

Fingernails down a chalkboard: why it hurts our ears

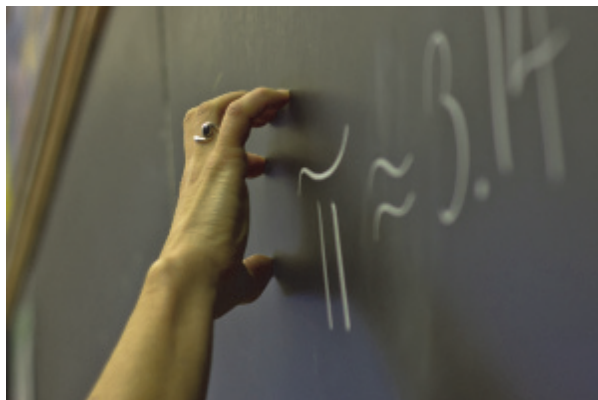
By Janet Fang | October 30, 2011, 9:46 PM PDT

ScreeEechh. This and other kinds of excruciating noise make us shudder, but we've never really known why.

Knowing what makes certain sounds painful could help engineers figure out the frequencies to adjust in order to make annoying sounds, such as construction, more pleasing to our ears.

Turns out, there are 2 factors at work: **knowing where the sound is coming from and the design of our ear canals**. ScienceNOW reports.

Musicologists Michael Oehler of the Macromedia University for Media and Communication and Christoph Reuter of the University of Vienna asked listeners to rank sounds in a listening test. These recordings included fingernails scratching down a chalkboard, chalk against slate, Styrofoam squeaks, and scraping a plate with a fork.



Then they modified the recordings of fingernails and chalk, removing various frequency ranges and extracting either the (a) tonal, musical-pitch parts or (b) the scraping, growling, noise-like parts.

Some listeners were told the true source of the sounds, while others were told that the sounds were part of contemporary musical compositions. They then rated the pleasantness or unpleasantness of the sounds while the researchers measured physical indicators of their distress: **heart rate, blood pressure, and the electrical conductivity of their skin**.

This is what they found:

- **Skin conductivity changed significantly when listeners heard a sound they later reported as unpleasant.**
- 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**, and removing those made the sounds much easier to listen to.
- Deleting the tonal parts of sound entirely also made listeners perceive the sound as more pleasant. Removing the noisy, scraping parts of the sound made little difference.
- **If listeners 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 our ear canal may be to blame. Previous studies have shown that the **ear canal amplifies certain frequencies**, amplifying the chalkboard screech within our ears to painful effect.

The work will be reported this week at the Acoustical Society of America conference in San Diego.

From ScienceNOW.

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