Scientists study how mid-level noise burstsmaffect the concentration of arithmetic-solving test subjects

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Noise can be distracting, especially to a person trying to concentrate on a difficult task. Studying annoying noises helps architects design better building environments and policy makers choose effective noise regulations. To better understand how short noise bursts affect humans' mental state, researchers from the University of Nebraska – Lincoln played quarter-second-long white noise clips to test subjects as they worked on arithmetic problems. The researchers noticed a slight general trend toward lower performance when louder noises were played, and also identified sound level ranges that caused participants to report significant levels of annoyance. The researchers report their findings at the 164th meeting of the Acoustical Society of America (ASA), held Oct. 22 – 26 in Kansas City, Missouri.

The motivation for the research came from NASA's low-boom supersonic aircraft program. Sonic booms, generated when aircraft traveling faster than the speed of sound leave cones of compressed air in their wake, are loud and potentially unnerving. In 1964, when the Federal Aviation Administration starting flying supersonic jets regularly over Oklahoma City as part of a test called Operation Bongo, many citizens filed complaints and damage claims. NASA is now working on developing aircraft that create softer booms, but is it not clear at what volume regular booms, as might be created by commercial supersonic aircraft flying over land, would be acceptable.

Lily Wang, an architectural acoustician at the University of Nebraska – Lincoln, worked with her graduate student Christopher Ainley to design an experiment to test how noise bursts affect the performance and perceptions of test subjects. Previous studies had looked at loud noises of more than 80 decibels (dB), louder than an average vacuum cleaner, and found a clear effect on subjects' ability to solve arithmetic problems. Wang and her team reduced the volume to see if they could find a threshold value under which the noise would not significantly affect the participants. Twenty-seven test subjects were asked to memorize 6-digit numbers, and then, when shown a 4-digit number, the subjects had to subtract the second number from the first number in their heads and type the answer on a keyboard. Occasionally the researchers would play a quarter-second burst of noise while the second number appeared on the screen.

The researchers tested noise bursts in the range of approximately 50 – 80 dBA. The dBA unit indicates that the volume was measured with a filter used to approximate the human ear's response to sound. The noise levels were comparable to about the sound level on a suburban street corner at the low end, to vacuum-cleaner loud at the high end. While the test subjects solved a lower percentage of problems correctly when interrupted with a noise at the louder end of the spectrum, the difference was not enough to be statistically significant. However, there was a significant difference in the levels of annoyance that the participants reported when quizzed afterwards about their perceptions of the noise environment. "The test subjects sort of adjusted to the quieter booms, but the louder ones remained jolting," says Wang. "This suggests that the acceptable noise from sonic booms should not be higher than 70 dBA once it gets inside the house."

The researchers' lab did not have the necessary equipment to mimic the very low-frequency component of the noise produced by sonic booms, Wang notes, but the work helped to quantify the effect of the short duration characteristic of the booms. As a next step, the researchers hope to study perceptions of the rattling component of noise that is often associated with supersonic jets passing overhead.

More information: asa.aip.org/asasearch.html

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