

Noise causes problems in elderly care



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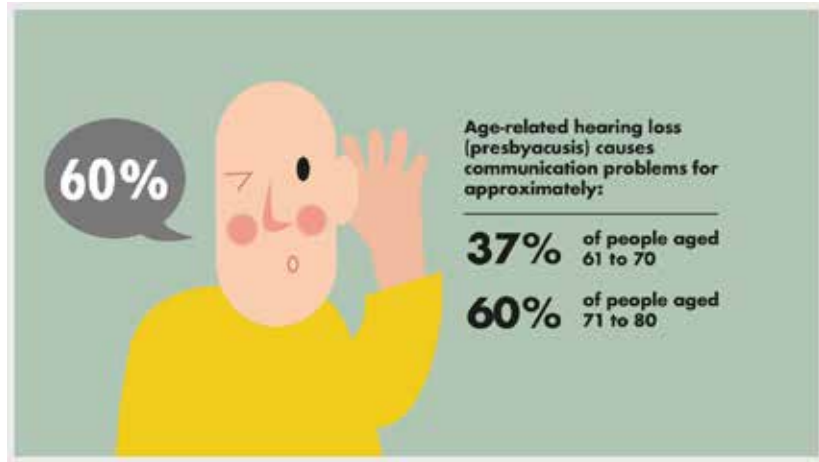


The importance of room acoustics in designing spaces for the elderly ear and people with dementia

In a dementia clinic in Denmark an acoustic intervention was carried out to discover if room acoustics has an impact on staff and patients. The results showed that just installing an acoustic ceiling reduced sound levels and reverberation at the same time as improving speech clarity. The doctors involved also felt that the communication became easier and the risk of making mistakes decreased after installing the acoustic ceiling.

Background – An ageing world

All over the world we see demographic changes with regards to age – we are simply living longer. As time goes by, we will be challenged by hearing loss, dementia and other age related conditions. Hearing is developed for the outdoors and a world of direct natural sounds, few sound reflections and low reverberation time - and the overall acoustics of highly absorbent sky.



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¹ Arneborg, E., Deutsche Seniorenliga e.V., Altersschwerhörigkeit – Symptome, Ursachen, Folgen, Diagnostik, Therapie, (Age-related hearing loss – symptoms, causes, consequences, diagnosis, therapy) Ausgabe 2010; Dalton et al., 2003; Chia et al., 2007; Chisolm et al., 2004

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What is dementia?

The number of people with dementia is increasing. Globally, the numbers of people living with dementia will increase from 50 million in 2018 to 152 million in 2050, which in total is a 204% increase². Today, 5.2% of people over the age of 60 are living with dementia globally³.

Dementia is an umbrella term for a collection of symptoms that affect the brain and it will often impact a person's memory, hearing, mobility and ability to communicate in general. It is often characterized by a progressive change or decline in cognitive, social, motor and emotional ability. There is currently no cure for dementia.

People with dementia also have big challenges with orientation and to meet the needs of a person with dementia it is important to have strategies to create appropriate buildings suitable for the them to use.

² Dementia fact sheet December 2017; World Health Organisation

³ Prince, M., Bryce, R., Albanese, E., Wimo, A., Ribeiro, W., & Ferri, C. P. The global prevalence of dementia: A systematic review and metaanalysis. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association* 2013, 9(1), 63-75.

Studies have discussed the relationship between people with dementia and their physical environment and it is known that a building/room can have a therapeutic effect on people with dementia if it is well designed⁴. On the other hand, a recent study found a link between 'unwanted behavior' in people with dementia and high noise levels, which tells us that room acoustics can be crucial for these people and is:

“...one of the key architectural efforts in care environments for people with dementia⁵.”

The link between hearing loss and dementia

There are also links between hearing loss and dementia. Hearing loss is the most common form of disability found in Europe and has a huge impact on how we relate to people and spaces leading to social isolation. It is also more common as we age. A study at John Hopkins School of Medicine alongside other research institutions found that for every 10 decibels of hearing loss a person had there was a 27% increase in the likelihood of developing dementia in the follow up period⁶.

