

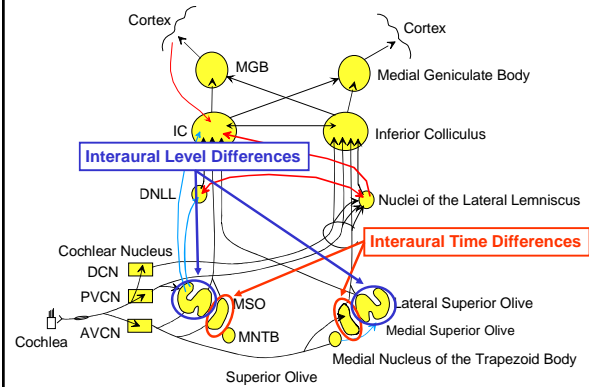
Processing in The Superior Olivary Complex

Alan R. Palmer

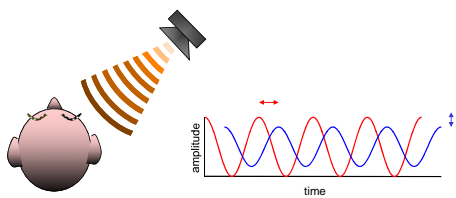
Medical Research Council Institute of Hearing Research
University Park
Nottingham NG7 2RD, UK



The Auditory Nervous System



Binaural cues for Localising Sounds in Space



Interaural *Time* Differences (ITDs)
Interaural *Level* Differences (ILDs)

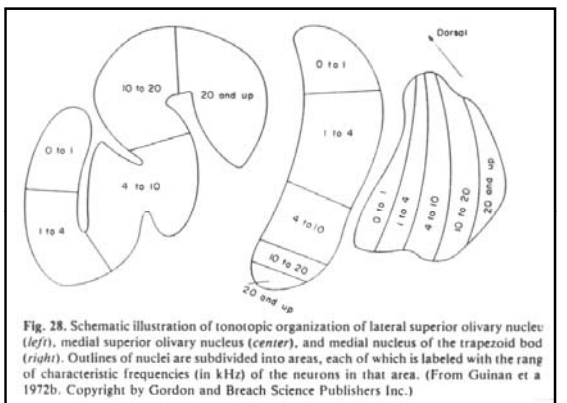


Fig. 28. Schematic illustration of tonotopic organization of lateral superior olivary nucleus (left), medial superior olivary nucleus (center), and medial nucleus of the trapezoid body (right). Outlines of nuclei are subdivided into areas, each of which is labeled with the range of characteristic frequencies (in kHz) of the neurons in that area. (From Guinan et al 1972b. Copyright by Gordon and Breach Science Publishers Inc.)

Binaural Mechanisms of Sound Localization

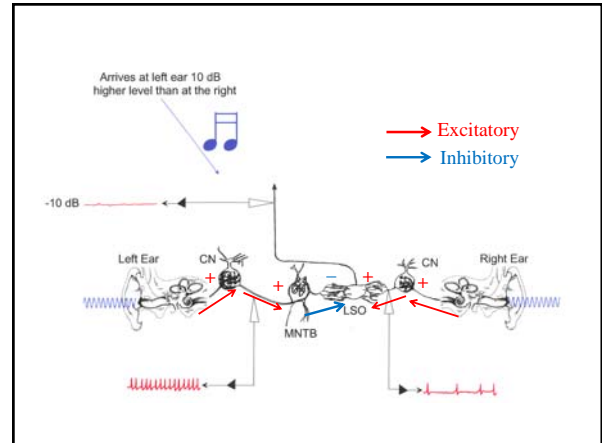
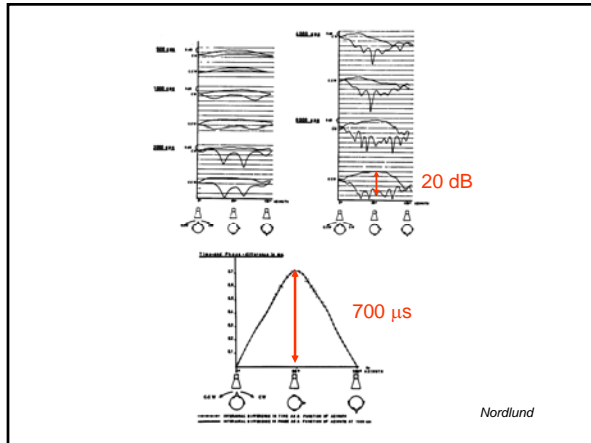
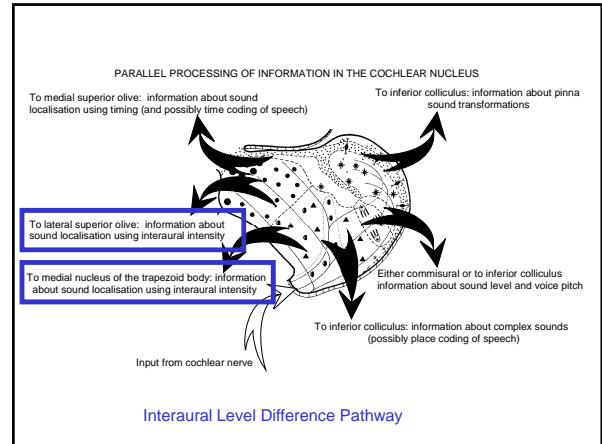
- Interaural time (or phase) difference at low frequency are initially analysed in the MSO by coincidence detectors connected by a delay line system.
- Interaural level differences at high frequency are initially analysed in the LSO by input that is inhibitory from one ear and excitatory from the other.

