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Hearing protection and communication devices

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The humble headphones have not only been used for listening to music over the years, they have played an integral part in safety and communications.

Headsets and headphones are currently used in a wide range of industries, from military/defence, building and factory sites, call centres and emergency services just to name a few.

The technology has grown with the times and devices have been redesigned to include features such as noise cancellation, acoustic shock protection and active/passive noise reduction to meet strict safety standards and workplace regulations.

Headphones and headsets can now protect against hazardous noise in the workplace, help operators communicate with workers out in the field and allow users to talk on mobile devices hands-free.

Most recently, headphones and headsets have become wireless, removing the dreaded cable connecting the phones to a device. These cables tended to limit movement of the user and had a habit of getting tangled easily.

The size of the earphones has been reduced for comfort, with ear bud headphones becoming popular. These mould into the ear canal and can be custom made to suit each individual's ear cavity. They also 'seal off' the surrounding noise by essentially acting as an earplug.

Headphones and headsets have survived the inundation of loudspeakers and found a niche area in a variety of industries. They have grown to serve an important purpose, whether that is to help call operators save lives or prevent factory workers from hearing loss.

Who knows where the technology is heading, but they will surely be around for much longer yet.

Kylie Baracz
Editor – *Radio Comms Asia-Pacific*

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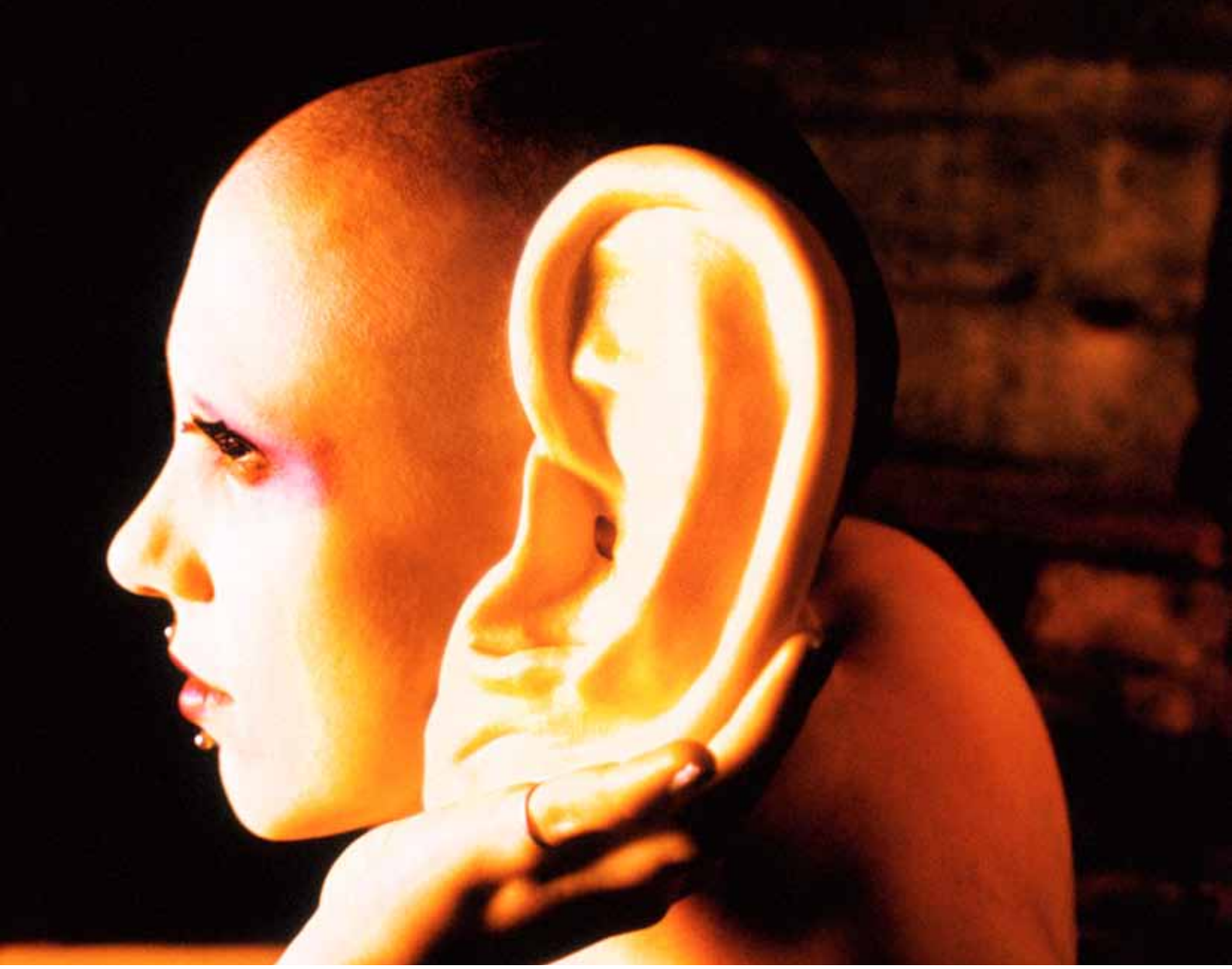