⁴ Fleming, R., & Purandare, N. Long-term care for people with dementia: Environmental design guidelines. *International Psychogeriatrics*, 22(7), 1084–1096.

Tilly, J., & Reed, P. Literature review: Intervention research on caring for people with dementia in assisted living and nursing homes. *Alzheimer's Care Today* 2008, 9(1), 24–32.

Day, K., & Carreon, D. The therapeutic design of environments for people with dementia: A review of the empirical research. *The Gerontologist*, 2000, 40(4), 397.

⁵ Marquardt, G, Bueter, K, Motzek T. Impact of the Design of the Built Environment on People with Dementia: An Evidence-Based Review. *Health Environments Research & Design Journal* 2014, 8 (1), 127–157.

⁶ Frank R. Lin et al. Hearing Loss and Cognitive Decline in Older Adults. *JAMA Intern Med.* 2013;173(4):293-299

How does room acoustics impact people with dementia?

For people with dementia it is said that the hearing – of all the senses – has the highest impact when it comes to quality of life since people with dementia often suffer from extreme noise sensitivity. This can lead to confusion, anxiety and increased stress levels.

Furthermore, physiological reactions to sound can result in increased heart rate, high blood pressure and heavy fatigue. All these symptoms can lead to social isolation because the person with dementia simply cannot deal with the noise.

The perceptual problems experienced by people with dementia mean they may lose the ability to accurately interpret what they hear, finding certain sounds frustrating. So it becomes impossible to interpret what they hear at the same time as their bodies are alert because of physiological reactions to sound.



Acoustic intervention in a dementia clinic in Denmark

To investigate what impact room acoustics have on staff and patients an intervention study was done in a dementia clinic in Århus, Denmark. The study was part of a BA project at The Technical University of Denmark^{7, 8}.

The room that was used for the study was an office where the doctors carry out cognitive testing of patients – to figure out if the patient has dementia and if so to what degree it has affected them. In the office there will often be the doctor, the patient and relatives.

The room is approximately 16 m² and is acoustically very reverberant (echoey). All the surfaces are hard; the floor is wooden and the walls are concrete and gypsum. The ceiling is a sound reflective plasterboard solution. The intervention was to change the acoustically reflective ceiling to one which absorbs sound.

Acoustic measurements were done in the clinic before and after the installation of the ceiling and, due to practical constraints, questionnaires were completed by staff with one doctor also participating in a qualitative interview.

⁷ Qupersimat, R. Intervention study of room acoustics at the dementia clinic in Århus university hospital, 2019

⁸ Beldam, M. et al. Room acoustics in dementia care affect staff and patients. *Internoise*, Seoul Korea, 2020

Acoustic descriptors

In building regulations around the world reverberation time (T_{20}) is often the only parameter used for guidance, but speech clarity (C_{50}) is crucial when it comes to elderly care. Communication must be clear and the sound level should not be allowed to build up. Therefore, it was decided to include speech clarity as an investigated acoustic parameter, as well as reverberation time.

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.

Noticeable differences according to ISO 3382-1

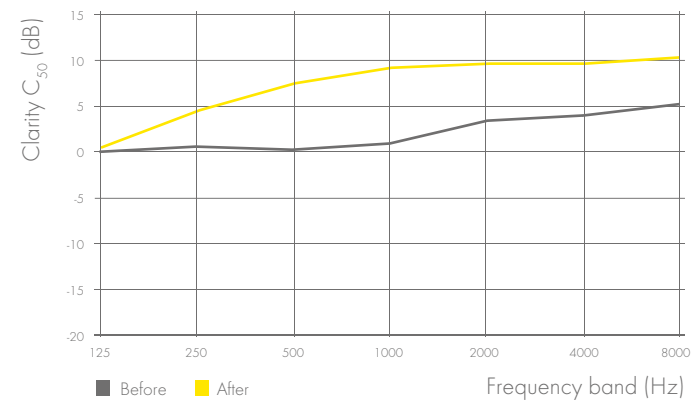
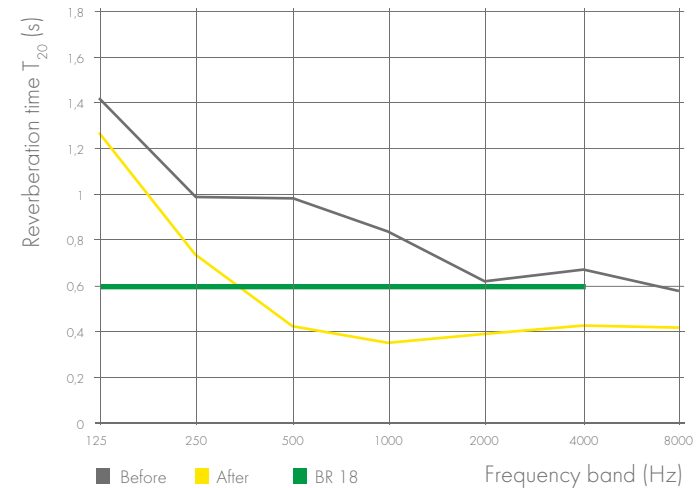
Subjective listener aspect	Room acoustic quantity	Noticeable difference
Perceived reverberance	Reverberation Time T_{20} in seconds	5%
Perceived clarity of sound	Speech Clarity C_{50} in dB	1 dB

