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Why the sound of fingernails on a chalkboard irks you

(topic overview)

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The sound of fingernails on a chalkboard sets many people's teeth on edge, and now a team of researchers from the University of Cologne in Germany and the University of Vienna in Austria think they know why.
In a study designed to pinpoint the source of this and similarly irritating sounds, scientists found that the most obnoxious elements of the noises may be amplified by the shape of the human ear. The team will present its results at the 162nd meeting of the Acoustical Society of America (ASA), which runs from Oct. 31 - Nov. 4 in San Diego, Calif. In the study, scientists removed information from actual audio clips of people scraping their nails or bits of chalk against a chalkboard. They then played these modified clips to willing participants. Half the study subjects were told what the sounds were; the other half thought that they were listening to selections from contemporary music. Scientists asked the participants to rate each sound's unpleasantness, and also gauged the subjects' stress responses to the noises by measuring their blood pressure, heart rate, and skin conductivity (a measure of sweating). [1] Then we're not scientists. What we want to know, science, is why a person would ever actually want to scrape their nails on the chalkboard. Alas, in order to conduct this experiment and provide this public service, the scientists had to play a lot of fingernail-scraping clips for the poor souls co-opted into their experiment. Half the study subjects were told what the sounds were; the other half thought that they were listening to selections from contemporary music. Scientists asked the

participants to rate each sound's unpleasantness, and also gauged the subjects' stress responses to the noises by measuring their blood pressure, heart rate, and skin conductivity (a measure of sweating). With the awful chalkboard noises, scientists found that when they removed pitch information in the range of 2000 hertz and 4000 hertz, at the peak of human hearing, from the recordings, the noises were considered more pleasant than in the other versions. "One explanation for people's sensitivity to this band of frequencies is that sounds in this range are amplified due to the anatomy of the ear canal; they are literally louder to us than other sounds are. [2]

The researchers, Michael 'hler of the Macromedia University for Media and Communication in Cologne and Christoph Reuter from the University of Vienna, first picked out two sounds they determined were the most annoying to people: scratching fingernails on a chalkboard and squealing chalk on a slate. They then played the sounds to a group of volunteers, half of whom were told their real origin and the other half who believed they came from contemporary music. The researchers found that people who believed the sounds were art rated them as less grating than those who knew where they really came from, suggesting a psychological component to people's annoyance. They also found that the research subjects had clear physiological reactions to the noises, such as increased heart rate, sweating and blood pressure regardless of their beliefs of the sounds' origin. This is apparently the consequence of the pitch frequency of the sounds, between 2,000 and 4,000 hertz, which hits the'sweet spot' at which the human ear is considered to be most sensitive because of the anatomy of the ear canal, the scientists said. [3] The sound pitch, which typically hits between 2,000 and 4,000 hertz, is naturally amplified by the shape of human ear canals, according to researchers. Most of the participants, regardless of how they rated the sound, exhibited higher heart rates and blood pressure to some of the sounds. Their findings will be presented at the Acoustical Society of America annual meeting in San Diego this week. Thattheory didn't stick. Others had trouble nailing down what sound frequencies seemed to be about the most irritating. Researchers say they can now pinpoint what's so darn annoying about nails on a chalkboard and similar sounds. [4] Researchers also said that the sound pitch which is between 2,000 and 4,000 hertz gets amplified due to the shape of the human ear canals. Irrespective of how participants rated the sounds, most of them portrayed a higher heart rate and blood pressure when they were exposed to peculiar and unpleasant sounds. [5]

