FM SYSTEMS

A summary of a presentation at the Summer Meeting 2009 by Tony Murphy of Phonak UK

"I am going to talk to you about FM systems and some of the limitations of cochlear implants and give some pointers in the direction of useful things that can help you in your lives to improve your hearing and understanding in different, difficult situations.

Whilst cochlear implant users are generally pleased with their outcomes all users are fully aware of some of the current limitations of this modern technology. One of these is the limited range of the microphone in the device and another is the problem of background noise which masks the incoming sound. The microphones have, on average, a range of about 2-3 metres depending on the acoustic environment and thus good speech perception drops off considerably as the sound source moves farther away. Directional microphones can only do so much. The issues of background noise are multiple and severely affect the signal to noise ratio (SNR) which needs to be maximised to achieve a satisfactory result

Clever electronics in the sound processor can now provide a wide dynamic range, though still less than normal hearing as the processor has to compress the incoming signal to achieve a satisfactory result. Noise cancellation and multiple programmes can provide specific solutions. Both frequency and temporal resolution are also compromised and this affects the perceived sound range and speech perception. The room we are in today has some acoustic problems and there isn't a hearing instrument in the world that can solve that. The problem is unless someone can invent a hearing instrument that knows what I am going to say before I say it, it doesn't matter how wonderful that technology is within the hearing instrument, if that information is missing before it goes into the device microphone there is very little one can do about it.

But there is a solution outside of the sound processor and this is wireless technology or as it generally known FM. The technique is to wirelessly connect the sound source directly into the sound processor thus by- passing the environment of the speaker and the listener and eliminating all the acoustic and noise issues mentioned above. The speaker has a microphone and a FM transmitter and the listener has an FM receiver plugged directly into their processor. These processor plug in adaptors are very light weight and are self powered.

There are several situations where FM systems can be very effective for cochlear implant users (see Figure 1). In the home, the TV can have the transmitter plugged into the back of the TV and the CI user can enjoy the TV programme without affecting the room volume level for other viewers.

FM offers proven benefits for CI recipients

- Improved signal-to-noise ratio
- Reduced effects of reverberation
- Better communication over distance
- Better use of small dynamic range
- Higher performance and understanding in real life environments
- More freedom of movement for speaker and listener

Fig1

In the car where there is always a lot of road and tyre noise, CI users can hear much better if their passenger(s) use the FM microphone. For mobile phone use, where 3G instruments are the best for CI users, the user can have a hand free set up which again improves the S/N ratio. Extending this feature can provide hands free mobile phone use in the car which can be very effective. Most pubs and restaurants are noisy places and again here the FM system setup can be very beneficial. And again at social functions, parties and other such gatherings a FM system will give valuable support and make the occasion more enjoyable. In all these scenarios the user can either use their own FM adaptor or use a neck loop with their T coil setting. Whilst all these situations will involve in part some cable linkups, these are minimal and well worth the effort.

Bluetooth technology can also be brought into play which eliminates cable connections. This is very clever but it is important that both instruments are not only Bluetooth compatible but also that they are matched, that the components can 'talk' to one another. Price and thereby quality plays a part here. You know the adage –you only get what you pay for; well that is very true in this matter and professional advice is recommended in selecting the system components.

For those CI users at work, a FM system can be very important when faced with business meetings

and group discussions. This equally applies to students in lecture halls and school children in classrooms where the speaker is often some distance away and there can be a high level of noise.

The results of a study of 24 users looking at speech in different noisy type environments for various different cochlear implant wearers are shown in Fig 2. The yellow bars are the cochlear implant alone and the blue bars with FM. You can see that in most cases how much speech understanding has been dramatically improved by using FM system. The mean result of the study was a threefold improvement in speech recognition. If anyone has any doubts whether or not they would benefit from an FM systems, these results just goes to prove that.