Binaural Hearing

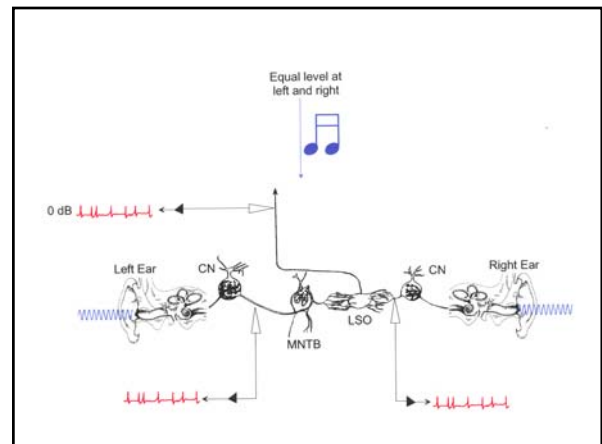
The ability to extract specific forms of auditory information using two ears, that would not be possible using one ear only.

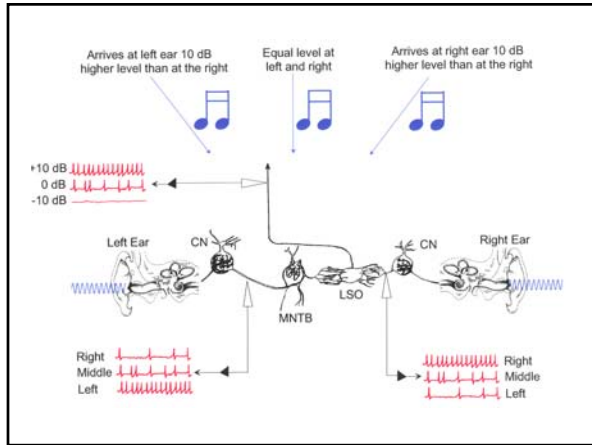
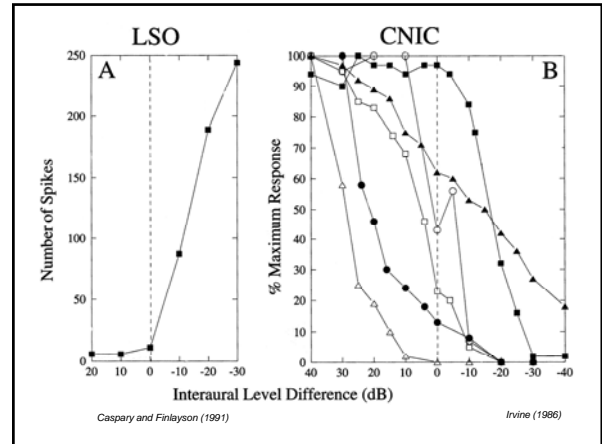
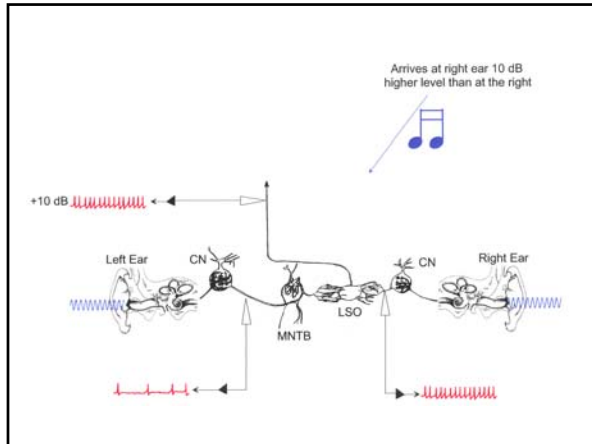
Advantages of Two Ears

