MONDAY MORNING AUDITORY THRESHOLD IN WEAVERS

BY

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The view is questioned that 5.00 p.m. on Friday to 8.00 a.m. on Monday constitutes an adequate interval for the recovery of occupationally induced temporary threshold shift.

Group mean pure tone thresholds were determined for a group of young weaving shed operatives on a Monday morning and compared with those obtained, from the same group, after a 16-day absence from noise.

The 16-day thresholds were lower than the results on a Monday morning; the largest mean difference was at 4 kc/s and amounted to 7.3 dB.

It was concluded that the Monday morning threshold of these weavers had a component of temporary threshold shift, the exact magnitude of which is unknown.

Monday morning is a convenient time to carry out audiometric tests on people exposed to noise at their work.

The view that the week-end, 5 p.m. on Friday to 8 a.m. on Monday, is an adequate interval for the recovery of temporary threshold shift (T.T.S.) is frequently expressed in the literature on audiometric procedures. For example:

(1) Hinchcliffe and Littler (1958) are of the opinion that, for industrial situations in general, recovery from T.T.S. should be complete by the time the operative is ready to start work again after the week-end break. In addition, they consider that in the majority of noisy industries noise-induced T.T.S. disappears overnight.

(2) Burns and Littler (1960) recommend that audiometric examinations should always be conducted before the start of the working week or at least 16 hours after the end of the last exposure to noise in order to minimize the errors due to the inclusion of T.T.S.

(3) Ward (1957), in an investigation of the hearing of Naval aircraft maintenance personnel, accepted a 16-hour recovery period as the best compromise between scientific accuracy and operational expediency. However, he observes that a longer rest would have been preferable.

(4) Rudmose (1957) suggests that a waiting time of about 48 hours is usually sufficient for what he terms 'long-term' recovery. His view is based in

part on the findings of the American Standards Association Exploratory Sub-committee's report 'The Relations of Hearing Loss to Noise Exposure' (1954), which contains data on threshold shifts as a function of the interval between cessation of noise exposure and the measurement of hearing level.

In this report thresholds obtained 48 hours and six weeks after the cessation of exposure are compared. There is clear indication of an improvement in threshold associated with the longer absence from noise exposure. An improvement in a group of 13 persons amounted to 10 dB at 4 kc/s, suggesting that a threshold measured as long as 48 hours after noise exposure has an element of T.T.S.

Because this observation seems to be in conflict with some of the recommendations cited above an investigation was proposed.

Object of the Investigation

The object of the investigation was to explore the extent of the recovery from T.T.S. during a normal week-end break away from noise. A normal week-end is taken here to mean a break of at least 56 hours between Friday and Monday.

The hypothesis to be tested was that full recovery of T.T.S. on a Monday morning after a normal week-end would be indicated by the thresholds not differing from those obtained after a longer interval away from noise. On the other hand, if the thresh-

holds for a Monday after a normal week-end were significantly worse, this would be evidence of an incomplete recovery of T.T.S.

Organization of the Investigation

Weaving was chosen as the occupation for study. Young operatives from two mills were asked to take part in the investigation. They were selected solely on the basis of their availability and lack of gross otological abnormality. All had previously taken part in one or more audiometric tests, and their noise exposure varied between one and 10 years. Details of the individuals are given in Table 1.

Each individual had been given an ear, nose, and throat examination, and all but three were considered to be otologically normal. The three exceptions showed evidence of left tympanic membrane scarring, and measurements for these ears have therefore been excluded.

There were three operatives from one mill (group A) and 14 from the other (group B). In all, 31 ears were tested.

An analysis of the noise to which the two groups were habitually exposed is presented in the Figure. The octave band sound pressure levels are shown on a chart of the proposed International Standards

TABLE 1

DATA ON SUBJECTS WHO UNDERWENT HEARING TESTS

Group	Sex	Age (yr.)	Duration of Occupational Noise Exposure before 1st Audiogram (months)	Ears Tested
A	M	18	12	2
	F	18	36	2
	M	17	8	2
B	M	18	15	R
	M	20	27	2
	M	20	57	2
	F	19	27	2
	M	35	129	2
	F	17	11	2
	F	27	13	2
	F	22	11	2
	M	20	17	2
	F	19	13	2
	M	19	11	2
	M	20	13	2
	F	27	69	2
	M	20	27	2

Organization noise rating system, as given by Kosten and Van Os (1962).

Because of the similarity in noise levels in the two weaving sheds the results for the two groups have been combined. Glorig, Ward, and Nixon's (1962) data indicate that these levels are sufficiently high for a measurable T.T.S. to be expected after a working day's exposure.

FIGURE—Representative octave band sound pressure levels of weaving noise to which groups A and B were exposed. Plotted on proposed I.S.O. noise rating curves, as given by Kosten and Van Os (1962).

Investigation Procedure

An audiometric examination was first carried out on each individual on a normal Monday morning. The duration of the week-end varied from 56 to 72 hours, and the data have been combined for these time intervals. Both groups were tested a second time after an absence from noise of about 16 days. The interval between the first and second test was one to three months. Group A was tested a third time on a normal Monday one month after returning to working routine.

Thresholds obtained on a Monday morning after the normal week-end's absence from noise will be termed 'short absence' thresholds. 'Long absence' will be used to describe the thresholds obtained immediately after the 16-day absence.

