Cochlear Nonlinearities

- Linear System Equations
- Nonlinear Systems
- Evidence of Nonlinearity in the Auditory System
- Two-tone Suppression

In a linear system of y=mx+b, the input is close to the output due to homogeneity and superposition. Homogeneity is when the input is directly related to the output and superposition follows the rule of additive properties, where the output equals the sum of the input signals.

A nonlinear system is expressed with a coefficient, exponent or with a line with no consistent slope, such a y=x^2. The hearing system is nonlinear because it does not meet the requirements of homogeneity and superposition.

This evidence is found in the harmonic distortion and combination of tones in the system. Harmonic distortion represents he harmonics of the input hat are present in the output; in combination of tones you can find intermodulation distortion. This concept is the basis of an example of a nonlinear system in the auditory system – the (1) presence of otoacoustic emissions, particularly in distortion product otoacoustic emissions. In DPOAEs he output includes frequencies that were not presented in the input (2F1-F2). Another example of a nonlinearity in the cochlea is (2) two tone suppression, which occurs when the input of two sinusoid waves results in an output of a suppressed sound due to the reduction in BM displacement. The non-linear saturation of input-output function is believed to be the derivative of cochlear nonlinearities, hence why OAE testing is a good measure of outer-hair cell function.