- Improved detection / increased loudness
- Removing interference from echoes
- Improved detection of sounds in interfering backgrounds
- *Spatial localization*
- Detection of auditory motion

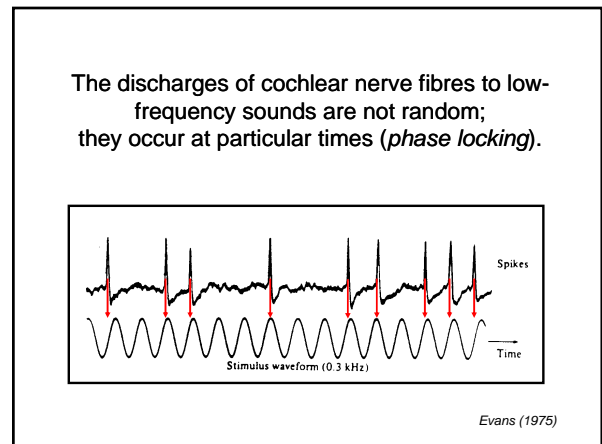
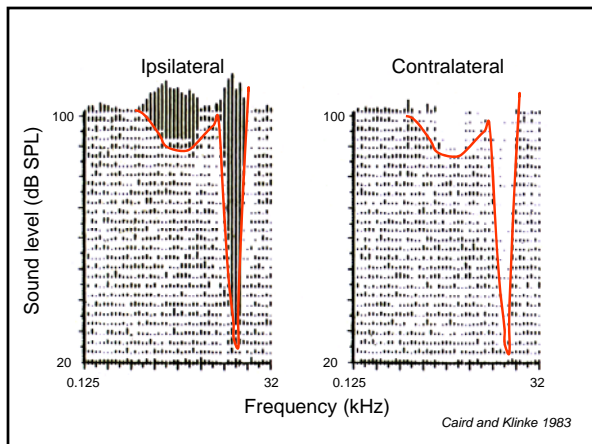


