

Article updated: 10/31/2011 1:58 PM

## Study explores why we hate certain sounds

By

Some sounds are excruciating. Take fingernails squeaking on a chalkboard. The noise makes many people shudder, but researchers never knew exactly why. A new study finds that there are two factors at work: the knowledge of where the sound is coming from and the unfortunate design of our ear canals.

Previous research found that the painful parts of unpleasant sounds appear to be in the middle range of audible frequencies. But scientists didn't nail down exactly which frequencies or explain why the sounds were painful. So musicologists Michael Oehler of the Macromedia University for Media and Communication in Cologne, Germany, and Christoph Reuter of the University of Vienna asked listeners to rank sounds in a listening test. Fingernails raking against a chalkboard and chalk squeaking against slate were the most unpleasant sounds from a family of recordings, which also included sounds such as Styrofoam squeaks and scraping a plate with a fork.

The researchers then modified the recordings of fingernails and chalk, removing or attenuating various frequency ranges. They also modified the sounds by selectively extracting either the tonal, musical-pitch parts or the scraping, growling, noiselike parts of the sound. Some listeners were told the true source of the sounds, whereas others were told that the sounds were part of contemporary musical compositions. The same listeners then rated the pleasantness or unpleasantness of the sounds while the researchers measured physical indicators of distress: the listeners' heart rate, blood pressure, and the electrical conductivity of their skin.

As they will report next week at the Acoustical Society of America conference in San Diego, California, Oehler and Reuter found that a listener's skin conductivity changed significantly when the person heard a sound he or she later reported as unpleasant, showing that disturbing sounds do cause a measurable physical reaction. More surprisingly, they found that the frequencies responsible for making a sound unpleasant were commonly found in human speech, which ranges from 150 to 7000 hertz (Hz). The offending frequencies were in the range of 2000 to 4000 Hz. Removing those made the sounds much easier to listen to. Deleting the tonal parts of the sound entirely also made listeners perceive the sound as more pleasant, whereas removing other frequencies or the noisy, scraping parts of the sound made little difference.

The ratings also changed depending on what the listeners thought the sounds were. If they thought a sound came from a musical composition, they rated it as less unpleasant than if they knew it actually was fingernails on a chalkboard. But their skin conductivity changed consistently even when they thought the chalkboard sound was from music and rated it as less unpleasant.

The researchers suspect that the shape of the human ear canal may be to blame for the pain. Previous studies have shown that the ear canal amplifies certain frequencies, including those in the range of 2000 to 4000 Hz. A loud screech on a chalkboard could be amplified within our ears to painful effect, the researchers propose.

Combining physiological measurements of pain such as skin conductance with psychological ratings of uncomfortable sounds is new and makes an important point about perception, says Reinhard Kopiez, a musicologist at the Hanover University of Music, Drama and Media in Germany, who was not involved in the study. Kopiez says the research shows just how important context is in the enjoyment of music. "The audience enjoys the performance because of the knowledge about the (artistic) origins of a sound, although the physiological response remains the same as for uncomfortable sounds," Kopiez says.

Oehler and Reuter intend to explore the parameters of unpleasant noises further in the future. Knowing what makes certain sounds painful, they say, could help engineers know which frequencies to modify or mask in order to make annoying sounds, such as whining vacuum cleaners, screeching factory machinery, or grating

construction equipment, more pleasing to the ears.

---

Copyright © 2011 Paddock Publications, Inc. All rights reserved.