

Headpiece Microphone Study

BATOD Conference 2017

Pauline Cobbold and Colin Peake
Auditory Implant Service
University of Southampton

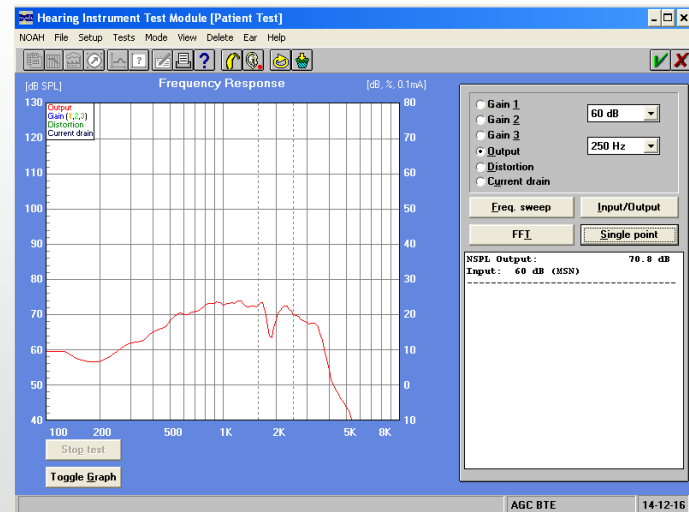
Background to study

- The Auditory Implant Service at the University of Southampton undertakes initial fitting of radio systems.
- It was observed that some children achieved better-than-expected results when using a radio system during the validation process.
- These results tended to centre on children using the Neptune processor* utilising a head worn microphone.



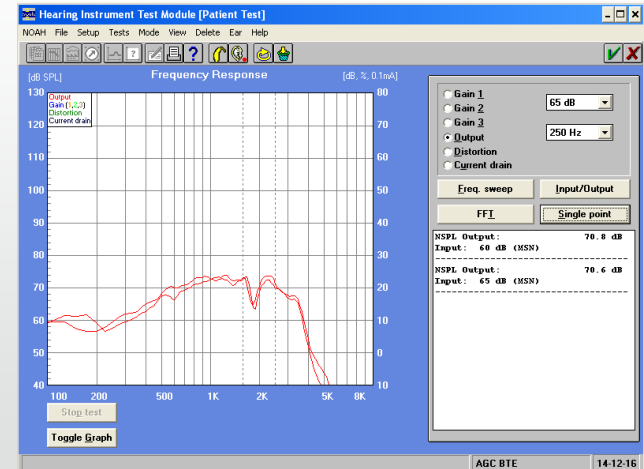
Verification process - Processor FR curve

- The Neptune speech processor shown set up in the test box. ©
- Test box output at 60 dB
- Processor programme on radio aid setting.
- A frequency response curve at 60 dB is obtained



Verification process- Radio receiver FR curve

- The transmitter microphone replaces the headpiece microphone.
- The radio receiver is attached to the processor.
- Second curve run at 65 dB, and Rx volume adjusted to produce as close a match as possible. (Inspiro is in Verification mode)



Why 60/65 dB?

- ToD's will be used to balancing (verification) using 65 dB to the hearing aid and 65 dB to the Tx microphone.
- This provides 75-80 dB at the hearing aid (microphone worn 15 cm from mouth).
- Also gives a 15-20 dB SNR in classroom (assuming 60 dB of background noise), and is in accordance with BATOD guidance.
- However, 75-80 dB too high a level for CI sound processors due to very high levels of compression

High levels of compression

- In normal hearing there are approximately 100 'steps' between the quietest and loudest sounds we hear. ©
- For CI users there may be as few as 10.



Graphic courtesy of Cochlear™



Why 60/65 dB?

- So if 75-80 dB too high a level for CI sound processors due to high levels of compression. ©
- Radio aid output is reduced by 5 dB. ©
- Hard to judge 5 dB difference in a test box curve, so instead . . .
- We turn the test box **UP** 5 dB instead and adjust the curves to match.