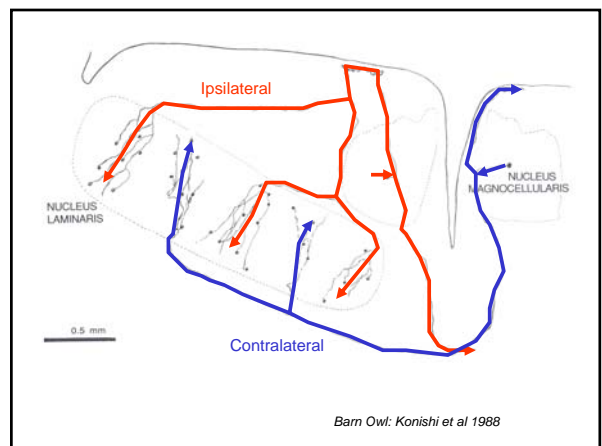
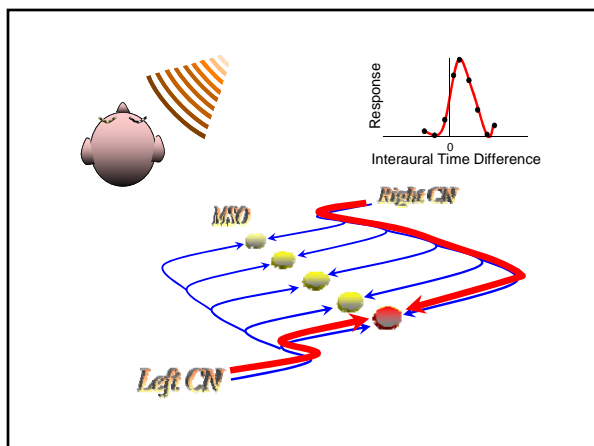
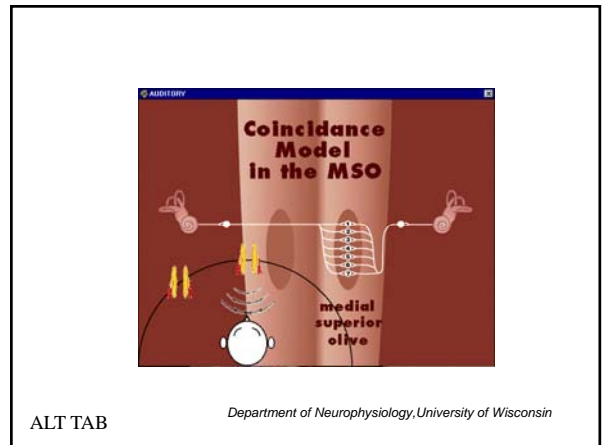
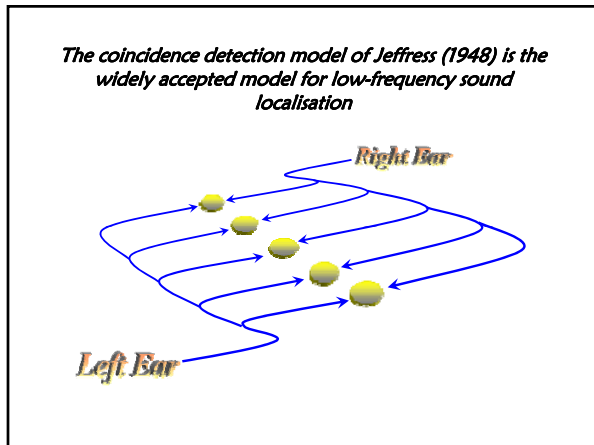
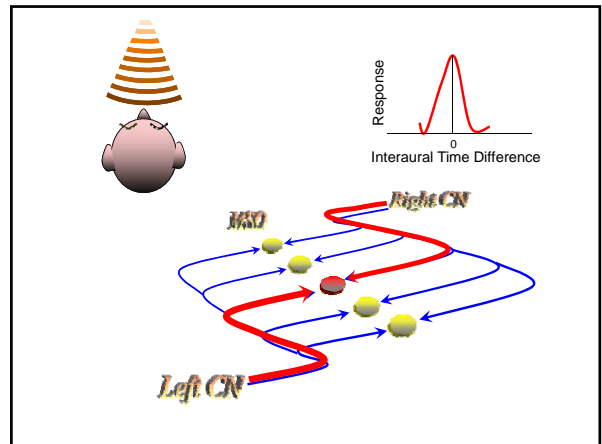
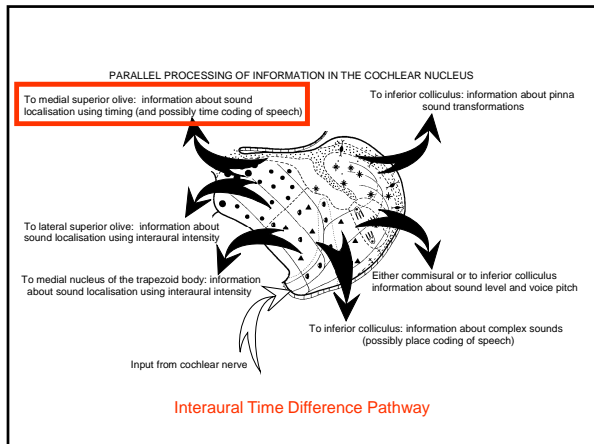
Interaural level differences (high frequency)

