

## Macroaudiology – a Working Model of Hearing

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I would like to present a model of hearing which gives a theoretical basis for the clinical assessment and treatment of hearing problems, based on everyday observation and experience.

Despite its involvement in areas of provision of rehabilitative as well as investigative services, audiology has not been particularly successful in developing and presenting an easily understandable model of human hearing and its importance to people. In part this has been due to a tendency to focus on the minutiae of hearing rather than developing an over-view.

- Behavioural audiometry
- Electroacoustics
  - Tympanometry
  - Hearing aids
- Electrophysiology

### **Figure 1. The tools of the trade**

While the minutiae are important in allowing audiologists to develop an understanding of a patient's auditory function, they are essentially meaningless to the patient and tend to diminish the audiologist's ability to integrate their understanding of the patient's auditory function into an understanding of the patient's needs as a person who has come to them for help. With time and

experience, audiologists working in this area tend to develop an informal understanding of the process, but this is not taught early in audiological education.

The macroaudiological model disregards the microaudiological information and approaches the hearing process,

## THE BLACK BOX

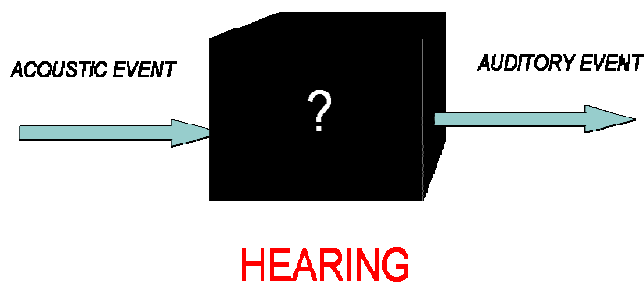


Figure 2. The black box

whereby an acoustic event becomes an auditory event, as a "black box". From behavioural observation, we can surmise what processes must take place within the black box

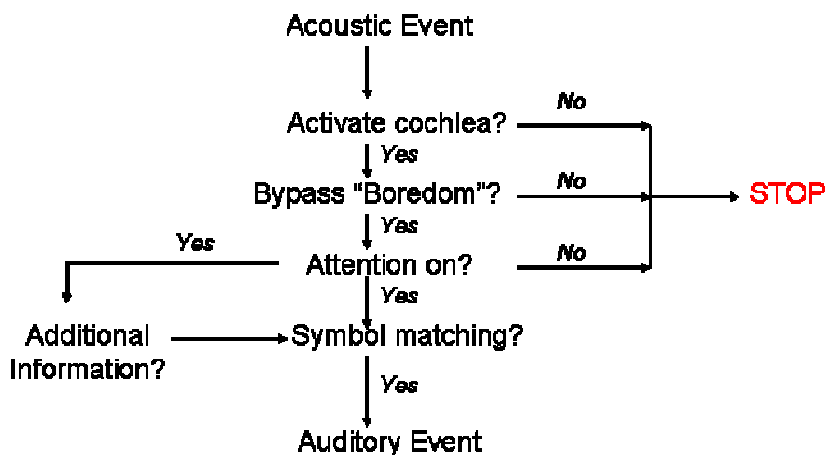


Figure 3. The working model

The exact sequence of events inside the black box is not of great importance. It can be seen that any reduction in the cochlear input will be likely to disrupt processing further along the model, but as importantly, it can be seen that variables such as attention, recognition and the ability or inclination to seek additional information to allow symbol-matching are all likely to affect the production of an appropriate auditory event.

It almost goes without saying that audition is a misunderstood and confusing process, especially for people with impaired hearing and, equally, for those dealing with them on an everyday basis. Audition in humans is a secondary sensory process, one which occurs in the background of our consciousness, the results of which occasionally insert themselves into our consciousness. A number of different experiences are generated by our hearing systems; but the one that concerns us most as audiologists, especially in the field of hearing treatment or the provision of rehabilitative services, is the ability to use our hearing to make sense of the vocal acoustic events created by other humans.

An important part of the model is its recognition of the place of hearing in human interaction. Hearing is the dominant mode of human communication and any reduction in the efficiency of the hearing process, for whatever reason, results in a communication barrier. This in turn has profound effects not only on the affected individual, but also on those other individuals who are trying to interact with them. In everyday informal human communication, responsibility for ensuring that the message has succeeded is on the listener. For instance, if the message fails, it is the listener in most instances who will instigate a repetition. Not only does this destroy the normal flow and rhythm of interaction, but it inconveniences the speaker who generally will react with annoyance. The annoyance is expressed either verbally or non-verbally, and the

social ambience deteriorates. Most people will not be aware of this sort of dynamic, but the net result is for a hearing-impaired individual to become progressively socially isolated.

A key concept of the model is information. The model assumes that we extract symbolic information from our sensory input and that it is to the symbolic content that we react, rather than to the sensory input itself. Sensory debilitation will reduce the information capacity of that sensory channel, and this in turn will reduce the likelihood of a successful symbol match occurring later in the process. Similarly, if there is any reduction in the system's ability to make the symbol match, for instance through the individual attending to some other event, or being under stress, worried about something, depressed or otherwise distracted, the symbol matching may fail to occur. When this happens with auditory function, the person fails "to hear". It is apparent that the effects of sensory debility and "central" distraction are additive.