Listen up to new rules for hearing protection

Carolyn Jackson, editor, Safety Solutions

On 1 January 2012, Occupational Health and Safety laws began to change with the introduction of the new harmonisation laws across Australia. The new Work Health and Safety Act (WHS Act) will replace all individual state and territory OHS legislation, and will eventually be implemented Australia-wide. The WHS Act has commenced operation in New South Wales, Queensland, the Northern Territory and the ACT. Tasmania and South Australia have confirmed they will commence the new Act on 1 January 2013. Western Australia has committed to introducing it, but is uncertain about when and with what amendments but it is likely to be in 2014. Victoria still remains uncertain.

The person conducting a business or undertaking (PCBU) has the primary duty under the new WHS Act to make sure the regulations are met. According the regulation, in order to manage risk the PCBU must:

- Identify reasonably foreseeable hazards that could give rise to the risk;
- Eliminate the risk so far as is reasonably practicable;
- If it is not reasonably practicable to eliminate the risk - minimise the risk so far as is reasonably practicable by implementing control measures in accordance with the hierarchy of control;

- Maintain the implemented control measure so that it remains effective;
- Review, and if necessary revise, risk control measures so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health and safety.

What about noise safety?

Noise-induced hearing damage and industrial deafness are major health and safety issues for employers and employees. In addition, they represent permanent disabilities for the worker, which increases workers compensation premiums and replacement and training costs.

Noisy workplaces can be costly, both economically and physically. The total cost of hearing loss claims to businesses in Australia in the 2010/11 financial year was over $54 million and noise-induced hearing loss is not reversible, so all care should be taken to try to prevent hearing loss from happening in the first place.

The Australian Exposure Standards state that any noise that exceeds the equivalent of eight hours continuous exposure to 85 dB(A) or a peak of 140 dB(B) is over the noise threshold handled by a worker. To avoid injury, all PCBUs must ensure that their workers aren't exposed to noise that exceeds this standard.

Managing risks related to noise will assist in protecting workers from hearing loss, improving the conditions for communication and creating a more productive work environment. According to WorkCover NSW, strategies for managing noisy environments should include:

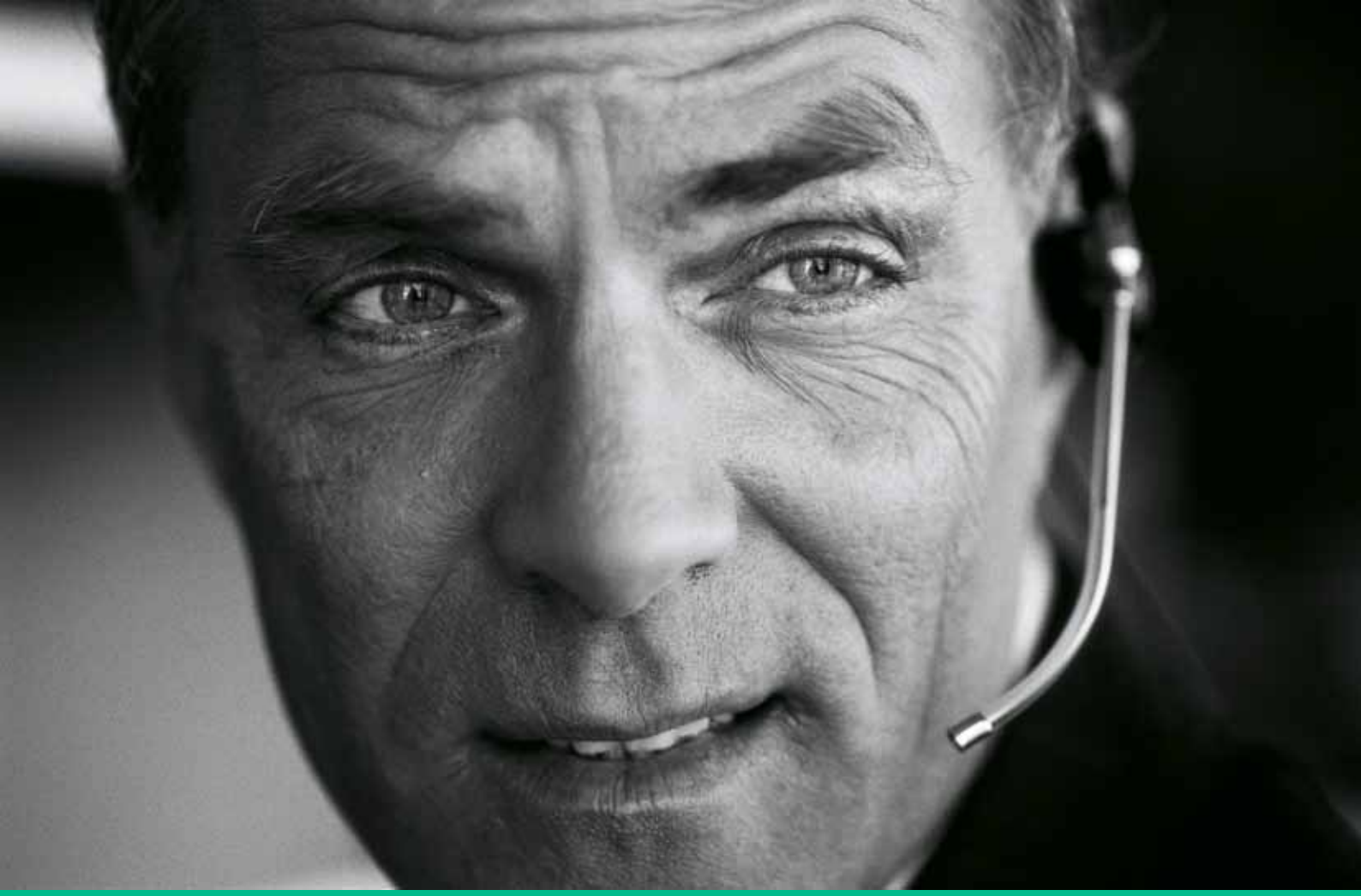
- Controlling the risk, by eliminating the hazards, substituting/isolating/reducing the risk of the hazards through engineering controls or reducing the exposure to the hazard by using the correct PPE;
- Attachment of safety warning signs to noisy equipment to remind workers to use all safety precautions, including using supplied ear protection;
- Ear protection should have attenuation SLC80 rating marked on the equipment;
- All workers frequently exposed to noise should have audiometric testing three months into starting the job and every two years thereafter;
- A risk assessment should be carried out every time the worker's everyday duties change.

To work safely, workers must be able to hear warning signals above any other noise (ambient noise) at the workplace. For clear audibility, the noise level of the warning signal should be at least 65 dB(A) and more than 15 dB(A) greater than the ambient noise level at any position in the signal reception area.

If PPE is used at the workplace, the PCBU must ensure the equipment is suitable for the work and the person wearing it. The equipment must be selected to minimise the risk and be well maintained so it continues to do so. The worker must wear the appropriate PPE according to instructions given.

