Key Note

# Chapter 15: Changes in perception through the life-span

## Key note 15D: Losses of hearing can be associated with improved hearing for some sounds

High-frequency losses in hearing can be associated with improvements in processing sounds at lower frequencies. In some individuals, the inner hair cells or their afferent neurons in a local region of the cochlea are so impaired that they signal no or very little information to the brain. Such a region is known as a ‘dead region’ (Moore, 2004). The occurrence and extent of a cochlear dead region may be estimated from measurements of the thresholds for pure tones presented in the presence of masking noise. If hair cells within the dead region would normally respond maximally to the tone, it will only be heard if it activates hair cells in another part of the cochlea. However, its threshold will be higher and it will be more easily masked by the noise. A threshold which is 10 dB or more higher than normal is taken to indicate a dead region (Moore, 2004). A high-frequency dead region is defined by its lower edge frequency (*f*e), the highest frequency at which impairments are first detected, and from which they extend upwards in frequency.

Several studies have shown that processing of frequencies just below *f*e is better than normal. For example, Moore and Vinay (2009) measured thresholds in participants with unilateral high-frequency losses produced by cochlear dead regions for frequency discrimination of sinusoidal tones just below *f*e in frequency, randomly changing the loudness of the tones over a 12 dB range to reduce the reliability of loudness cues. They also measured thresholds for sinusoidal modulation of a sinusoidal carrier tone (of a frequency below *f*e), and the ability to identify consonants in nonsense syllables. The consonants were filtered to remove frequencies above *f*e, and presented in noise filtered so that it contained only frequencies above *f*e, with the aim of preventing detection of the consonants by any residual higher frequency mechanisms. In all three tasks, thresholds were lower for the ear with the dead region than for the other ear. As have others, the authors suggested that because of continued lack of input from the dead region, cortical neurons which previously responded to those frequencies have reorganised so that they now respond to neighbouring frequencies. This enhanced cortical representation for those frequencies is what underlies superior performance.

Moore BCJ (2004) Dead regions in the cochlea: conceptual foundations, diagnosis and clinical applications. *Ear and Hearing* 25: 98–116.

Moore BCJ, Vinay SN (2009) Enhanced discrimination of low-frequency sounds for subjects with high-frequency dead regions. *Brain* 132: 524–536.