Psychophysical Measurements of Inner Ear Processes with Category Scaling of Loudness

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It is well known that receptors of inner ear react very sensitively to biochemical changes [Thalmann, 1975]. These changes may be induced by noise [Schacht, 1982; Ward, 1970] or related to cardiovascular diseases, stress and other factors which are supposed to influence peripheral blood flow [Angelborg et al., 1979; Plath, 1977].

Psychophysical effects correlated with noise-induced inner ear processes are normally revealed by measuring the hearing threshold during a certain time period (temporary threshold shift, TTS). Compared to numerous investigations on TTS there are only few studies on noise-induced supra-threshold effects. These effects are usually measured with the so-called ABLB technique (alternate binaural loudness balance). Yet this method is suitable for asymmetrical hearing loss only.

As some factors such as noise or drugs alter the sensitivity of receptors both effects should be taken into account: sensitivity loss as well as sensitivity enhancement. In the case of sensorineural hearing loss the latter effect is called recruitment. This phenomenon can be detected only on suprathreshold levels.

If both ears are affected, ABLB technique cannot be used because no standard representing normal hearing is available. In this case, the only available standard is the frame of reference for loudness which is represented in memory, assuming that a sound of 75 dB heard under normal conditions may be evaluated as 'middle loud'. If the hearing sensitivity is diminished by ototoxic factors then the same sound may be judged as 'soft' like a sound of 60 dB would be evaluated under normal conditions. Thus a hearing loss of 15 dB is present.

For more reliable measuring we use a category scale with 5 categories. Each of them is subdivided into 10 steps for finer grading. Additionally, each category is verbalized as 'very soft' (1-10), 'soft' (11-20), 'medium' (21-30), 'loud' (31-40) and 'very loud' (41-50). This combination of category rating and

fine-tuning has been proven as convenient procedure to enhance the reliability of scal-ings without many replications of judgments for averaging.

This method of category scaling was theoretically founded for psychoacoustics by Hellbrück [in preparation], Heller [1985] as well as experimentally verified by Hellbrück and Moser [1985] and Hellbrück and Sebald [1984]. Recently, we have conducted some experiments on after-effects of noise on loud-ness using a special programmable audiometer which is based on compact-disc technology [Moser, description in preparation]. This audiometer is especially prepared for this loudness scaling procedure. Our recent experiments on noise-induced after-effects showed characteristic temporary loudness shifts (TLS) as well as supra-threshold hypersensitivities (Overshoots') [Hellbrück and Sebald, 1984]. Moreover, TLS seems to be dependent on factors which can influence the peripheral blood flow [Hellbrück and Wi-nicker, in preparation].

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