Does Noise Susceptibility using Headworn Microphones Suggest Earlier Radio Aid Fitting?  Pauline Cobbold and Colin Peake

Background to Study

The University of Southampton Auditory Implant Service (USAIS) undertakes the initial fit of radio aid systems to children with cochlear implants. Routine speech in noise testing of children wearing cochlear implants suggested that children using head-worn microphones might be more susceptible to background noise than those wearing forward facing microphones. If this proved to be the case, such children might be considered suitable for an earlier radio aid fitting than might normally be the case.

Method

• 13 children took part in the study, all using Neptune processors.
• All needed to be able to undertake several presentations of the toy test.
• Radio aid systems used included Comfort Audio DT20 and Phonak Roger X (ear level systems), and Connevans FM Genie (body worn system).

A frequency response curve was obtained in an Aurical test box at 60 dB with the speech processor alone, and then at 65 dB with the radio aid transmitter replacing the speech processor in the test box. The gain of the radio aid receiver was adjusted so that the output curves matched.

If a teacher’s voice at 15 cm from the mouth is approx. 75 dB, and conversational speech is taken to be 60 dB, a 15 dB advantage due to natural amplification would result. For CI users this is reduced to 10 dB by increasing the test box level by 5 dB, hence use of 60/65 dB.

Variable noise was used in both conditions; the noise used was pink noise and increased after two correct responses until an incorrect response was made and the noise then reduced. After 6 such reversals the test stops and the noise level averaged. Signal to noise ratio (SNR) is calculated by subtracting the averaged noise level from the constant 65dB speech in both conditions. The radio aid advantage is the difference between the two SNRs.

Results

The results indicate a wide range of ability to discriminate speech in noise with or without a radio aid system, +17 dB to -2 dB with speech processors alone.

Using the 10 dB advantage protocol, all users demonstrated an improvement. However a greater than 10dB average advantage was actually obtained. The improvement ranged from 9 dB up to 21 dB with the mean at 15 dB.

Discussion

These results were compared to a random sample of other speech processors with forward facing microphones and radio aids set up using the same protocol (see table below), and the following features are worthy of note:

• There is a significant difference between the average SN thresholds for ear level microphones and headworn microphones (9.08 as opposed to 2.16 dB).
• The mean SN ratio for children wearing processors plus radio aids is very similar (~6.5 dB against ~5.92 dB).
• It appears that the advantage of using radio aids with speech processors with head-worn microphones is significantly greater because of the susceptibility of the headworn microphones to background noise.

There is a significant difference in performance between the two microphone positions ($t(29)=4.85, p<0.001, r=0.65$ (2-tailed)).

Conclusion

The findings of this study suggest that children wearing head-worn microphones, and who spend significant amounts of time in noisy educational environments might benefit from earlier radio aid fitting than might normally be indicated for younger children. Ear-worn microphones can take advantage of inter-aural timing and intensity differences, a conclusion which accords with the view of Wolfe and Schafer:

“However, the authors strongly recommend ear-level microphones when possible in order to take advantage of interaural timing cues that are more likely to be available if binaural hearing technology is worn on or near the ears rather than on the body.”


Verification

Speech in variable noise testing was performed with speech processors alone and then with the balanced radio aid system. The speech test used was the McCormick Toy Test using 6 pairs (man and lamb being omitted).

The McCormick Toy Test is used for simplicity, bearing in mind that speech discrimination testing is not the object of the routine but to compare the two conditions quickly and easily.