Using various heart rate and skin resistance measurements the scientists also studied the effects of the sounds on the bodies of the listeners. The listeners had clear reactions, such as sweating and blood pressure rises, to the annoying sounds. The scientists believe this is because the frequency of these two sounds, between 2,000 and 4,000 hertz, strikes at the region of the human ear considered most sensitive because of the anatomy of the ear canal. [6] Indicated are the areas encompassed by music and speech and the area between 2000 Hz and 4000 Hz, where the human ear is most sensitive. The parts of the sounds in this frequency range were particularly important for the perceived unpleasantness (after Fastl & Zwicker, 2006, p. 17). Christoph Reuter from the University of Vienna's Musicological Institute and Michael Oehler of Macromedia University for Media and Communication in Germany, have managed to enlist volunteers to listen to such sounds while having their biological signs measured for reactions. They will be giving a presentation on their findings to the Acoustical Society of America today. The two had 104 volunteers listen to recordings of various unpleasant sounds, 24 of them hooked up to devices that recorded their heart rate, blood pressure and galvanic skin response (a measure of skin conductance - not exactly a measure of the degree of skin crawling but perhaps close). The volunteers were all asked to rate their level of discomfort as each sound was played. [7] Some listeners were told the true source of the sounds, whereas others were told the sounds were part of contemporary musical compositions. The same listeners then rated the pleasantness or unpleasantness of the sounds while researchers measured physical indicators of distress: the listeners' heart rate, blood pressure, and the electrical conductivity of their skin. 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). [8] During the study, research participants were made to hear unpleasant as well as pleasant sounds, for instance the sound of nails on a chalkboard or a fork scraping a plate. Some of the participants were warned about the sounds they were about to hear while the rest were told that they were to hear a piece of music. Physical reactions of the participants like heart rate and blood pressure were recorded while they listened to the sounds. They were also asked to rate the sounds as pleasant or unpleasant. The research showed that those who were informed earlier about the sound they were likely to hear rated the sound more positively as compared to those who were misled about the source of the sound.

Researchers are of the opinion that our response to these sounds could be part physiological and part psychological.[5] Some were told the sound was part of a musical piece, while others were told the truth. The researchers measured the physical reactions of participants, such as their heart rate and blood pressure, while they were listening to the sound.[4]

The researchers measured heart rate, blood pressure and skin conductivity to work out which sounds were the worst.[9] The recordings included fingernails scratching down a blackboard, chalk against slate and squeaking polystyrene. The researchers, based in Germany and Austria, monitored levels of distress in the volunteers, including their heart rate, blood pressure and the electrical conductivity of their skin.[10]

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As part of the experiment, the volunteers were given different explanations regarding the source of the sounds. Some were told a noise played was part of a musical composition, while others were told the truth, i.e. that it was in fact a recording of fingernails being dragged across a chalkboard, etc. Those that believed it was part of a musical composition rated the sounds as less unpleasant, though their bodies disagreed, showing just as much reaction as those that were told what the sounds really were. In some instances, the researchers removed some parts of the recordings, such as the noisy scraping parts, before playing them for the volunteers, but that appeared to have no discernible reduction in distress, which showed that it was the middle frequencies that caused the problem, not the rough scratchy parts. Because the noise turned out to be most offensive when in the same range as the human voice, the authors speculate that because previous studies have shown that the human ear canal is shaped in such a way as to amplify frequencies in the human voice range, other noises that appear in that range that are amplified as well, come across as harsh and offensive. The two conclude that the reason people react so badly to fingernails scraping a chalkboard is because of the frequency range of the sounds that are produced combined with the structure of the ear canal, and that the effect is worsened when the person hearing it knows its source.[7] The human ear is known to be particularly sensitive to pitches in the mid- to low-level range of frequencies, between 2000 hertz and 4000 hertz, which is the peak of human hearing. It turns out that when scientists removed all the pitch information in this range from the audio recordings, the study participants rated the noises as more pleasant than other versions of the sounds. One explanation for people's sensitivity to this band of frequencies is that sounds in this range are amplified due to the anatomy of the ear canal; they are literally louder to us than other sounds are.[1]