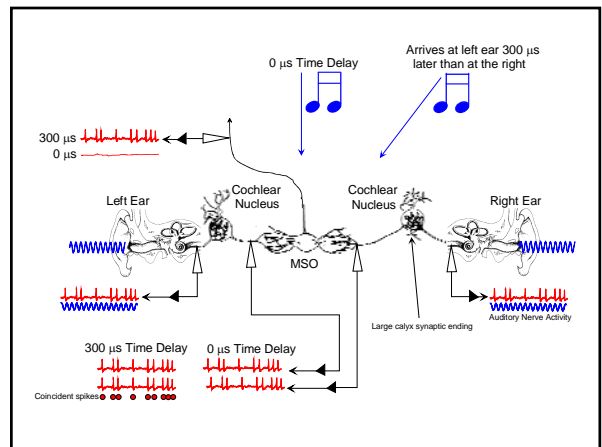
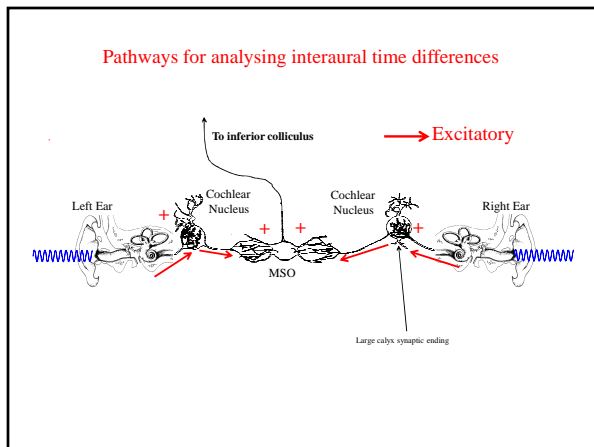
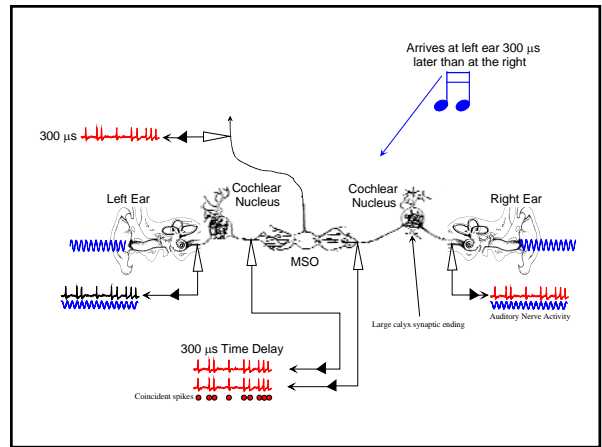
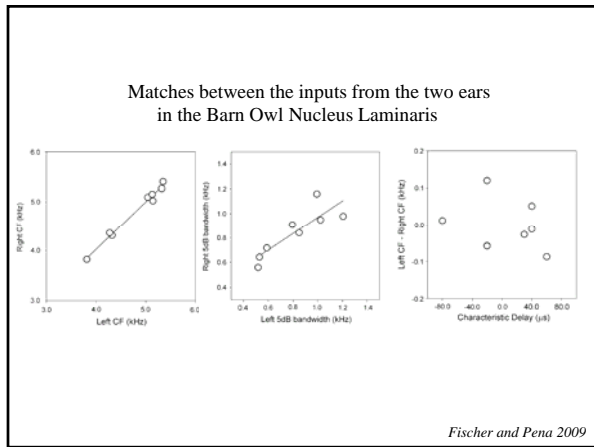
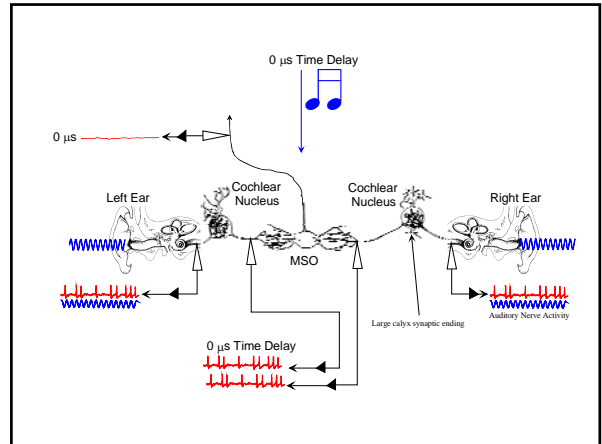
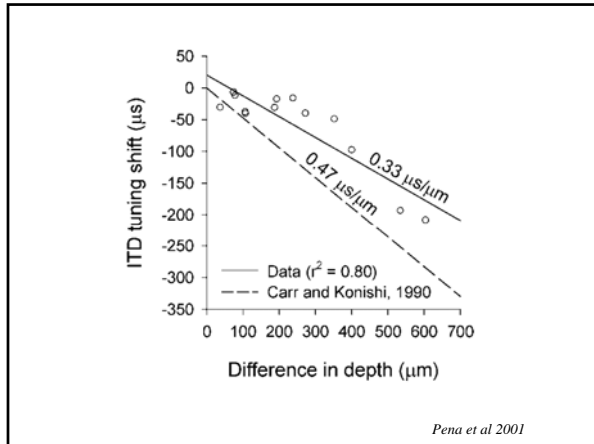