Room acoustic results

The results before and after installing the sound absorbent ceiling show a remarkable improvement on both reverberation time and speech clarity. To meet the Danish building regulation (BR18) the room has to meet reverberation time ≤ 0.6 sec. (with a variation of 20% for 125 Hz) and the ceiling before intervention did not meet the standard at any of the frequency bands.

After installing the ceiling, the regulation was met on several frequencies and the results for speech clarity showed an improvement of more than 5 dB at many frequencies – which means that the differences can clearly be perceived by the human ear.

Clarity is not yet in the Danish building regulation for healthcare facilities but in this case it is highly relevant to evaluate since the rooms are meant for communication – and the patients usually have a hearing impairment.

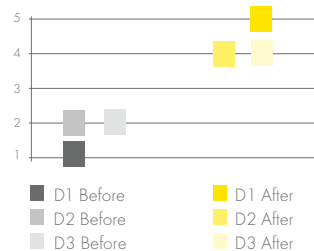


Results and statements, staff

It is difficult to just rely on acoustic measurements when it comes to human perception of sound. We hear so much more than ‘just’ the room acoustic descriptors.

The doctors in the clinic were asked to fill in a questionnaire and the results were as follows:

On a scale from 1–5, where 1 is poor and 5 is excellent, how good are the room acoustics?



The results show that there was a big difference for the doctors before and after installing the acoustic ceiling and the frequency of issues around lack of hearing is strikingly noticeable before the intervention.

One doctor mentioned that before the treatment the poor room acoustics could lead to mistakes regarding the diagnosis:

“...sometimes I’m not sure if they don’t hear what I’m saying or if they don’t understand what I’m saying”

To the question

“Could you feel a difference after the intervention on yourself and your patients?” The doctor answered: “I could feel a big change. I no longer have to do the same effort in order to speak a certain way (...), the conversation is very relaxed now. It feels like being wrapped up in a way that is very comfortable in the room. The atmosphere in the room is more warm and comfortable (...). It means a lot, not only for my work but also for the conversation itself and the patients”.

An Ecophon solution was used

Because of fire demands and a low ceiling height it was not possible to make the best acoustic solution: a suspended ceiling in a grid system. To make sure that the clinic could still live up to the building regulation in regard to ceiling height and fire demands a glued 20 mm. solution was mounted (Ecophon Focus™ B).

Next step in this clinic could be to install a few free hanging units and wall panels to make sure that the regulation was met on all frequency bands.

Some general ways to design an acoustically calming space for the elderly:

- Use the building envelope to block intrusive, loud, external noise such as busy traffic, or deliveries.
- Consider sound insulation and sound absorption in corridors to affect noise intrusion into adjacent spaces.
- Provide a quiet room, to enable the person with dementia to process information in a space without too many stimuli and to help calm agitated people.
- Consider enhanced visual cues for people with hearing loss as they rely more on the visual sense.
- Use sound absorption in the ceiling and preferably on the walls to enhance comfort and to improve communication when clear speech is required. Otherwise noise levels can rise quickly.





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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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