The code of practice ***Managing noise and preventing hearing loss at work*** has been published by Safe Work Australia and applies to all types of work and all workplaces covered by the WHS Act where there is the potential for exposure to noise that can contribute to hearing loss. Further details are available on the Safe Work Australia website.

The information in this article is of a general nature and is not intended to address the circumstances of any particular individual or entity. Fines for not complying with the WHS Act are substantial; therefore, it is recommended that independent legal expert advice be sought to ensure compliance has been met for your particular circumstances.



Ear, ear: a brief history of headphones

Mike Smyth, specialist technical writer, Westwick-Farrow Media

Headphones have been with us since the beginning of the 20th century when they are said to have been invented by one Nathaniel Baldwin who produced early models in his kitchen and later interested the US Navy in their adoption. They were the only way to hear the faint signals coming through the air by radio as the age of loudspeakers had not yet arrived.

With the advent of broadcast radio they again were the only way of hearing the signals, and even when loudspeakers did come on the scene, headphones created a niche for themselves which still exists today.

These early devices, which used moving iron drivers, were sensitive enough but lack of damping made for poor sound quality. The impedance needed for telegraph work was around 75 Ω but for radio reception they had to be more sensitive still and this raised their impedance to around 2000 Ω to match the outputs of the triode anodes of the receivers of the time.

Today these values have changed somewhat. Low-impedance phones are typically 16-32 Ω and high-impedance types are between 100 and 600 Ω. As the impedance increases, more voltage but less current is needed and the loudness for a given voltage decreases. With low voltage, very common in much equipment, the impedance has decreased.

Early headphones were very uncomfortable to wear for any length of time because of the hard wooden and then plastic cases that contained the workings and the usually tight headbands to which they were attached. Their very limited frequency response and construction that made them prone to distortion were strong discouragements for prolonged wearing and listening.

For a while, headphones were the only way to hear radio and telegraph signals as the early speakers were not only large and cumbersome but also very insensitive and again, prone to distortion. But as speakers got better, headphone use by the general public declined. However, it expanded in

specialised industries such as the maritime and the budding aviation industry where both sound security and ease of hearing were essential.

Technology took a quantum leap forward with the advent of the moving coil, also known as the dynamic, headphone and this has become the most common device. It reduced background noise and made individual voices recognisable above the hiss and crackle of earlier devices while other technologies such as the electret and balanced armature have further improved quality.

These advancements turned makers towards making their headphones more comfortable for the wearer, recognising that this was a prerequisite for long-time wearing by specialised users. Soft surrounds, lighter units and adjustable headbands all contributed to a much more pleasant wearing experience.

Hand in hand with this came moves to exclude extraneous noise, in some cases made all the more important because by now headphones had reached a point of being a hi-fi device comparable with the best speakers.

Today, the best noise-cancelling phones are in-ear canal devices or closed back types while open back and ear bud versions give some noise isolation as well. For really effective noise cancellation, closed back phones attenuate by 8-12 dB but in-ear devices are even better at 10-15 dB.

Headphones and headsets (those with a microphone attached) are widely used in many industries. Emergency services are particularly suited to wireless headphones, as workers need to have free hands at all times and not have their movements impeded by equipment.

Mobile phone users are increasingly turning to Bluetooth for a hands-free means of communication while even office phones are going wireless for the freedom they afford. In the mining industry, especially long-wall underground mining, safety is paramount and radio/phone equipment has to be intrinsically safe because the smallest spark could cause a disastrous explosion.

Although jet engines are today nothing like as noisy as their forebears, they still represent a major source of noise in all aircraft. So for pilots, radio operators, navigators in the airforce and anyone else who has to wear a headset or headphones for a long time, both comfort and outside noise exclusion are important factors that equipment manufacturers have gone a long way to take into account.

And while the many technical improvements were going on, the price per unit has been falling and the choice has been rising.

With the advent of first the miniature, portable cassette player and later the iPod, tiny ear bud phones have taken the market by storm. They are now used by many two-way radio operators because they are so small, unobtrusive and efficient.

Two technologies seem likely to dominate the headphone market in the near to medium future. Unified communications (UC) is an integrated set of voice, data and video communications. Headset manufacturers are providing UC-certified headsets to integrate directly into certain platforms. They are now available in wireless for hands-free communication.