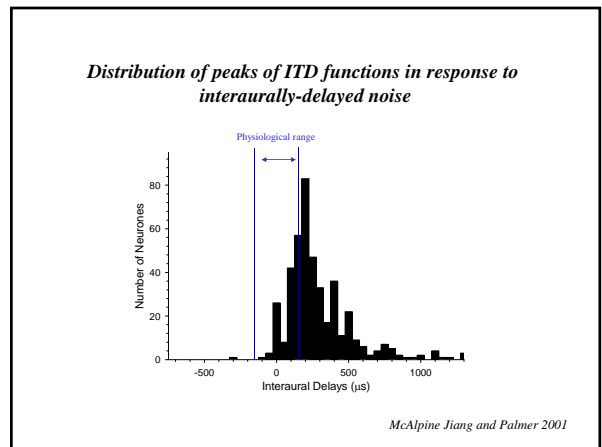
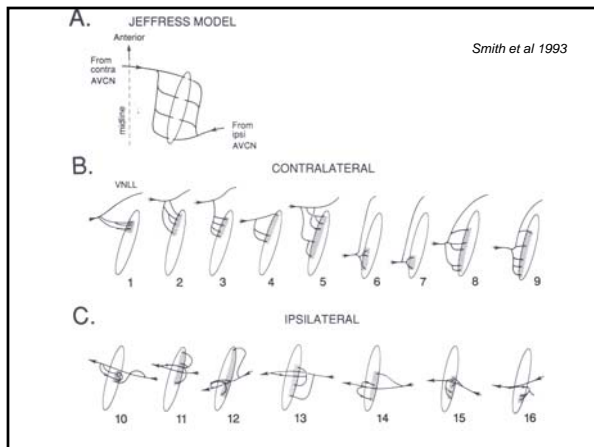
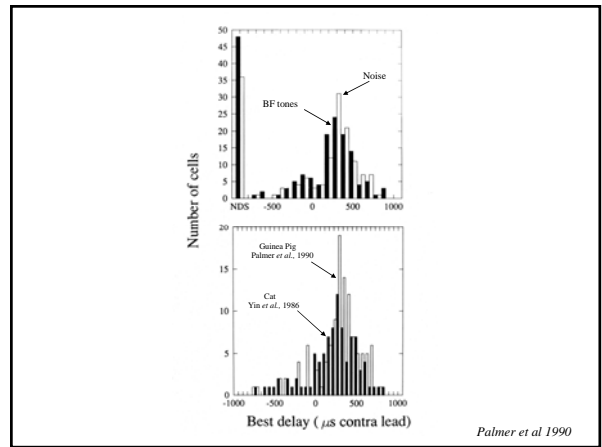
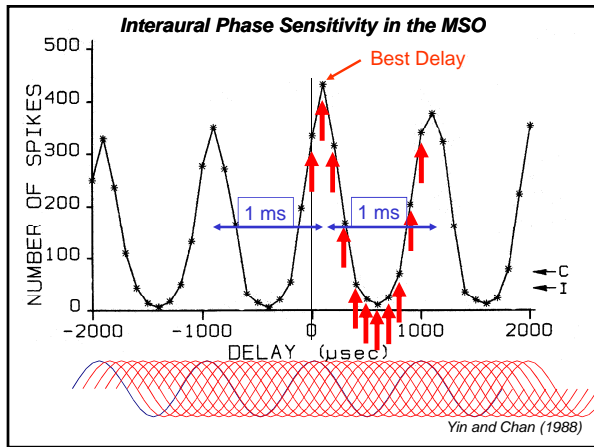
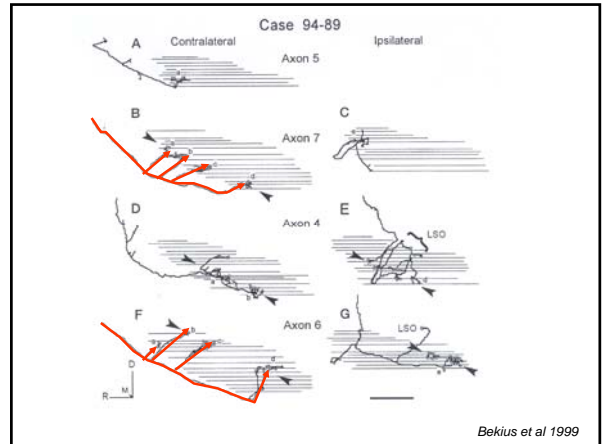
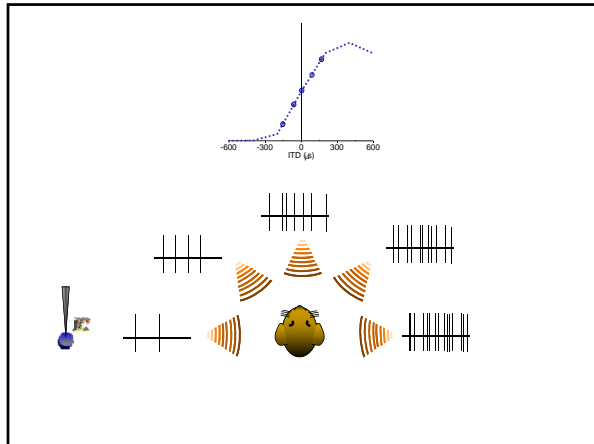


Interaural time differences
(low frequency)