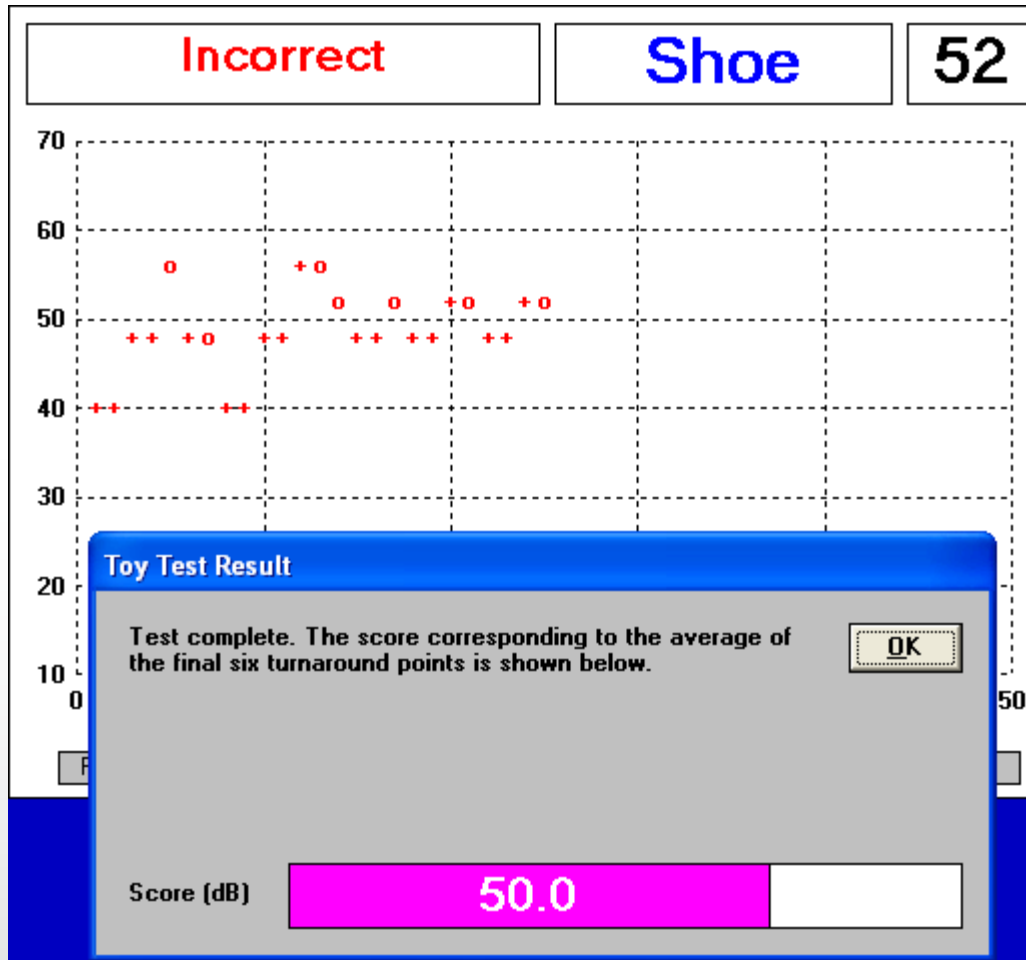
The validation process – set up

- Children are placed midway between signal source and noise source.
- Signal is constant 65 dB speech at the ear.
- Noise is pink noise – variable, commencing normally at 50 dB. (Starting SNR +15. Values taken at the ear).
- Test used is McCormick toy test for any age group.
- Man/Lamb pair always omitted.



The validation process – procedure

- After every two correct responses the noise increases by 8 dB.
- After any wrong response the noise reduces by 8 dB.
- After 6 reversals* the test stops and the average noise level is calculated.
- Threshold is calculated at 71% correct



A calibration correction factor of 10 dB has to be added to the noise score

Data for current
year. All processor
types except Naida
and Rondo

| SessionDate | Type | SNR no radio | SNR + radio | Advantage |
|-------------|---------------------|--------------|--------------|--------------|
| 31-Mar-16 | Comfort Audio DH10 | -3 | -17 | 14 |
| 23-Dec-15 | Comfort Audio DH10 | 1 | -12 | 13 |
| 12-Feb-16 | Roger 14 | 8 | -5 | 13 |
| 20-Jun-16 | Roger 14 | 9 | -4 | 13 |
| 30-Jun-16 | Comfort Audio DH10 | 3 | -10 | 13 |
| 09-Nov-16 | Comfort Audio DH10 | 4 | -9 | 13 |
| 17-Nov-16 | Comfort Audio DT 20 | 5 | -8 | 13 |
| 28-Jul-16 | Comfort Audio DH10 | 12 | 2 | 10 |
| 09-Sep-16 | Comfort Audio DH10 | 2 | -8 | 10 |
| 28-Jan-16 | Comfort Audio DH10 | 5 | -4 | 9 |
| 05-May-16 | Comfort Audio DH10 | 6 | -3 | 9 |
| 20-Jun-16 | Roger 14 | 11 | 2 | 9 |
| 04-Aug-16 | Phonak ML14i | 3 | -6 | 9 |
| 27-Sep-16 | Comfort Audio DT 20 | 8 | -1 | 9 |
| 28-Jan-16 | Connevens Genie | 2 | -6 | 8 |
| 13-Jun-16 | Roger X | 2 | -6 | 8 |
| 01-Aug-16 | Phonak ML14i | -2 | -10 | 8 |
| 03-Aug-16 | Roger 14 | 7 | -1 | 8 |
| 28-Jan-16 | Roger 14 | 0 | -7 | 7 |
| 01-Feb-16 | Comfort Audio DH10 | -5 | -12 | 7 |
| 22-Feb-16 | Comfort Audio DH10 | 2 | -5 | 7 |
| 18-Apr-16 | Comfort Audio DH10 | -4 | -11 | 7 |
| 25-Jul-16 | Comfort Audio DH10 | -9 | -15 | 6 |
| 27-Jul-16 | Roger X | 3 | -3 | 6 |
| 28-Jul-16 | Roger X | 2 | -4 | 6 |
| 01-Aug-16 | Comfort Audio DH10 | 8 | 2 | 6 |
| 01-Jun-16 | Connevens Genie | -7 | -12 | 5 |
| 29-Jun-16 | Roger X | 1 | -4 | 5 |
| 02-Aug-16 | Comfort Audio DH10 | -1 | -6 | 5 |
| | Averages | 2.52 | -6.31 | 8.827 |

