not depends on the 'harmonicity' of the notes being played.

Cognitive neuroscientist Marion Cousineau of the University of Montreal in Quebec and her colleagues evaluated these explanations for preferences about consonance and dissonance by comparing the responses of a control group of people with normal hearing to those of people with amusia — an inability to distinguish between different musical tones.

Unpleasing sounds

Consonant chords are, roughly speaking, made up of notes that 'sound good' together, like middle C and the G above it (an interval called a fifth). Dissonant chords are combinations that sound jarring, like middle C and the C sharp above (a minor second). The reason why we should like one but not the other has long vexed both musicians and cognitive scientists.

It has often been suggested that humans have innate preferences for consonance over dissonance, leading some to conclude that music in which dissonance features prominently is violating a natural law and is bound to sound bad. Others, including Schoenberg himself, have argued that dissonance is merely a matter of convention, and that we can learn to love it.

However, there has long been thought to be a physiological reason why at least some kinds of dissonance sound jarring. Two tones close in frequency interfere to produce 'beating': what we hear is just a single tone rising and falling in loudness. If the difference in frequency is within a certain range, rapid beats create a rattling sound called roughness. An aversion to roughness has seemed consistent with the common dislike of intervals such as minor seconds.

Yet when Cousineau and colleagues asked amusic subjects to rate the pleasantness of a whole series of intervals, they showed no distinctions between any of the intervals. In contrast, normal-hearing people rated small intervals (minor seconds and major seconds, such as C–D) and large but sub-octave intervals (minor sevenths (C–B flat) and major sevenths (C–B)) as very unpleasant.

Out of harmony

Then the researchers tested how both groups felt about beating. They found that the amusics could hear it and disliked it about as much as the control group. So apparently something else was causing the latter to dislike the dissonant intervals.

> **"Rock bands often deliberately introduce roughness and dissonance into their sounds, much to the delight of their audiences."**

Those preferences seem to stem from the so-called harmonicity of consonant intervals. Notes contain many overtones — frequencies that are whole-number multiples of the basic frequency in the note. For consonant intervals the overtones of the two notes tend to coincide as whole-number multiples, whereas for dissonant intervals this is no longer the case: they look more like the irregular overtones for sounds that are 'inharmonic', such as metal being struck.

The control group preferred consonant intervals with these regular harmonic relationships over artificial 'consonant' ones in which the overtones were subtly shifted to be inharmonic while the basic tones remained the same. The amusics, meanwhile, registered no difference between the two cases: they seem insensitive to harmonicity.

Co-author Josh McDermott at New York University reported previously that harmonicity seems more important than beating for dissonance aversion in normal hearers[2]. In the new paper he and his colleagues argue that the lack of sensitivity both to harmonicity and dissonance in amusics now adds to that case[1].

Diana Deutsch, a music psychologist at the University of California at San Diego, says that the work is “of potential interest for the study of amusia”, but questions whether it adds much to our understanding of normal hearing. In particular she wonders if the findings will survive in the context of everyday music listening, where people seem to display contrary preferences. “Rock bands often deliberately introduce roughness and dissonance into their sounds, much to the delight of their audiences”, she says.

Sandra Trehub, an auditory psychologist at the University of Toronto at Mississauga, agrees, saying that there are plenty of musical traditions in which both roughness and dissonance are appreciated. “It's hard to imagine a folk tradition based on something that’s inherently negative,” she says.

But McDermott says that the results do not necessarily imply that there is anything innate about a preference for harmonicity, and indeed he suspects that learning plays a role. “Other approaches will be needed to address the innateness issue,” he says.

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References

1. Cousineau, M., McDermott, J. H. & Peretz, I. *Proc. Natl Acad. Sci. USA* http://dx.doi.org/10.1073/pnas.1207989109 (2012).
2. McDermott, J. H., Lehr, A. J. & Oxenham, A. J. *Curr. Biol.* **20**, 1035–1041 (2010).