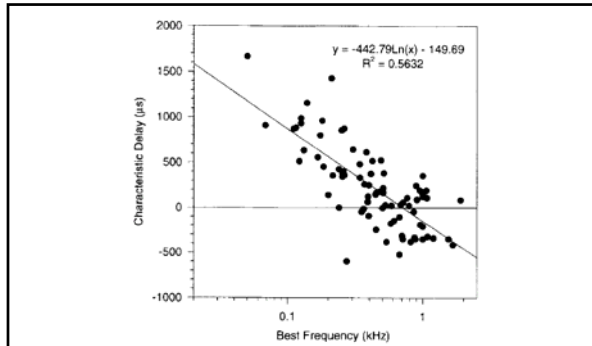
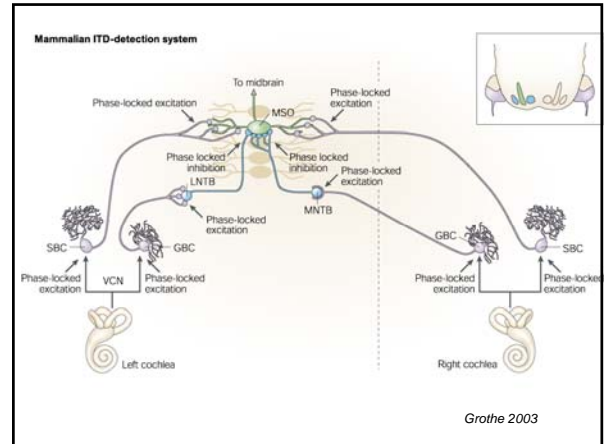
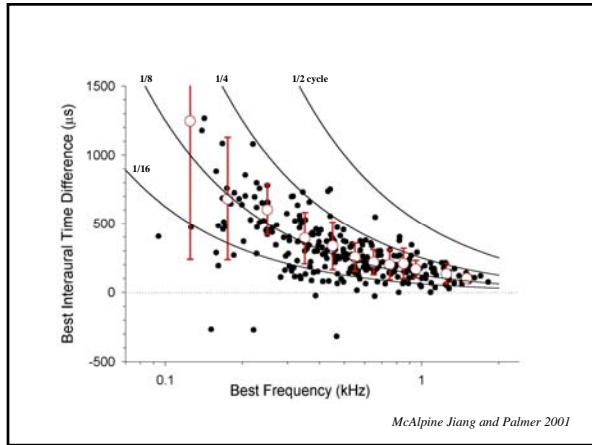


Fig. 13. Plot of CD versus BF for the 81 units showing linear BP versus frequency plots, and χ^2 values less than 0.002.