Data for processors with
head-worn microphone.
(15 Naida +1 Rondo)

| SessionDate | Type | SNR no Radio | SNR + radio | Advantage |
|-------------|---------------------|--------------|-------------|-----------|
| 28-Jan-16 | Connevans Genie | 17 | -4 | 21 |
| 07-Sep-15 | Comfort Audio DT 20 | 10 | -10 | 20 |
| 23-Oct-15 | Comfort Audio DT 20 | 12 | -8 | 20 |
| 28-Oct-15 | Comfort Audio DT 20 | 14 | -4 | 18 |
| 17-Aug-15 | Comfort Audio DT 20 | 10 | -6 | 16 |
| 26-Oct-15 | Comfort Audio DT 20 | 4 | -10 | 14 |
| 28-Apr-15 | Comfort Audio DT 20 | -2 | -15 | 13 |
| 28-Jan-16 | Connevans Genie | 6 | -7 | 13 |
| 07-Dec-16 | Roger X | 7 | -6 | 13 |
| 10-Feb-14 | Comfort Audio DT 20 | 7 | -5 | 12 |
| 06-Sep-16 | Comfort Audio DT 20 | 9 | -2 | 11 |
| 22-Jul-15 | Comfort Audio DT 20 | 11 | 1 | 10 |
| 27-Aug-15 | Comfort Audio DT 20 | 6 | -4 | 10 |
| 26-Aug-15 | Comfort Audio DH 10 | -3 | -15 | 12 |
| 16-Aug-16 | Comfort Audio DT 20 | 4 | -6 | 10 |
| 22-Jul-15 | Comfort Audio DT 20 | 13 | 4 | 9 |
| | | 7.8125 | -6.0625 | 13.875 |

In Summary

| | SNR no Radio | SNR + radio | Advantage |
|--------------------------|---------------------|--------------------|------------------|
| Headworn mic data | 7.8125 | -6.0625 | 13.875 |
| F/F mic data | 2.52 | -6.31 | 8.827 |

Upgrade data – 3 cases.

| Head-word Mic | | | Naida with ear-level Mic | | |
|---------------|-------------|-----------|--------------------------|-------------|-----------|
| SiN no Radio | SiN + Radio | Advantage | SiN no Radio | SiN + Radio | Advantage |
| 14 | -4 | 18 | 2 | -5 | 7 |
| 17 | -4 | 21 | 6 | -2 | 8 |
| 15 | 5 | 10 | 0 | -10 | 10 |

Should we be surprised?

- Probably not, our instinct would suggest as much.

“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.”

Wolfe and Schafer. Programming Cochlear Implants 2nd Ed, 2015

Other features
highlighted by the data

Other features highlighted by the data

- Great range of speech detection ability in noise.
- For forward facing microphones -
SNR -9 dB to + 12 dB. Range 21 dB. Average 2.3 dB
n=128 (No account taken of processor noise reduction strategy).
- For headworn microphones
range speech detection ability in noise from an SNR of +17 dB to -3 dB.
Range 20 dB. Average 7.8 dB (n=17)

The future for head-worn microphone

- Directional head-worn microphones?
- Work well in progress e.g. Cochlear Kanso with dual microphone technology
- Ear level might be better than ‘top of the head’ – there will be some head-shadow effect and natural noise reduction.



- [video](#)

hello?



yeah it's me, have you seen the remote control anywhere?