According to a Frost and Sullivan report on the industry, UC would appear to be a growth area that is going to provide huge versatility as it effectively links home landline phones, mobile phones, videoconferencing, email and software driven phones that allow calls to be made across the internet without specialised equipment other than a computer.

The second technology is wireless headsets, as mentioned previously. Allowing a freedom from cables and plugs, it is increasingly being used in control centres for emergency services and by the general public in a range of applications.

In whatever shape or form, headsets and headphones have provided clear hearing and communication for users in many industries. It is a safe bet that the technology will continue to improve in the near future.

Preventing acoustic shock

Kylie Baracz, editor, Radio Comms Asia-Pacific

Acoustic shock is an involuntary trauma reaction that occurs as a result of exposure to an acoustic incident. Acoustic incidents are sudden, unexpected loud noises occurring during headset use, including crackles, hisses, whistles, shrieks or high-pitched noises. Workers using headsets or telephone handsets are particularly vulnerable to acoustic shock because of their increased likelihood of exposure to an acoustic incident close to the ear.

According to WorkCover NSW, the injury is not caused by the volume of the headset, as most headphones are electronically limited to a peak noise level of 123 decibels, but by a sudden rise in noise levels.

These rises may be from faulty or damaged networks, improper headset equipment, broadband and narrowband interference, feedback oscillation, alarm signals, receivers slammed down or dropped, and noises made close to the receiver.

High background noise levels at the workplace, tension and middle ear inflammations can also increase the risk of acoustic shock occurring from an acoustic incident, as workers will turn up their headset volume to hear over the background noise.

Symptoms of acoustic shock can include: burning sensations or sharp pain around the ear, a feeling of fullness in the ear, dizziness, nausea, tinnitus and/or eardrum fluttering, headaches, fatigue, off-balance feeling, hypersensitivity and over alertness. Sometimes it can also lead to hearing loss.

After an acoustic shock incident, workers should remove their headset immediately, report to the persons conducting a business or undertaking (PCBU) or a supervisor and move to a quiet area. The supervisor or PCBU should then check the equipment and, if damaged or faulty, remove it from the work environment. The affected worker should be checked by an audiologist if symptoms become severe.

According to WorkCover NSW, top tips to prevent acoustic shock include: providing high-quality headsets with acoustic shock protection devices; giving prompt attention to damaged equipment and network faults; ensuring the proper fitting, use and maintenance of headsets; reducing background noise in the room; providing information and training on how to detect warning sounds; and ensuring workers turn the headset volume down as soon as possible after a changeover if they are sharing a desk.

Current headsets on the market feature active/passive noise reduction, noise-cancelling microphones and acoustic shock protection, and can be designed to fit under hardhats and helmets. The technology is constantly updating to include the latest in OHS features.

Safe Work Australia says that if personal protection equipment (PPE) is used correctly, the likelihood of injury from hazardous noise in the workplace is reduced. However, PPE use needs to be constantly monitored and maintained for it to be effective.

For more information on hazardous noise and acoustic shock, the code of practice guideline 'Managing noise and preventing hearing loss at work' is available for workers on the WorkCover website: www.workcover.nsw.gov.au.

Scientists study how noise bursts affect concentration

American Institute of Physics, as published on SafetySolutions.net.au.

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 towards 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 22-26 October in Kansas City, Missouri.

The motivation for the research came from NASA's low-boom supersonic aircraft program. Sonic booms, generated when aircraft travelling faster than the speed of sound leave cones of compressed air in their wake, and 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 it is 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 memorise 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," Wang said. "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.

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"Sennheiser Communications is a dynamic player in a highly competitive market, with a strong design ethic, and it's clear that innovation is part of Sennheiser's DNA," said Frost & Sullivan Information and Communications Technology Research Director for Europe, Adrian Drozd. "In selecting the company for this Award, the independent judging panel that scrutinized Frost & Sullivan's analysis was impressed by the innovative design and features, solid go-to-market strategy and, above all, strong market potential of the DW Wireless Series headsets."

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