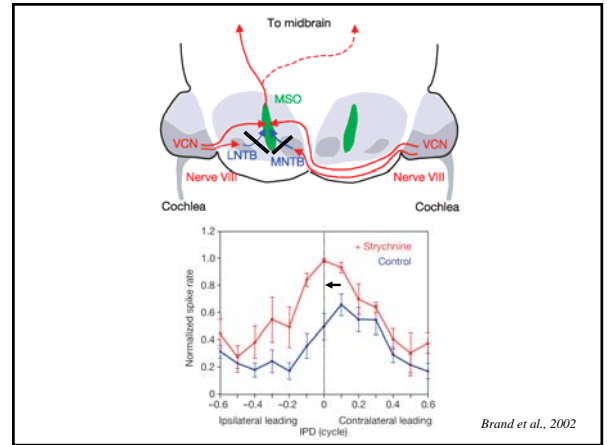
McAlpine, Jiang and Palmer 1996



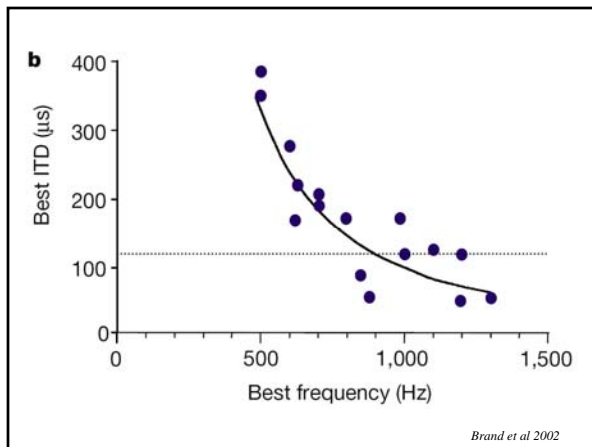
Grothe 2003



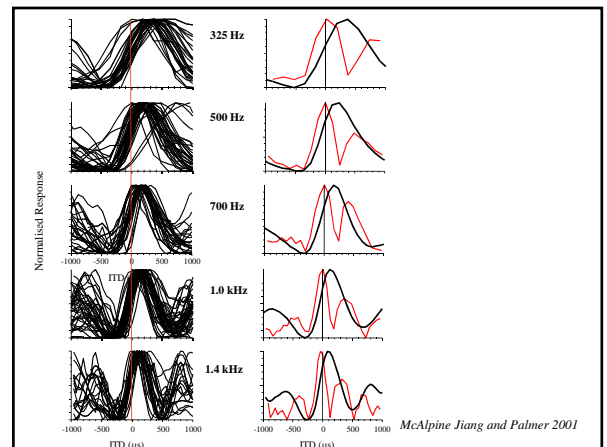
McAlpine Jiang and Palmer 2001



Brand et al., 2002

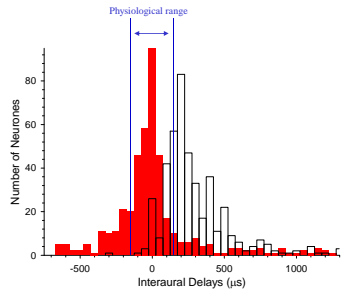


Brand et al 2002



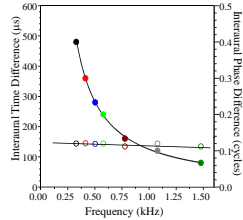
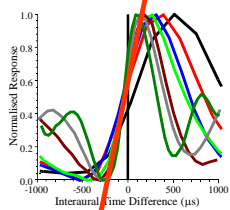
McAlpine Jiang and Palmer 2001

Distribution of steepest slopes of ITD functions in response to interaurally-delayed noise



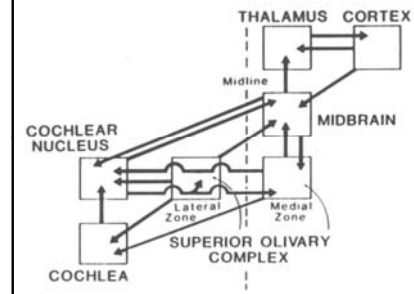
McAlpine Jiang and Palmer 2001

Descending pathways



McAlpine Jiang and Palmer 2001

THE DESCENDING AUDITORY SYSTEM



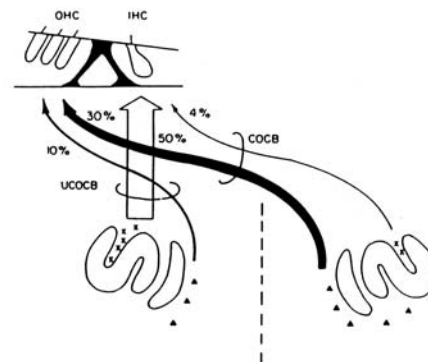
Spangler and Warr 1991

ITD processing is BF-dependent.

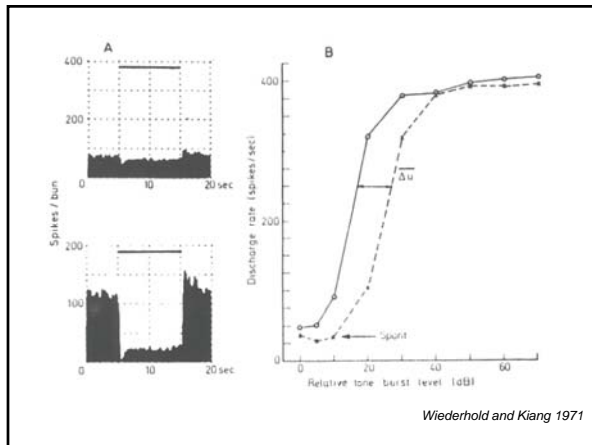
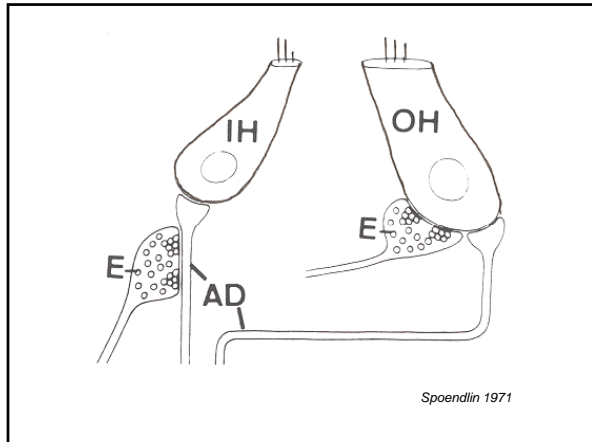
ITD functions are steepest around midline.

The consequence of this is that:

As ITD increases across the physiological range the activity at any frequency increases



Warr 1978, Warr and Guinan 1979



Function of the descending or centrifugal innervation

- Protection from acoustic trauma
- Control of the mechanical state of the cochlea
- Involvement in selective attention
- Detection of complex signal in noise