KEY POINT SUMMARY

OBJECTIVES

To simulate operating room auditory conditions and investigate the effect of operating noise on human auditory function.

Effect of noise on auditory processing in the operating room

Way, J., Long, A., Weihing, J., Ritchie, R., Jones, R., Bush, M., Shinn, J.B. 2015 |
Journal of the American College of Surgeons. Volume 216, Issue 5, Pages 933-938

Key Concepts/Context

Noise in operating rooms (ORs), defined as any unwanted sound impeding on normal hearing, can be grouped into two categories: equipment-related noise and staff-created noise. Equipment-related noise can come from anesthesia equipment and alarms, suction devices, or surgical instruments such as cautery devices, dissection tools, and drills. Staff-created noise can come from opening and closing doors, conversations, overhead pages, and music. All of these noise sources contribute to the average ambient noise in ORs, which is 65 dBA with peak levels reaching120 dBA. High sound levels in the OR can create impaired surgeon concentration, stress in staff members, errors in communication, and hearing loss. These variables can lead to issues of patient safety. Previous studies suggest that speech signals must be 10 to 15 dB HL above ambient noise sources in order be understood with 90% accuracy, therefore OR personnel would have to speak at levels around 80 dB to reach a level of 90% verbal comprehensibility.

Methods

15 American surgeons with a mean age of 33.6 and a mean of six years' operative experience were recruited. All participants had normal hearing, which was defined by a pure-tone average (500, 1,000, and 2,000 Hz) >25 dB HL. Mean audiological thresholds of participants were within the normal range for frequencies, which is between 500 and 4,000 Hz.

Each participant took the Speech In Noise Test-Revised (SPIN-R), a standardized test used to evaluate hearing ability while background noise is present. Participants repeated the last word in a total of 50 sentences (25 sentences that are "highly predictably" and 25 with "low predictability") under different four conditions while sitting still and while being tasked with an activity. Condition 1 presented sentences quietly at 70 dB SPL (normal or equivalent conversational levels recorded in the OR). Condition 2 had sentences that were also presented in quiet conditions, but a simulated filter effect similar to surgical masks was used. Condition 3 presented surgeons with different sentences with 65 dB SPL of OR noise. In condition 4, classic rock played over OR noise for an overall level of 74.2 dB SPL.

All participants took the SPIN-R test in a "tasked" state and "untasked" state. In the untasked state, participants were seated in a soundproofed room with two speakers delivering the SPIN-R questions. Participants sat quietly and repeated the last word in each sentence they heard. In the tasked state, participants were positioned identically to the untasked state, but they were required to complete manual dexterity tasks through a laptop program while taking the SPIN-R test.

Findings

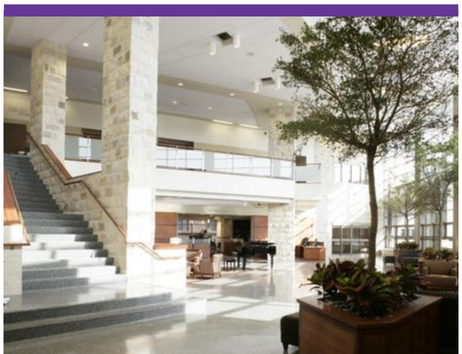
Participants generally performed poorer on the SPIN-R test while in the tasked state as opposed to the untasked state. Regarding predictability, participants performed significantly better when identifying "highly predictable" SPIN-R sentences. Statistical analysis of all four auditory conditions in both the tasked and untasked states suggest that as the complexity of the OR's auditory environment increases, the potential for communicative errors increases as well.

Design Implications

The design of OR acoustics could be tailored to help absorb sound and decrease unnecessary echoes or reverberations. Since lip-reading often helps with verbal comprehension, masks worn in the OR could be designed to be more transparent while still offering the same level of protection. Doors connected to the OR could be designed to open and close as quietly as possible. Equipment used specifically in the OR could be designed to have less noisy elements, such as wheels that roll smoothly, alarms that aren't considered disruptive, or components that don't dangle and bump together.

Limitations

The author identified several limitations of the study. A simulated environment rather than a real OR was used for all experiments, so some variables that can only be found in a real OR could not be accounted for in the study. The experiment involved the participants performing simple yet unfamiliar tasks; both the familiarity with the task and the task's complexity might also influence auditory processing. The Lombard effect, in which people tend to subconsciously increase the volume of their voice in loud environments, was not accounted for in this study. Participants in the study had average OR experience of six years, but it is unknown how much experience influences the ability to communicate in the OR. It could be possible that surgeons with more experience could be better equipped to handle distractions in the OR. Lastly, surgeons were the only subjects in this study; nurses and anesthesia staff were not accounted for.



The Center for Health Design: Moving Healthcare Forward

The Center for Health Design advances best practices and empowers healthcare leaders with quality research that demonstrates the value of design to improve health outcomes, patient experience of care, and provider/staff satisfaction and performance.

Learn more at www.healthdesign.org

The Knowledge Repository is provided with the funding support of:

Additional key point summaries provided by: