Psychoacoustical verification of current theories on the generation of human distortion product otoacoustic emissions

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When two pure tones (or primaries) of slightly different frequencies (f1 and f2) are presented to the ear, new frequency components are generated by nonlinear interaction of the primaries in the cochlea. These new components can be heard and emitted from the cochlea back to the ear canal. The level of the 2f1-f2 emitted distortion is regarded as an indicator of the physiological state of the cochlea. This indicator, known as the distortion product otoacoustic emission or DPOAE, is most sensitive when the primaries have levels that evoke maximal-level DPOAEs. Efforts have been directed to obtain these levels empirically but the optimal primary-level combination is still controversial. The controversy could be clarified by elucidating the cochlear mechanical conditions that maximize DPOAE levels. The current view is that maximal-level DPOAEs occur for primaries producing equal excitation at the cochlear place tuned to f2, but this conjecture cannot be tested directly in living humans because it is impossible to record cochlear motion while monitoring ear canal DPOAE levels. Here, the conjecture is tested using psychoacoustical methods like those used to infer human peripheral compression. Results support the current view for f2 frequencies of 1 and 4 and for levels below around 65 dB SPL. The present approach may be extended to test other uncertainties on the generation mechanisms of human DPOAEs.

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