The model differs from the traditional audiological approach by not focussing on any particular aspect of audition, such as speech discrimination. A commonly recognised difficulty of the traditional approach which does over-emphasise speech discrimination is that systems which maximise speech discrimination are often not practical in that they tend not to be used in an everyday setting. Similarly, strategies of signal processing in hearing aids are often aimed at duplicating central auditory functions which function poorly in a particular individual, not through failing central processing, but simply to sensory debility and its consequences. An example is the search for a means of separating (desired) speech from (undesired) noise.

The model recognises how individual receptive communication strategies may be situation-bound. An example is the individual with a mild degree of hearing disability who copes well with it in their usual environment. Frequently

this author has seen patients who are convinced that their hearing has deteriorated suddenly but who are otherwise symptom-free and who, with serial testing, fail to demonstrate further deterioration, but have in common a significant change in their social environment. For instance, they may have changed employment, retired or been made redundant. Communication strategies which they have developed for their previous environment are no longer appropriate in their new environment and their reaction is that their hearing must have become worse.

A further example is given by elderly people with poor hearing who feel that their difficulties with receptive communication are due to declining mental powers, but who are otherwise competent. When information is restricted in a particular channel due to sensory failure or environmental factors, if there is appropriate information available from other sources,

- No background noise
- Proximity
- Visual connection
- Speaker is clear,
  - Not too fast
  - Not too loud
- Attention

**Figure 4. The listening environment - a macroaudiological concept**

such as other sensory channels or from memory, accurate symbol matching can frequently occur. Given access to adequate information, people with hearing impairment can often conduct a normal conversation, for instance. Depending on the severity of the hearing loss, and on the reduction of the quality of the

listening environment, most people can synthesize an adequate representation of the hearing process to the extent that they can understand what is being said to them. This is an important, although frequently overlooked observation. It takes mental effort, however, and if the hearing loss is too great, or more commonly the listening environment is inadequate, the synthesized hearing result lies tantalisingly beyond the listener's capabilities. The common response to this is "If only I could concentrate harder I would be able to understand". The common interpretation of this experience is that their receptive communicative difficulties must be due to their failing powers of concentration.

This introduction to the ideas of macroaudiology has necessarily been brief. When used clinically, however, this approach has been shown to give a perspective of the hearing process which allows ready empathy with the patient's experience, and allows the clinician to interact with the patient at the level of the patient's experience.

1. To enable the patient to be **in control** of their listening experiences.
2. To encourage the patient to have **confidence** in their listening experiences.
3. To reduce the difficulties experienced **by other people** when talking to the patient

**Figure 5. The aims of macroaudiological intervention**

The approach tends to emphasize what the patient can do with their hearing rather than what they cannot. Simple explanations of the problems, successes and interpersonal effects of a patient's hearing ability can be given to the patient and their significant others. This helps to demystify the problems associated with hearing loss and allows for a rational basis to be given to their experience. Using this approach, it is common for the patient and/or their

significant other to state a strong recognition of their own experiences and it is not unusual to be told by them that they feel that "at last somebody understands what is happening to them". Armed with this perspective, patients can start to solve their own hearing problems by taking charge of communication situations rather than enduring passive isolation.

- **Theoretical model consistent with patient's experience.**
- **Predicts consequences of hearing loss**
- **Allows guidelines for:**
  - When to intervene
  - Statable goals for intervention
  - Testable goals
- **Asserts patient's rights**
- **Offers recognisable framework for auditory experience**
- **Asserts social nature of problem**

**Figure 6. Summary of practical consequences**

One practical consequence of this approach is that it helps to determine when hearing aids may be appropriate. A difficulty associated with the traditional approach is compliance with hearing aid use, and it has been generally difficult to predict accurately who will be a successful candidate. Macroaudiology predicts that successful hearing aid candidates will be those who experience significant disruption to their chosen life-style from their hearing loss, more or less independent of the degree of hearing loss. This consideration also predicts fairly accurately whether an individual is more likely to use binaural hearing aids. By making hearing aid intervention the decision of the informed patient rather than the "expert audiologist", the model asserts the patients' Rights to determine their own level of treatment, and this helps to ensure a high level of compliance.

The adequacy of audiological intervention can similarly be tested against

statable goals.

- **To produce people who:**
  - **Recognise & accept hearing limitations**
  - **Know what those limitations are**
  - **Can actively manage their listening environments without shame or guilt**
- **To allow the individual to retain their preferred social placement through:**
  - **Understanding the effects of their hearing loss**
  - **Sharing the responsibility for communication success**

**Figure 7. The eventual goals of macroaudiological intervention**

Informed patients are encouraged to take responsibility for their own hearing performance and to pursue the level of hearing adequacy which they feel is appropriate for them. Because macroaudiology tends to de-emphasise speech discrimination, hearing aid transparency becomes an obvious goal. Hearing aids are set up to allow the patient to approach as close as possible to the status of

a normal listener. This does not imply that the hearing aids should restore normal auditory thresholds, but that the hearing aid wearer should enjoy the same listening status enjoyed by normal listeners, namely the ability to forget about the process of audition and concentrate on enjoying the outcome.

If this type of model was incorporated into audiological education it may well result in the provision of more effective hearing treatment earlier in the audiologist's career, better outcomes for patients of all ages seeking assistance, and an improved image of audiology as the profession for dealing with hearing problems.