Phonak offer several system levels. The starting point is EasyLink transmitter which can be used with the MyLink receiver. This setup is ideal for home or leisure use. ZoomLink enables the user to change microphone settings. The next level is the SmartLink transmitter. Then the Inspiro which has built in both a monitoring facility and SoundCheck which measures the sound/noise levels and adjusts itself to maximise performance.

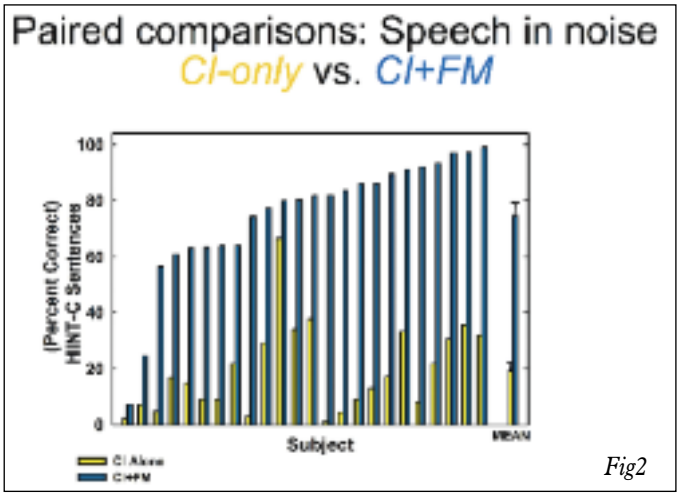

Fig2

We do not sell directly to members of the public but have a network of over 70 FM distribution centres across the UK (see www.phonak.co.uk). Our products are also available from RNID (see www.rnid.org.uk/shop) and Connevans (see www.connevans.co.uk) It is important that you understand your needs and get the system that you actually want. You can ring us up at any time, feel free. You can ring me directly, talk to me, ask questions, no issue at all. Advice is free!" *(Tony can be contacted at 07766993468 or email at Tony.Murphy@phonak.com)*

THE TWILIGHT LECTURE

Given by David McAlpine, Director UCL Ear Institute, London, on 12 March 2009

What the Brain Knows about Cochlear Implantation

"Cochlear implants are one of the most successful prosthetic devices to date enabling many profoundly deaf people to hear speech and attend to a range of environmental sounds. However, whilst their success over several decades in this regard is self evident, surprisingly little is known concerning the brain's response to implantation. This lack of knowledge can make it difficult to understand why some recipients perform well and others do not. Stimulation strategies in cochlear implantation generally try to introduce patterns of activity to the brain that are considered important in normal hearing. To date, this strategy has been driven from the perspective of cochlear psychophysics, with little regard as to whether this is optimal from the perspective of the central auditory nervous system. Arguably, other than as a repository for an implant, the cochlea is the least important structure in the outcome of a pre-lingually-deafened implant user. It is important to establish the evidence for what the brain is actually responding to in cochlear implantation.

The auditory nerve fibres (ANF) degrade with deafness and one of the limiting steps in the performance of an implant is the extent to which the remaining ANFs can provide the lower brain centres with sufficient input to perform their functions as normally as possible. This is, arguably, more relevant than the issue of cortical plasticity. It may be necessary to review the function and performance of the spiral ganglion neurons. It's not yet clear what the brain itself needs from by aural reception and this is a subject for continued research.

In the developing world of bilateral implantation, whilst each implant may be perfectly satisfactorily mapped in isolation, mismatches can occur between the two implants, and sensitivity to binaural cues, such as interaural time differences, requires very careful balancing of the implants. Current implant strategies remain bilateral rather than binaural, and understanding what the brain requires to achieve binaural processing will be critical. Unfortunately, different neural survival patterns can complicate this situation.

I contend that a "reverse-engineering" perspective on cochlear implantation must be adopted, one that suggests "neuron-oriented" stimulation strategies designed for maximum performance in listening tasks. Understanding how the brain responds to implantation, and adapting or modifying stimulation strategies accordingly, will potentially improve the capacity of future auditory implantable devices."