At every minute of every day, it seems, scientists are busily working to cure cancer and save the environment and make better robots who can do our jobs for us, and also to figure out why we hate the noise fingernails scraping a chalkboard so much. Fortunately for those breathlessly anticipating that last bit of information, a group of researchers from the University of Cologne and the University of Austria have uncovered the reason, or what they think is the reason, because, well, you can't be too sure about these things until years and years of study have been completed, and even then, who the hell knows? But what they think is that the sound of fingernails on a chalkboard is so abhorrent to humans because of HUMAN EARS. Yep. It's your ears' fault. Specifically, it's your ear's shape that makes you hate chalkboard nail scrapes. It amplifies the sound.[2] Researchers from Germany and Austria found that the noise of fingernails on a chalkboard is similar to human speech and human ears are "built" to hear sounds at that frequency. The researchers, led by Michael Oehler of the Macromedia University for Media and Communication in Cologne, used a test where some listeners thought they were hearing to "difficult" experimental music, and others were told they were listening to various horrible sounds. Nails on a blackboard ranked above sounds such as a fork scraping on a plate and squeaking polystyrene. It was found that the listeners who'd been told they were listening to fingernails were more disgusted and appalled than those who hadn't, the Daily Mail reported.[9]

Chalkboard squeak may be irksome because the most obnoxious elements of the sound sit right in the sweet spot of human hearing. "We supposed that frequencies in the low-mid range would play a major role" in the unpleasantness of the sounds, said Michael Oehler, professor of media and music management at the University of Cologne in Germany, who will present his team's findings at the conference.[1]

Now German and Austrian scientists have presented new findings that suggest something else is at work, and it has to do with the shape of our ear canals. In work presented yesterday at the Acoustical Society of America conference in San Diego (see abstract) Christoph Reuter and Michael Oehler described how they picked two

sounds: scratching fingernails on a chalkboard, and chalk being dragged across a slate. They then broke people into two groups. They told one group the sounds were contemporary music, and the other group they told the truth. [6] A team of German and Austrian scientists say they've identified why the sound of fingernails on a chalkboard is so annoying. It's a combination of the shape of the ear canal and the power of suggestion. [3]

Human speech can range anywhere from 150 hz to 7,500 hz, but that middle range appears to get magnified by the shape of our ear canals. When the frequencies between 2,000 and 4,000 were turned down, the subjects reported far less unpleasantness than when those frequencies had been turned up. The researchers hope to use their findings to determine ways to get rid of ear-piercing sounds found in machinery, vacuum cleaners, and hopefully, the brakes on TTC subway cars. [11] Removing the "scrappiest" parts of the nail-on-blackboard sound made no difference to how unpleasant people found it. They found that there is a physical response to sounds such as nails on a blackboard, and surprisingly, the "worst" sounds were those in the range of human speech, which varies between 2,000Hz and 4,000Hz. [9] After analyzing the results the two found that the sounds that caused the most stress in the volunteers came from the 2,000 to 4,000 hertz range, which coincidence or not, is the same range as that produced by the human voice. This was somewhat expected as prior research by others had shown that people reacted more to the medium tones in chalkboard scraping than the high tones; that prior research had not narrowed the frequency range so clearly however. [7] The sound of nails down blackboards is disturbing to us because it lurks within the range that we are programmed to hear most intensely -- the frequency range of the human voice. [9]

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. [8] Fingernails raking against a chalkboard and chalk squeaking against slate were the most unpleasant sounds from a family of recordings, which also included Styrofoam squeaks and scraping a plate with a fork. [8] Musicologists in Europe have found that fingernails raking against a chalkboard and chalk squeaking against slate were the most unpleasant sounds from a group of recordings. [8]

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. Their skin conductivity changed consistently even when they thought the chalkboard sound was from music and rated it as less unpleasant. [8] The influence of pitch information was greater than we thought." Of potential interest to psychologists is the finding that participants who knew that the sounds they were hearing came from nails on a chalkboard rated these sounds more unpleasant, and experienced a higher degree of sweating, than the people who thought they were listening to music. [1]

