

HEARING PRODUCTS AND ACOUSTIC REGULATIONS IN SCHOOL

1+1 could equal 3, if a classroom is acoustically regulated when using hearing systems

By Anna K Lejon, November 2014

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Abstract:

Using hearing products or FM/digital hearing systems is one of the most efficient ways of improving the hearing situation in a classroom for a hearing impaired student. But is a technical solution the only way of improving the sound situation in a classroom? This white paper will tell more about the results from a study where working memory has been tested in different situations; using hearing products only, making acoustic regulations only and finally using hearing products in an acoustic regulated classroom.

Introduction

Using FM/digital hearing systems in schools makes the sound environment much better for hearing impaired students. In many cases, this is the only way that hearing impaired students can take an active part in the classroom education.

So what does an FM/digital hearing system do? Since the 1970's research has shown that FM/digital hearing systems improve the signal-to-noise ratio and speech intelligibility.

In this study, a cooperation between Comfort Audio and Ecophon, we have looked at the school sound environment from a different angle. Our assumption is that both digital hearing systems and acoustic improve the speech intelligibility, but what about the effects on working memory?

Working memory

Working memory or short term memory is the capacity for holding a small amount of information in mind, readily available for a short period of time. Working memory plays an important role in reading. For example, the start of a sentence has to be held in mind while reading to get the full picture. Another example is the

ability to remember several instructions and perform them, i.e. "look at page 5 and read the second paragraph".

Working memory also seems to be an important factor in speech understanding in noise for persons with a hearing impairment. (2011)

The Class

The class in the study was an ordinary fifth-grade class with 20 students. One of the students had a moderate hearing loss. The hearing impaired student had been using hearing aids and a traditional FM-system. However, the system was rarely used because it was perceived as difficult and the sound was noisy.

Method

The study was divided into three phases; each of the phases lasted about one month. The study started with a baseline test.

The first phase entailed installing the hearing system in the class and to start using it. The hearing system, a digital system, consisted of a teacher microphone, eight student microphones, a neckloop receiver and two loudspeakers.

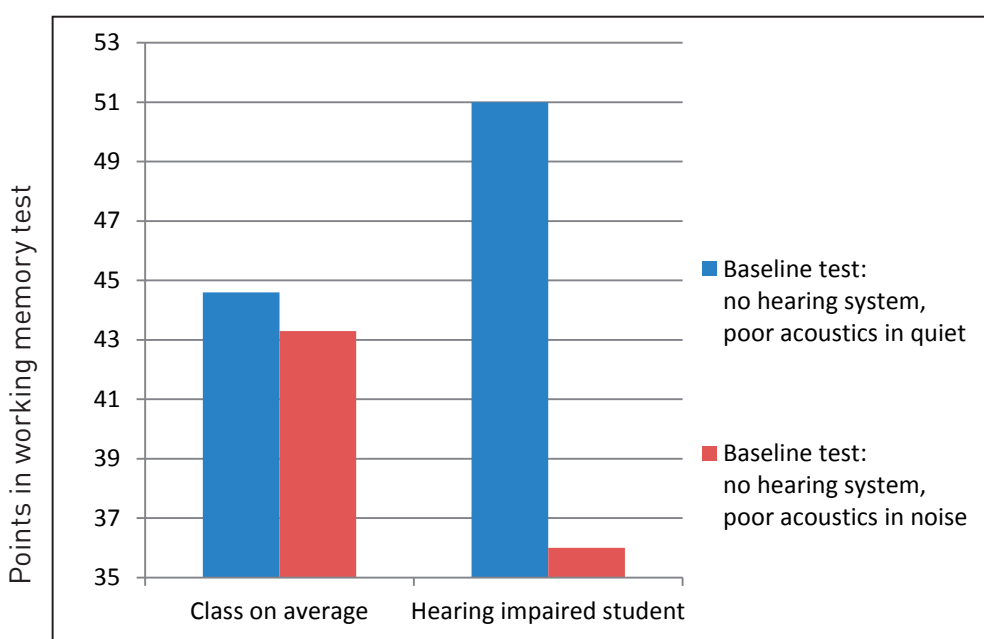
In the second phase the classroom was acoustically regulated, with sound absorbers to minimize echo and reverberation time and maximize the speech clarity. In this phase the hearing system was not used.

In the third phase the hearing system was used in the acoustically regulated classroom.

After each phase the class was subjected to three different tests, performed in both a quiet and noisy environment. This white paper focuses on the result for working memory where the students should remember a sequence of words and then write them down.

Result

The graph below shows the results for the class on average compared with the results for the hearing impaired student in the baseline testing.



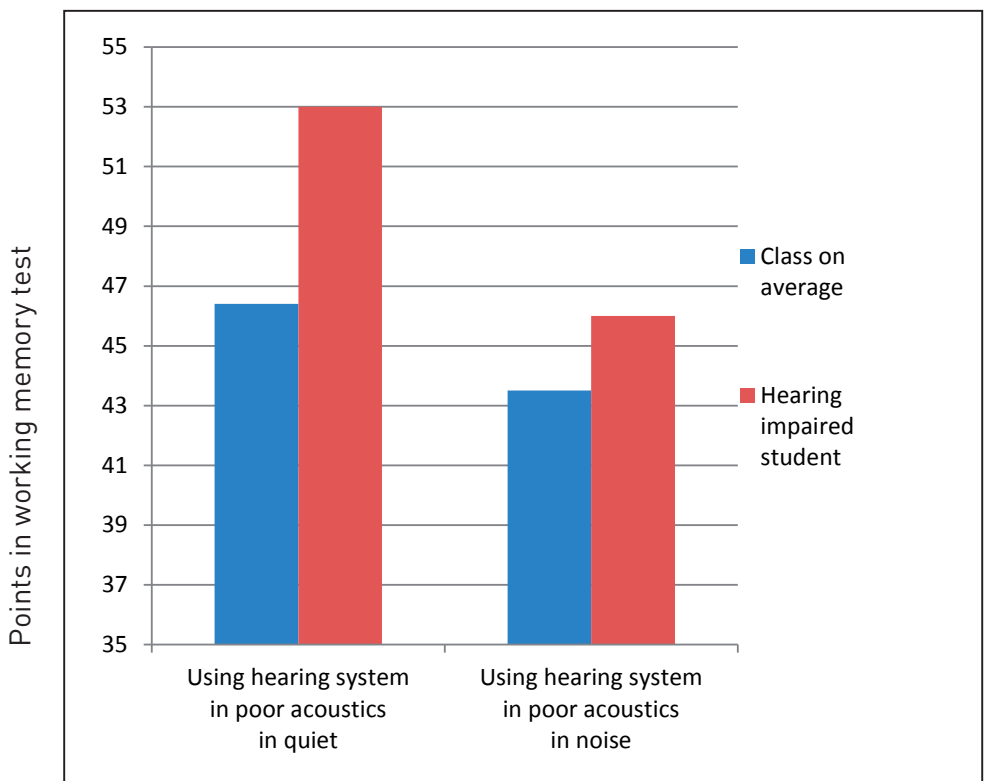
The graph shows the results from the baseline testing, the blue bars represent results in quiet, the red bars represent results in background noise.

The results for the class on average does not show a big difference between quiet (blue bar) and noise (red bar). The students do not seem to be affected by the noise that much. More interesting is to look at the results for the hearing impaired student. As a starting point the hearing impaired student has a better result than the class on average in a quiet environment. However, in noise the performance falls dramatically.

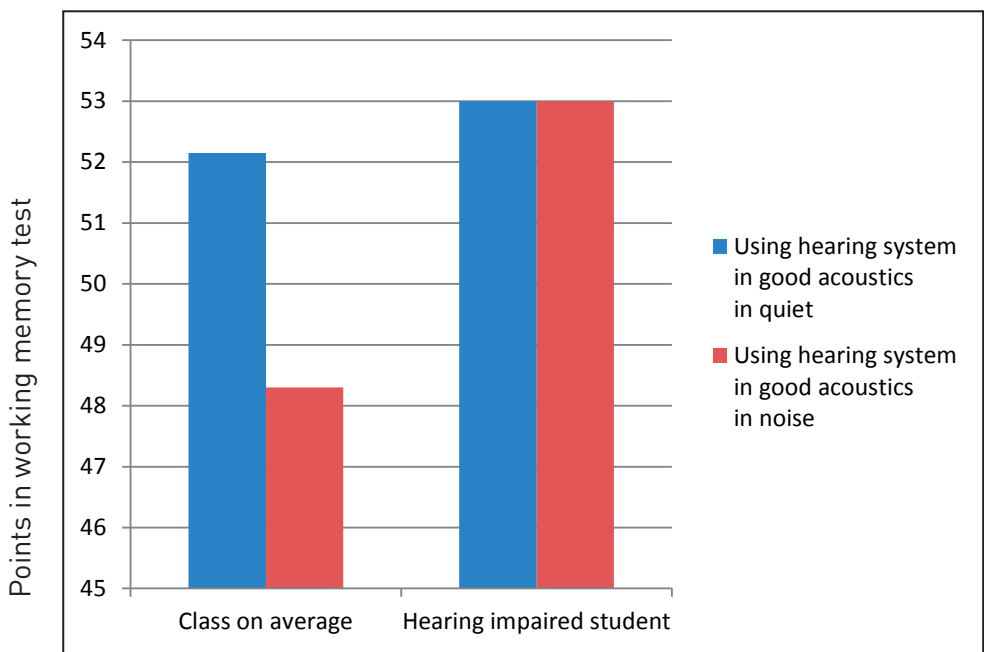
The result shows that the hearing impaired student's working memory in this case was occupied with hearing in noise and understanding rather than keeping the information in mind.

If looking at the result individually, the hearing impaired student was one of the three students that had the best results in quiet (blue bar). In noise the result was the opposite, here the hearing impaired student was one of the three that had the worst result.

The next phase in the study was to test the class after installing the hearing system. The tests were done both in quiet and in noise. The hearing system is affecting the result of the hearing impaired student the most, a predicted outcome.



At the end of the study the same test was redone, and the result is shown in the graph below.

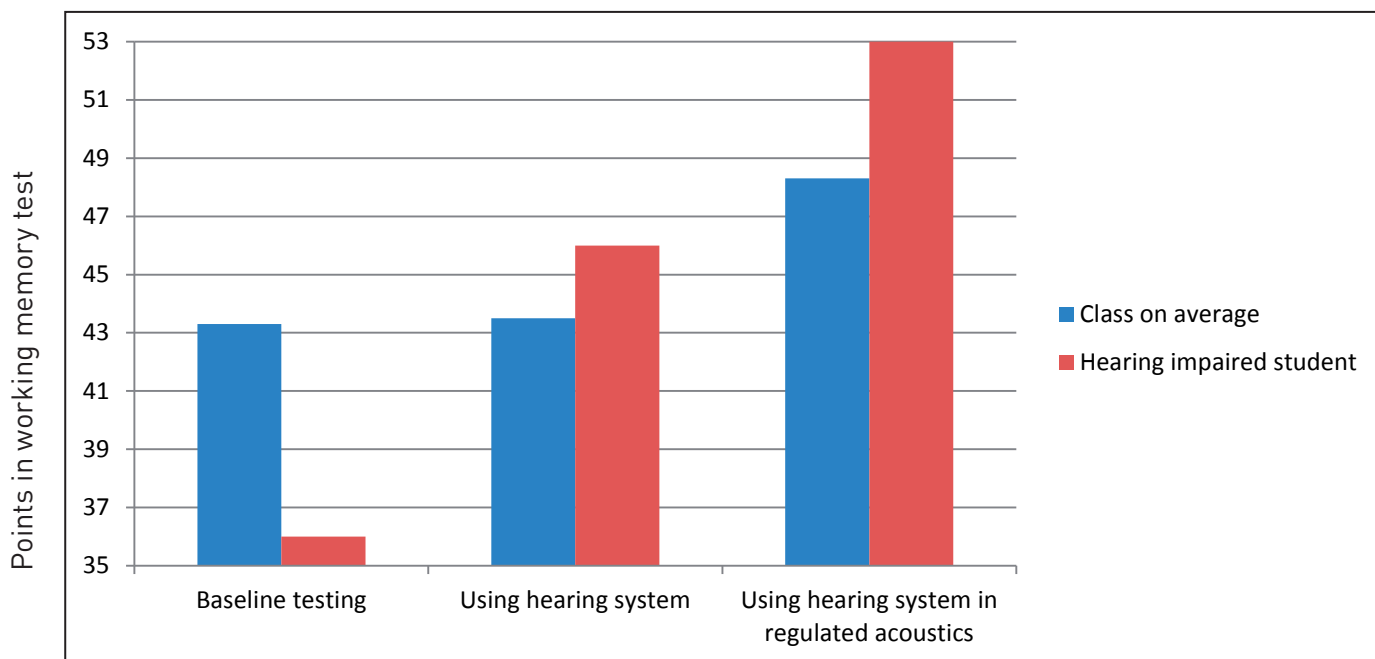


As the graph shows, the result for the class on average drops in noise.

For the hearing impaired student, the result stays at the same level. In fact, it seems like the hearing impaired student had a better starting point for hearing in noise than the rest of the class since the background noise was not transmitted by the hearing system.

Discussion

Surprisingly, the hearing impaired student got good results using only hearing aids in a very poor acoustic environment in quiet, without disturbing background noise. In talking to the hearing impaired student, the feeling is that this is a student who works hard with strategies like lip-reading, reading on the black-board and watching the other students performing in school. In an environment with noise the test-results went from one of the best to one of the worst. The teacher's general impression of the hearing impaired student was that this is one of the better students in the class.



Graph shows test results in noise

The results show that the class on average did not benefit from using the hearing system in noise in the classroom before the acoustic regulation. Why is that?

The answer is that if the acoustics are poor the effect of using external loud speakers will not be that big, unfortunately. The effects of poor acoustics, like echo and background noise, are amplified and presented in the loudspeakers. For the hearing impaired student the difference was big, the test results improved with 27% using a hearing system in noise even if the acoustics were not regulated. The explanation - the hearing impaired student is hearing the sounds through the hearing system and M+T setting and the sound is not mixed in the same ratio with echo and background noise as for the rest of the class.

According to the test result it seems like the class on average and the hearing impaired student benefited from the acoustic regulation and the usage of a hearing system. The results become better both in quiet and in noise. If we compare the result from the baseline testing to the result using a hearing system in the regulated acoustic classroom, the improvement is 47% for the hearing impaired student which is a large difference for that individual. What could be said about the rest of the class? Do they benefit from a hearing system, in this case loudspeakers, and an acoustically regulated classroom? Comparing the result for the class on average the improvement is 12%.

What does this mean during a normal day at school? No one benefits from a poor acoustic environment, no matter hearing loss, normal hearing, concentration problems or voice problems. A day in school demands a lot of students today. Instruction is given, students have to keep the focus and concentration even if other groups in the class are talking and discussing.

After using the classroom with acoustic regulation and the hearing system the teacher said that she did not understand how they did it before, but as she filled in "What choice did we have?"

Summary

To summarize this study you could say that to arrive at $1+1=3$, the acoustic has to be good and a good hearing system should be used. The positive effect does not only benefit the hearing impaired student, it makes the school experience better for everyone in the classroom, both the rest of the class and the teacher.

References

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