Symposium on Psychophysical Models and Physiological Facts in Hearing, Tutzing, Ger., 1974.

Facts and Models in Hearing

Proceedings of the

Symposium on Psychophysical Models and Physiological Facts in Hearing

held at Tutzing, Oberbayern, Federal Republic of Germany, April 22–26, 1974

Edited by

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Springer-Verlag
Berlin Heidelberg New York 1974

Zwicker: TUNING CURVES

PROCEDURE: (1) Set the CF-tone to a small sound pressure level (corresponding to for example SL=5dB) and keep it constant during the measurement. (2a)Vary the frequency f of the additional f-tone and its sound pressure level SPL so that the CF-tone is just masked. (2b) When using a BÉKÉSY-Type audiometer (method of tracking), the SPL of the f-tone (the masker!) can be varied by the observer, while the frequency of the f-tone (the masker!) changes slowly. This way, the psychoacoustical tuning curve can be recorded directly (see Fig. 2).
All measurements were performed monaurally using earphones and an equalizing network as described in ZWICKER and FELDTKELLER (1967). The CF-tone is switched on and off for 600 ms, respectively.

RESULTS: a) Effect of sensation level of CF-tone. Fig. 1 shows the SPL of the f-tone necessary to just mask a CF-tone at different sensation levels (SL=2dB, 5dB, 25dB and 45dB; CF = 2 kHz) as function of its frequency f. Measurements at SL=2dB are very difficult, since even without masking by the f-tone the CF-tone is heard part of the time only. For SL=5dB the result is not much different but much more reproducable. Around the characteristic frequency beats make reliable measurements difficult. If the SL is increased further (SL=25dB, 45dB), the contour changes not only its shape, but in addition combination tones produced by the hearing system's nonlinearity become audi-

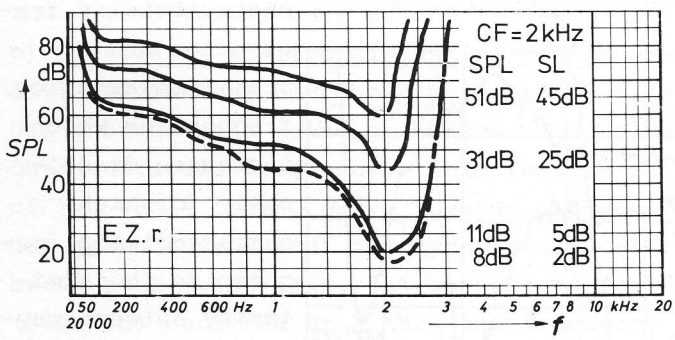

Fig. 1: SPL of a pure tone (ordinate) which just masks a 2kHz-tone of different SPL's and SL's respectively (parameter), as function of its frequency f.

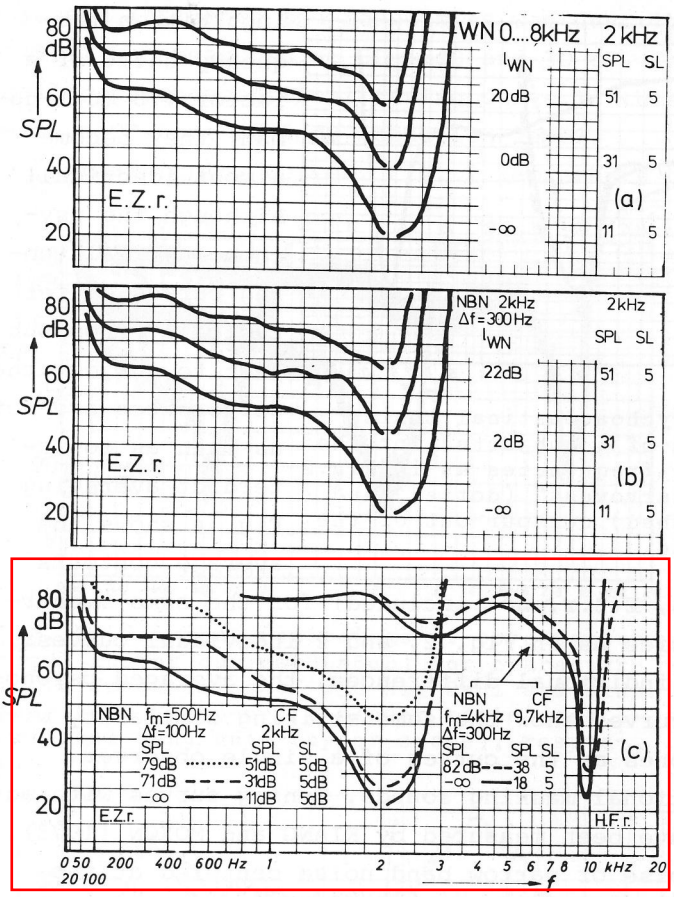

Fig. 5: Psychoacoustical tuning curves obtained during additional masking with a) white Noise (WN) the density level l_{WN} of with is given, b) narrow band Noise (NBN) centered at 2 kHz with the same density levels l_{WN} as in a), c) narrow band noise centered at 500 Hz and 4 kHz, respectively. CF is 2 kHz, and 9,7 kHz additionaly for c).

(Fig. 1). Some small differences still remain, but the unmasked psychoacoustical tuning curves produced at the higher sensation level are good approximations in both cases. Additional masking produced by sounds in frequency regions apart from the frequency of the CF-tone is more effective for sounds below, than for sounds above the CF-tone (see ZWICKER and FELDTKELLER 1967). KIANG and MOXON (1973) gave an example for a fibre with very high characteristic frequency of about 19 kHz and an additional narrow band noise centered at 1 kHz. The tuning curve remained almost unchanged; only near the CF it was shifted towards higher levels. The corresponding psychoacoustical tuning curves for CF = 2 kHz with an additional narrow band masker centered at 500 Hz are shown in Fig. 5c. For medium level of the masker the tuning curve is changed mostly at frequencies around the frequency of the masker. For