The participants were asked to rate how pleasant or unpleasant the noise sounded. Those who were told the sound was a piece of music were more likely to rate the noise as less unpleasant, compared to those who knew the true source of the sound. According to researchers, these findings suggest that part of the annoyance to these noises might partly be in your head. [4] The psychological effect didn't account for how unpleasant we found the sound. Even listeners who were told they were listening to music still had a measurable "disgust" response, the researchers said. [9]

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. [8] The sound of fingernails on a chalkboard sets many people's teeth on edge, and now a team of researchers from the University of Cologne in Germany and the University of Vienna in Austria think they know why. [1]

A team of researchers from the University of Cologne and the University of Austria have discovered the reason why most of us shut our ears and contort our faces when we hear the sound of nails on a chalk board. [5] In what was surely one of the most annoying studies to have ever been undertaken, German and Austrian researchers have uncovered just why the sound of nails on a chalkboard is so grating. [11]

Music experts now claim the shape of our inner ear is to blame for the blood-curdling effect. The research could eventually be used to eradicate the annoying sounds made

by high-pitched machinery such as vacuum cleaners. In an attempt to find out why certain noises have such a powerful effect, musicologists asked listeners to rank sounds in order of dislike.[10] According to Professor J. Hurrumphington Dinkle, Head of Ear Noise at the University of Krakatoa (East of Java), fingernails on a blackboard is annoying because "it sounds like Yoko Ono."[6]

Nothing seems more annoying that the sound of fingernails running down a chalkboard.[4] The researchers played the sound of fingernails on chalkboards to listeners, but would alter which frequencies were coming across loudest.[11] Here's another experiment that should be done: test a group of people with 1) the sound of fingernails on slate, and 2) synthetic music with the same dominant frequency as fingernails-on-slate, but with a mix of harmonious secondary frequencies rather than all of the clashing secondary frequencies present in fingernails-on-slate.[6]

Previous research found the painful parts of unpleasant sounds appear to be in the middle range of audible frequencies.[8] Well, maybe the sound of a fork scraping a ceramic plate. Research participants were exposed to the sound of nails on a chalkboard and similar sounds, such as a fork scraping a plate.[4] Scientists didn't nail down exactly which frequencies or explain why the sounds were painful.[8] Scientists have long been puzzled as to why the screeching sound made by fingernails running down a blackboard makes us flinch.[10]

Take fingernails squeaking on a chalkboard. Or the sound of a TTC subway train screeching to a halt.[8] The results contradict previous research, which suggested that people are disturbed by fingernails on a chalkboard because the noise resembles a primate's warning call.[3] The research, presented at the Acoustical Society of America in San Diego, U.S., on Thursday, could be useful to scientists hoping to find ways to mask noise from things like vacuum cleaners or aeroplanes.[3]

Wince. According to a team of German and Austrian scientists, it's a combination of the human ear canal and the power of suggestion, The Local Germany reported.[12] The researchers suspect that the shape of the human ear canal may be to blame for the pain.[8]

A new study finds there are two factors at work: the knowledge of where the sound is coming from and the unfortunate design of our ear canals.[8] The frequencies that the ear canal is optimized for are the frequencies at which speech is most intelligible to us. It looks like we've evolved to be able to hear each other better.[6]

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Styrofoam on cardboard and using a sharpie to write on (most)paper or cardboard. These sounds are so bad, they usually paralyse me. It is physically painful. Even thinking about them can cause my body to shake and shiver, as well my hair standing up on end. The fact that the thought can cause a similar reaction as actually hearing them makes me think it is also just as psychological as it is the physical ear design.[6] Chalkboard squeak may be irksome because the most obnoxious elements of the sound sit right in the sweet spot of human hearing."[2]

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.[8] The study found that skin conductivity - a measure of unease - changed significantly when listeners heard the noise.[10]

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The researchers used recordings of fingernails and chalk, removing frequencies to work out which had the worst effect.[9]

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