

# Good acoustics reduce stress in operating rooms



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A SOUND EFFECT ON PEOPLE



## Poor acoustics cause mistakes

*A study done at Hvidovre Hospital in Copenhagen, Denmark, has revealed that having a proper sound environment in operation rooms will reduce stress, improve communication and reduce mistakes.*

Sustainable working environments include good room acoustics. But working in an operation room (OR) can be a challenge. Due to hygiene regulations and demands the surfaces are often hard and reflective, which means sound easily bounces off all surfaces and spreads through-out the room. This leads to high sound pressure levels, bad speech clarity and long reverberation times.

### **The study**

At Hvidovre Hospital three operation rooms were part of this research project:

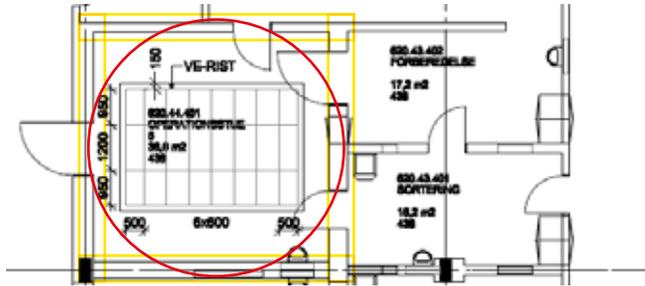
- OR 4 was used as a control room
- OR 5 had sound absorbers in the ceiling
- OR 6 had sound absorbers in the ceiling and on the walls

The rooms had the following dimensions:

- OR 4: 38.6 m<sup>2</sup>, 135 m<sup>3</sup>
- OR 5: 40.2 m<sup>2</sup>, 131 m<sup>3</sup>
- OR 6: 38.6 m<sup>2</sup>, 135 m<sup>3</sup>

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The sound-absorbing ceilings in OR 5 and OR 6 were installed in the centre of the ceiling and covered 14 m<sup>2</sup>. The wall absorbers in OR 6 were installed as a frieze where the ceiling meets the walls – in total 21.6 m<sup>2</sup>.



The study continued for three weeks and all staff members (nurses, doctors and other medical staff) answered questionnaires about the sound environment in general, and specifically about the sound environments' effect on wellbeing, mistakes and misunderstandings in the three rooms.

## Acoustic measurements

Room acoustic measurements were done in the three rooms and the descriptors evaluated were reverberation time (RT  $T_{20}$ ), speech transmission index (STI), speech clarity ( $C_{50}$ ) and spatial decay ( $DI_2$ ).

### Acoustic descriptors

Parameter	Measure	Explanation
Reverberation Time	$T_{20}$ [s]	Measures how fast the sound energy disappears in the space. A shorter reverberation time means the space has less disturbing echoes and feels more calm.
Speech Clarity	$C_{50}$ [dB]	Measures how well speech is perceived in the space. If the value increases, speech clarity is improved.
Speech Transmission Index	STI/Index 0-1	Measures quality of speech transfer from speaker to listener. If the value increases, speech transmission is improved.
Spatial decay [sound propagation]	$DI_2$ /dB	Describes the extent to which the sound decreases when the distance is doubled.

When looking at the acoustic measurements we see the positive trend from room to room – it gets better and better. It is important to remember that small differences in numbers mean a lot. For instance, the noticeable difference for speech clarity is 1 dB and for reverberation time only 5%. So small numbers can have a significant effect on people. As they did in this study.

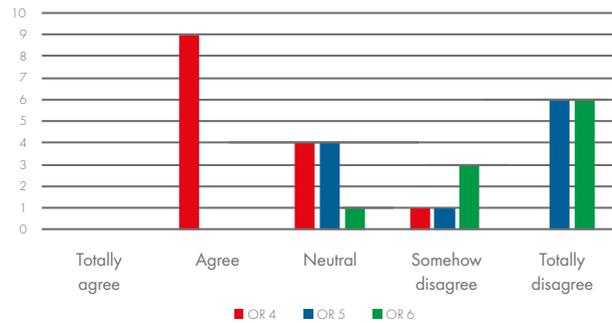
### Acoustic measurements in OR 4, OR 5 and OR 6

