Modeling and clinical diagnosis of dead regions in the cochlea

Warnaar, B.

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FOREWORD

When I started my PhD in 2005, I had no previous experience in the field of audiology or medicine, and hospitals for that matter (except being a patient on several occasion myself). The closest association I had with dead regions was that I liked to listen (which I still do) to heavy metal and death metal. It is fair to say that I was completely unaware of the capabilities of the auditory system and ignorant about the fragileness of its structures. Even after years of research in audiology, I’m still puzzled by the complexity of our hearing system which we utilize so unconsciously.

A lot of people have “heard” of audiology. Almost everybody seems to know someone else who has some kind of hearing problem. It should therefore come as no surprise that I’ve been told many stories about the auditory system over the years. Interestingly, those stories were never about the magnificent capabilities of the hearing system. Most turned into complaints about others, family members or just random strangers. An example: “That girl set the volume of her mp3-player to max! She must really be deaf? Or, she will be!” This observation is very accurate, because the girl in the example may indeed need to put the volume to max to enjoy her music if she has a hearing impairment, and if she is a normal-hearing person, than her hearing is at severe risk of temporary or permanent damage. The complaint also illustrates the common (mis)conceptions about hearing-impaired people: “Hearing impairment happens to the stupid. It’s their own fault! Besides, can someone ask if she can turn of that noise?”

Today’s mentality towards the hearing-impaired is often unforgiving. Even the elderly, who are by nature of their old age, supposed to be hard-of-hearing, are not free of these judgments. They are approached as being pigheaded and sluggish, whereas their inability to communicate properly is because they are (partly) disconnected from the outside world from having poor hearing.

My experience as researcher in the field of audiology has taught me that most hearing-impaired were actually born with poor hearing, having some very serious illness that affected the cells inside their hearing organ, the cochlea, or they were simply put to work in an environment with lots of noise without awareness of the risks involved. Take, for example, that hard working construction worker down the road. He is young, strong and tough, holding his pneumatic drill to destroy big bricks. And yes, he is even wearing hearing protective gear! However, no one tells him that he is still at severe risk of hearing trauma. His drill shakes his entire body, vigorously vibrating his skull and thus, despite the ear protection, puts a lot of strain on the hair cells inside his cochlea.

Perhaps a limited awareness and poor understanding is true for any kind of disability. We may help a blind person across the street, but usually only when
he/she wears sunglasses or doesn’t look too strange. We may avoid someone with a clear physical display, who is only missing a nose, some fingers and a limb or two. Anyone can tell those handicaps, but can you tell if you are good of hearing, have some mild high-frequency hearing loss or maybe even have a dead region? What does it mean to you when the audiologist tells you that you have 60 % hearing left? Can you tell your partner: “Sorry honey, I only heard 60 % of what you said! Can you repeat the other 40 %?”

**Figure** Causes of hearing loss.

Considering all of the prejudice hearing-impaired people have to suffer, try to imagine being a volunteer who is participating in an audiology research experiment. You have just finished a five hour session of listening to beeb, blieps and noise-like cracks through warm and claustrophobic headphones inside a depressingly small and smelly sound attenuating room. How would you feel when the experimenter suddenly starts jumping up and down in full excitement? Then, he explains his behavior: “Such wonderful results! I have been looking for these, for the past three years. It is very likely that you have a vast and extensive dead region in your left ear!” The ignorant fool then points happily to some confusing lines on a sheet of paper.

I have come full circle.