Test Method

The method has been described in a previous paper (Atherley and Dingwall-Fordyce, 1963). Using test tones of one to two seconds' duration and a 'two out of four correct' response criterion, the mean of the descending and ascending threshold was taken as the threshold measurement. The signal was delivered to a pair of TDH 39 ear-phones mounted on a spring headband, which the subject was allowed to adjust to his own comfort. The subject responded to the test tone by operating the push button of a signal light circuit. Each response was recorded by the tester, and the threshold was calculated after the test had been concluded. The test frequencies were 1, 2, 3, 4, 6, 8, and 0.5 kc/s, in this order, alternating left and right ears.

The audiometer was subjected to a calibration check on each day of the investigation. The calibration checking procedure has been discussed elsewhere (Atherley, 1964).

The test room was contained in a suitably designed vehicle, described by Lee, John, and Fowweather (1963). On the basis of testing, these authors concluded that the background noise in the audiometry test booth was of a sufficiently low level to permit the determination of a hearing level conforming to the British Standard for Normal Threshold of Hearing for Pure Tones by Ear-phone Listening (1954) for frequencies above 125 c/s. Actual tests (Atherley and Dingwall-Fordyce, 1963) on a group of otologically normal young persons showed no gross departures from 0 dB hearing level at the test frequencies used in this investigation with an audiometer calibrated to British Standard 2497 (1954).

Results

The group mean thresholds for the three test occasions are shown in Table 2. The group mean short absence threshold for the same ears obtained one to three months before the long absence was higher at all but one test frequency. The differences,

TABLE 2
GROUP MEAN THRESHOLDS ON THREE TEST OCCASIONS

Frequency (kc/s)	Test Occasion		
	I (dB)	II (dB)	III (dB)
0.5	5.7	3.1	7.7
1	6.05	6.05	8.55
2	12.8	11.8	13.4
3	21.6	17.2	22.2
4	30.3	23.0	29.6
6	15.9	13.0	18.0
8	5.4	1.4	7.6

Audiometer calibrated to B.S. 2497

I Monday thresholds one to three months before long absence (31 ears).

II Thresholds after a 16-day absence from noise (31 ears).

III Monday thresholds one month after long absence (six ears).

with their significance levels, are shown in Table 3. The largest mean difference is at 4 kc/s and amounts to 7.3 dB.

Short absence thresholds on six ears were measured one month after the resumption of normal working routine. Again the mean levels are higher

TABLE 3
GROUP MEAN THRESHOLDS ON TEST OCCASIONS SHOWN AS DIFFERENCES FROM THE THRESHOLDS OBTAINED AFTER A 16-DAY ABSENCE FROM NOISE

Frequency (kc/s)	II-I (dB)*	Significance of Difference	II-III (dB)*	Significance of Difference
0.5	2.6	P < 0.05 (t = 2.4)	4.6	
1	0		2.5	P < 0.05 (t = 3.6)
2	1.0		1.6	
3	4.4	P < 0.001 (t = 4.2)	5.0	P < 0.01 (t = 4.3)
4	7.3	P < 0.001 (t = 4.6)	6.6	P < 0.01 (t = 4.8)
6	2.9		5.0	
8	4.0	P < 0.01 (t = 2.8)	6.25	P < 0.01 (t = 4.5)

*Positive values denote a raised auditory threshold.

I Monday thresholds one to three months before long absence (31 ears).

II Thresholds after a 16-day absence from noise (31 ears).

III Monday thresholds one month after long absence (six ears).

than long absence values. The frequency showing the largest change is 4 kc/s, as before.

The audiometer calibration data are given in Table 4. Using the long absence test occasions as the reference point, differences in acoustic output of the ear-phones in dB (octave sound pressure levels) before and after the long absence are shown.

TABLE 4

DIFFERENCES IN MEAN CALIBRATION READINGS BEFORE (II-I) AND AFTER (II-III) 16-DAY ABSENCE AUDIOGRAM, IN dB (octave sound pressure levels)

Frequency (kc/s)	Attenuator Setting (dB)	Earphone			
		Left		Right	
		II-I	II-III	II-I	II-III
0.5	5	1.0	0.7	1.3	-0.1
1	15	1.3	0.5	0.7	0
2	15	0.7	0.7	0.9	1.2
4	15	1.4	1.5	1.2	2.4
6	15	0.9	1.6	1.2	-0.4
8	15	1.1	1.5	1.6	1.5

The instrument conformed to the British Standard for Normal Threshold of Hearing for Pure Tones by Earphone Listening (1954), and the hearing levels at which the calibration measurements were taken are also shown (Table 4).

Conclusions

The audiometer acoustic output changes are insufficient to account for the experimental observations. The changes of calibration are not significant at any frequency and in any case oppose the threshold differences. Instrument or measurement errors can therefore be excluded as the origin of the results obtained in the investigation.

The results show that these weavers had a Monday morning threshold which was improved upon when measurements were taken after a 16-day absence from noise. The threshold deteriorated again when measured once more on a normal Monday four weeks after the return to work.

There is no doubt that their normal Monday

morning threshold had a component of T.T.S., the exact magnitude of which is unknown.

The threshold obtained immediately after the long break from noise must be closer to the true threshold than is the normal Monday threshold. Exactly how close is not indicated by the results of this investigation and remains an important but unsolved problem.

It appears that these young operatives have a T.T.S. which, during working routines at least, never completely recovers. They have a temporary but fluctuating impairment of hearing which is present at all times, presumably adding itself to any permanent elevation of threshold which may be occurring at the same time.

These operatives are taking part in a larger long-term prospective study of noise-induced hearing loss changes; the findings of this experiment will make difficult the interpretation of any data obtained from them on a normal Monday morning until the relation between the T.T.S. component and the permanent threshold is resolved.

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