	OR 4	OR 5	OR 6
$T_{20}$ /sec. (average 125-4,000 Hz)	0.7	0.6	0.5
STI (distance)	0.65 (1.3 m) 0.65 (1.9 m) 0.64 (2.6 m)	0.74 (1.8 m) 0.62 (2.4 m) 0.60 (2.4 m)	0.70 (1.8 m) 0.72 (2.2 m) 0.65 (3.1 m)
$C_{50}$ /dB (average 125-4,000 Hz)	5.2	6.5	6.8
$DI_2$ /dB	2	2.6	2.8

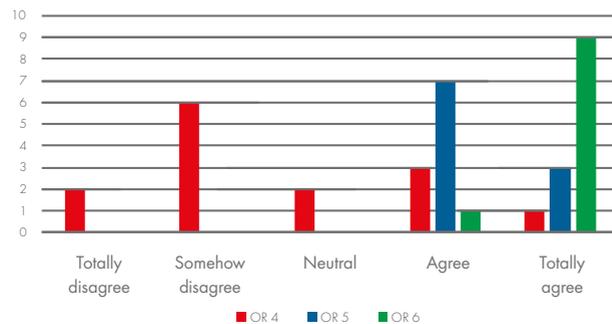
### Remarkable results

The staff members were asked questions relating to aspects like 'the sound environment makes me tired', 'the sound environment causes headaches' and 'the sound environment makes us talk louder'. In all cases the answers followed the trend of the acoustic measurements. In OP 4 staff were generally more disturbed and suffered because of the sound environment, in OP 5 they were more positive and in OP 6 they were the most pleased.

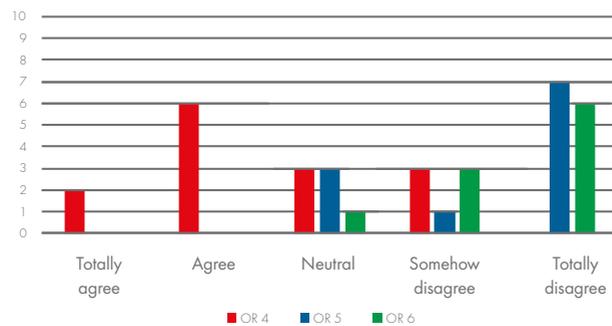
**The sound environment is stressful to me**



**I can easily communicate with my colleagues**



**The sound environment causes mistakes**



**Everybody benefits, and some even more than others**

One of the staff members was hearing impaired and used hearing aids on both ears. In the qualitative interview she stated the following:

**OR 4**

*Sometimes I just want to turn them [the hearing aids] off – but I actually have to turn the volume up to understand what the surgeon says!*

*I don't know where the sound is coming from – I cannot orient.*

**OR 6**

*There is a huge difference in the sound environment when I compare to a similar situation in OR 4.*

*I don't get the same amount of headaches, and I don't feel tired the same way.*

**The Ecophon solution**

In healthcare facilities it is important that the acoustic solution also meets the strongest hygiene demands in regards to cleaning and disinfection. In this study Ecophon provided the operation rooms with an Ecophon Hygiene™ class A solution for the ceiling and an Ecophon Hygiene™ class A solution for the walls.

**References**

Beldam, "Impact of acoustics on staff performance in operation rooms", Internoise, Madrid, 2019  
 Beldam, "The importance of several room acoustic descriptors in operation rooms", ICA – 23rd International Congress on Acoustics, Aachen, 2019



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Ecophon is the leading supplier of acoustic solutions. We contribute to healthier indoor environments, improving quality of life, wellbeing and working performance. As evolution has adapted the human senses to a life outdoors, our focus is to bring the ideal acoustic environments of nature into our modern indoor spaces. We know they will have a sound effect on people.



The principles guiding our work are grounded in our Swedish heritage, where a human approach and a common responsibility for people's lives and future challenges come naturally.

Ecophon is part of the Saint-Gobain Group, a world leader in sustainable habitat solutions. This is also one of the top 100 industrial groups in the world, constantly innovating to make living spaces more comfortable and cost-efficient. Saint-Gobain offer solutions to the major challenges of energy efficiency and environmental protection. No matter what new needs emerge in the habitat and construction markets, the future is made of Saint-Gobain.



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