EduLink and its effect on understanding speech in classroom situations

Summary
Children with Auditory Processing Disorders (APD) often have distinct problems in understanding their teacher. Rustling papers and ventilation systems create disturbing background noise. But also the classmates are talking simultaneously to the teacher. This so-called informational masking further degrades understanding of the teacher. EduLink allows for substantial improvement of the SNR and thus of speech understanding even in such difficult environments. Thus, in addition to conventional therapy, an FM system such as EduLink can be highly beneficial for children with APD.

Children with Auditory Processing Disorders (APD) often have pronounced difficulties in understanding speech in noisy environments. This puts these children at a disadvantage in school, as poor understanding of the teacher leads to learning problems. The amount of noise in classrooms can be extensive. The average noise level in classrooms has been investigated in several studies. Levels between 48 and 77 dB(A) have been measured [1-3]. For children with APD a signal-to-noise ratio (SNR) of 20 dB has been recommended [4]. Depending on the acoustic properties of the classroom and the location of the seat the actual SNR can be much worse, which makes sufficient understanding of the teacher virtually impossible for children with APD.

One measure to improve the SNR in the classroom is the use of FM systems. The teacher's voice is picked up and radio transmitted to a receiver worn by the student. The EduLink FM receiver is specifically developed to meet the needs of children with APD. The voice of the teacher is directly transmitted into the ear of the child. The ear canal remains completely open. Thus, environmental sound can be heard unaltered, and the child does not feel acoustically "isolated". Only the teacher's voice is amplified, which results in a SNR improvement.

Interfering noise in a classroom not only consists of rustling papers or noise from heating and ventilation systems, but also of talking classmates. This is called informational masking, as there is not only a masking effect from the sound energy of the noise, but also an additional masking effect due to distraction of concentration.
A study conducted at the University Hospital Zurich examined the effect of informational masking on speech understanding in children with APD and whether there is a benefit from EduLink in such a condition which reflects the situation in typical classrooms.

Setup of the study
Speech understanding in noise was measured in 9 children with APD and 11 children without APD (control group). The age of the children ranged from 8-10 years (mean: 9 years and 2 months). It was confirmed that the children had no additional attention deficit or hyperactivity. None of the children had a peripheral hearing loss. The intelligence of all children was at least average. Speech testing was conducted using the adaptive Oldenburg Sentence Test which is suited for children in this age group. Each test sentence consisted of 5 words. Prior to the speech testing it was ensured that all children were able to memorize five words in a row. The sentence test was conducted with two different noise types: i) a stationary background noise, having the same

spectrum as the speech material of the test, and ii) a female and a male talker each reading a story which is interesting for children. The target sentences were presented from the front direction with a distance of 3m between speaker and child. The noise was presented from the sides from a distance of 1m. In condition ii), the female talker was presented from the left speaker, and the male talker from the right speaker. In both conditions, the noise level was kept constant at 60 dB(A). The level of the target signal from the front was adapted to obtain the Speech Reception Threshold (SRT), i.e., the signal-to-noise ratio where 50% speech understanding was obtained.

Results

The figures below show the sentence test results. Low SRTs indicate good speech understanding. With interfering talkers as background noise, speech understanding was significantly worse, compared to broadband noise. The information content in the two stories, which were presented from the lateral speakers, distracted the children and lead to further decreased speech understanding of the "desired" speech, compared to broadband noise having the same level. This reflects a typical classroom situation with classmates talking simultaneously to the teacher.

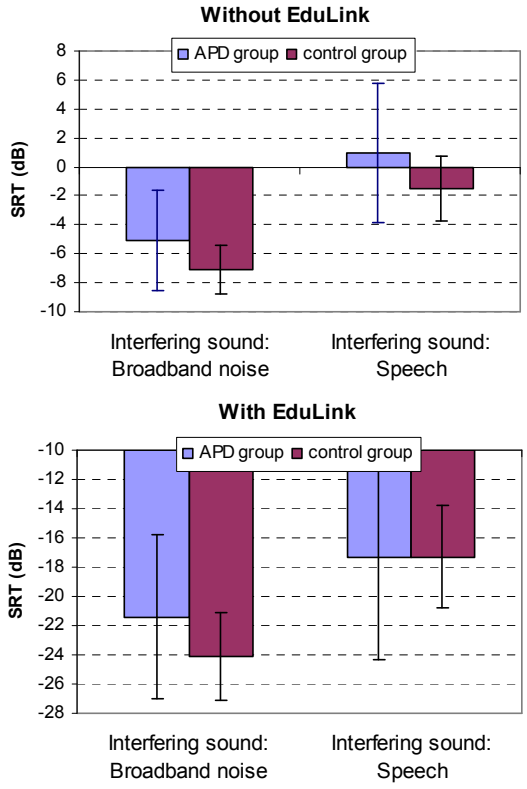

Fig. 1: Speech understanding without EduLink (top) and with EduLink (bottom).

Without EduLink, speech understanding of the APD children was worse than in the control group. However, the deviations in the APD group were higher than in the control group. While some APD children showed normal speech understanding in noise, others had major difficulties. With EduLink, speech understanding increased considerably in both groups. In the interfering talker condition (which is the condition reflecting typical classroom situations) children with APD reached the same speech understanding as the control group.

The SNR benefit with EduLink did not differ significantly between both groups and was between approximately 16 to 18 dB. This ensures that a sufficiently favorable signal-to-noise level is present at the children's ears, which in turn allows for adequate speech understanding even in challenging acoustic environments.

In summary, children with APD often have more difficulties in understanding speech in noisy environments compared to normal hearing peers. In classrooms, there can be extensive background noise which is mainly from classmates talking. EduLink allows for substantial speech understanding improvements in such difficult environments. This ensures that the teacher can be heard well, which is the prerequisite for effective learning.

Thus, in addition to conventional therapy, an FM system such as EduLink can be highly beneficial for children with APD.

References

[1] Finitzo-Hieber (1988) Classroom Acoustics. In Auditory Disorders in School Children, Thieme-Stratton, NY, 221-233
[2] Shield and Dockrell (2004). J Ac Soc Am 115(2):730-738
[3] Klatte et al. (2002); Einblicke, U Oldenburg (35):4-8
[4] Rosenkötter (2003); Auditive Wahrnehmungsstörungen. Klett-Cotta, Stuttgart

For further information please contact info@phonak.ch