DETERMINATION OF THE DIFFERENTIAL THRESHOLD FOR THE INTENSITY OF ACOUSTICAL STIMULI BY THE BILATERAL METHOD OF CONSTANT STIMULI

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We have experimentally verified the suitability and purposefulness of the measuring method described in [1] by the determination of the differential threshold for the intensity of tone and noise impulses. We have determined in a single experiment by means of the proposed method (thus under equal experimental conditions) the differential threshold for the comparative stimulus of a higher intensity as well as for the comparative stimulus of a lower intensity than that of the standard stimulus.

Since in the present work we deal with the determination of the differential threshold for the intensity of acoustical signals *DLI*, we specify its so-called statistical definition. Let us present to the subject the pairs of stimuli. The first constant stimulus *St*, the second comparative stimulus *Co*. *St* and *Co* differ only in the value of one parameter — intensity. Then *DLI* is an increment of the intensity of *Co* which the subject perceives in 50 % of the cases and does not perceive in 50% of the cases. Thus defined *DLI* is the statistical variable which cannot be directly obtained by one measurement.

During the measurement the subject was placed in the anechoic chamber, perfectly isolated from the enviroment. The experimentator first transmitted the light signal calling the subject's attention to the following acoustical signal. The interval between the light signal ensures as far as possible the constant degree of the subject's attention and does not tire him needlessly during the periods between the presented pairs. On the principle only one pair of stimuli was presented and after it the answer of the subject followed. The interval between the pairs of stimuli was aproximately 7 s.

Before the measurement a preliminary experiment was carried out. The preliminary experiment served for the training of the subjects, for the determination of the step k of the change *Co* and for the delimitation of the necessary range for the change of *Co*. It was shown that such arrangement of the test was convenient. The whole experiment contained 7 increasing and 7 decreasing series of pairs of stimuli. Each series included 9 pairs of stimuli. The step k of the change of *Co* was: *a)* $k = 0.5$ dB for the duration of stimuli $t = 100$, 50 ms; *b)* $k = 1.0$ dB for the duration of stimuli $t = 20$ ms. We have measured the pure tone of frequency $f = 1000$ Hz and the white noise *WN* on the sound level 60 dB. The envelope of the signals was of the gauss type. The interstimulating interval in the presented pair was $\Delta t = 150$ ms. Four persons between the ages of 20—28 years, beforehand carefully examined with the audiometer, were taking part in the measurement. The experiment was carried out by means of the tested and verified experimental device described in [2]. Every experiment lasted about 14 minutes.

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The measured experimental data were divided into two parts. In the first part the results of the subject's evaluations for $Co_j \leq St$, and in the second the subject's evaluations to stimuli, where $Co_j \geq St$, were reported. The values of *DLI* for both parts were determined by the method of the least squares (see [1], the relations (1) and (2)) are plotted in Table 1. On the basis of these values of *DLI* it is not possible to state that between the thresholds of both parts some systematic deviation exists. We do not find this deviation either when we compare the results of *DLI* obtained in the individual subjects, or by comparison of the *DLI* values obtained for the individual durations t of the stimuli. By a statistical test one can find that the occurring deviations are not significant at the level of the significance 0.05. Therefore one can presume that the deviations are caused by random errors.

Table 1

DLI determined by the bilateral method of constant stimuli by means of the method of the least squares.
DLI_1 — upper value, DLI_2 — lower value [dB] are determined by [1]. $\overline{DLI_1}$, $\overline{DLI_2}$, respectively, are arithmetic means of DLI_1, DLI_2, respectively.

	1 000 Hz			White noise		
	t			t		
Subject	100	50	20	100	50	20
1	0.81 0.96	0.75 0.80	1.58 1.60	0.80 0.85	0.70 0.81	1.77 1.83
2	0.81 0.70	0.86 0.91	1.59 1.50	0.72 0.87	0.81 0.85	1.60 1.69
3	0.70 0.61	0.80 0.70	1.56 1.70	0.80 0.80	0.86 0.72	1.64 1.56
4	0.95 0.81	0.90 1.02	1.41 1.36	0.86 0.79	0.96 0.91	1.84 1.76
$\overline{DLI_1}$ $\overline{DLI_2}$	0.82 0.78	0.83 0.86	1.54 1.54	0.80 0.83	0.83 0.82	1.71 1.71

The experiment was also evaluated in a manner typical for the method of limits. It has to be emphasized that the thus determined differential threshold DLI_{IN} does not agree with the statistical definition of the differential threshold quoted above. The values $DLI_K = \frac{1}{2}(DLI_1 + DLI_2)$ and DLI_{IN} respectively, are qouted in Table 2. Owing to different definitions of the differential threshold by the method of constant stimuli and by the method of limits, the values DLI_K and DLI_{IN} qouted in Table 2 cannot be compaired directly. It can be stated with satisfaction that the obtained results included in Table 2 are in good agreement with the values qouted by Krútel' [2].

From the values of *DLI* gained by the bilateral method of constant stimuli one can assert that for the given arrangement of the experiment (between the pair of stimuli

Table 2

DLI determined by the bilateral method of constant stimuli. DLI_K, DLI_{IN} [dB] determined by [1].

	1 000 Hz			White noise		
	t			*t*		
	100	50	20	100	50	20
DLI_K	0.80	0.84	1.54	0.81	0.83	1.71
DLI_{IN}	0.75	0.84	1.61	0.81	0.83	1.81

is the interstimulating interval, the envelope of the signals is of the gauss type) differential threshold for the intensity of acoustical stimuli does not depend upon relation of the comparative and standard stimuli. During the test no difficulties occur either from the side of the subject or from that of the experimentator.

On the basis of the plotted obtained results it can be stated that the bilateral meth of constant stimuli is suitable for the determination of the differential threshold for intensity of acoustical stimuli.

REFERENCES

[1] Kalužný J., Acta phys. slov., *24* (1974), 119.
[2] Krúteľ J., Thesis. Bratislava 1970.

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