AUDITORY LOCALIZATION IN HELMET WEARING AND NON-HELMET WEARING CONDITIONS**

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SYNOPSIS

Whether auditory localisation ability will he impaired under helmet wearing condition was the focus of study. Localisation functions were studied under helmet wearing and non-helmet wearing conditions. The results pointed out a definite overall impairment under helmet wearing condition and the worst hit directions were Bottom, Back and Top, No appreciable sex differences were observed.

I. Introduction

The present investigation was carried out in order to study the efficiency in auditory localization for normal subjects under 2 experimental conditions.

1. When the subject did not wear a helmet, and
2. When the subject wore a helmet.

The interest in this study is to compare the efficiencey in auditory localization under the 2 defined experimental conditions. The expectation was that wearing the helmet would impair/or distort auditory localization. With the recently introduced regulations in almost all the states of our country making helmet wearing compulsory for two wheel drivers, the results of such a study may be of some value.

II. Experimental Set Up

The investigation was carried out in the open space of the quadrangle measuring 60 x 60 feet in the All India Institute of Speech and Hearing, Mysore. This physical setting was relatively free from echoes and reverberations. The space in between the subject and the sound source was free from any objects disturbing

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the sound field. The entire field was free from extraneous traffic and other noises as the investigations were held in the holidays and out skirts of the city.

A standard sound perimeter (sound cage) manufactured by M/s Anand Agencies, Poona, along with its accessories was used. The sound cage was placed at the centre of the above site.

The frequency of the test tone was fixed at 500 Hz as it is a very important frequency of all types of horns used in vehicles. A constant sound field of 90 dB was produced at the peripheral rim of the transverse section of the sound cage. The presentations of sounds were snap and did not last for longer than a fraction of a second. The distance from the medial position of the subject's head to the source of sound was kept constant, namely 0.5 meter. For obtaining the sound source a signal of 500 Hz at 2 mv was obtained from the Radart frequency generator and fed to Audio Frequency Amplifier and then to a small speaker fixed in a cabinet with a high quality interruptor switch. The speaker and the amplifier were matched appropriately. A frequency counter was connected to the AF generator to check that the frequency deviation was within limits.

The sound field at the centre of the cage was measured by Bruel and Kjaer SPL meter along with Octave Filter. The Octave filter was employed to measure only the intensity of the test tone and to cut down the influence of external noise. Free field type 1" condenser microphone of B and K was used with the SPL meter. The calibration of the SPL meter with the condenser microphone was checked with piston phone of B and K type. The sound field was fixed at 90 dB, by adjusting the gain of the amplifier, by keeping the loudspeaker on the rim of the transverse plane of the sound cage. The experimental conditions were maintained throughout. The helmet was made of compressed fibre glass and it covered completely the external ears of the subject. It did not have any perforations near the ear zone.

Diagram of the arrangement for the experimental set up is shown in Fig. 1.

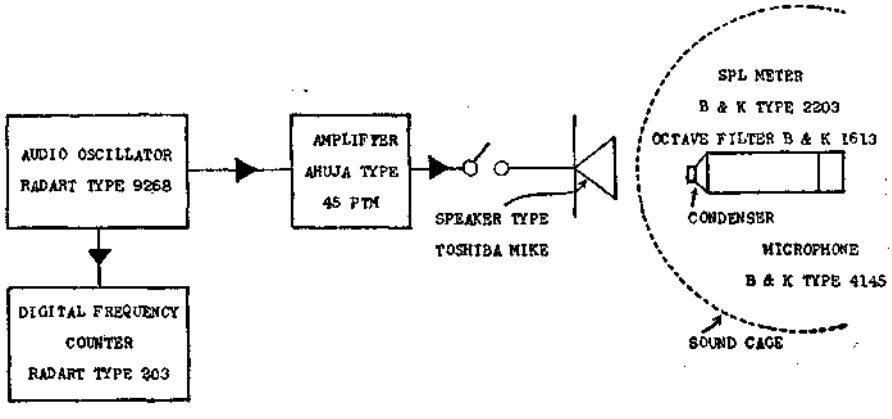

FIG. 1

III. Subjects

In all 30 subjects took the experiment, majority of these were students studying either for B.Sc. orfor M.Sc, in Speech and Hearing and the rest of them were the staff members. There were 16 male and 14 female subjects in the group. The subjects ranged in age from 19 years to 38 years with a mean age of 22.50 years. The mean age of the male group was 24.56 years and the mean age of the female group was 20.14 years. All the subjects had normal hearing,

IV. Methodology

All the 30 subjects were screened for their hearing acuity. The hearing evaluation was carried out in an audiometric room built to ASA specifications. The Madsen make, type OB 70 and TBN 60 clinical audiometers calibrated to ISO specifications were employed for testing. The test conditions were satisfactory. Only two subjects were found to have high frequency loss of about 30 dB average at 4 k, 6k and 8k Hz.

The subject sat on a height adjustable stool at the center of the sound perimeter. The head position was fixed by means of clamps, which did not make room for shifting the head position. The same head position facing the direct front of the sound cage was followed for every subject. Each subject was blindfold under both the experimental conditions. Before experimentation the subject was familiarised about all the ten directions from which sound was presented. He was given the option either to verbally indicate the direction or by means of right hand forefinger to point out the direction from which the sound was heard.

Ten directions were altogether used namely *Front, Back, Left, Right, Front Left, Front Right, Back left, Back Right, Top* and *Bottom.* From each direction sound was presented five times. A schedule was prepared for a random presentation of sounds from all these directions. Altogether there were 150 presentations for helmet wearing and 150 presentations for non-helmet wearing conditions. The direction indicated by the subject was recorded against each trial.

The diagram in Figure 2 illustrates the head position of the subject at the centre of the sound perimeter pointing out the eight directions from which sound was presented. Top and Bottom positions were two additional directions which are not included in the diagram.

The correct number of judgements under each direction for each subject under both the experimental conditions were calculated.

As mentioned earlier, each subject was tested on the audiometers in both the ears at the frequencies 250, 500, 1K, 2K, 4K, 6K and 8K. The maximum, minimum and average values for the entire group at all these frequency levels was worked out. The obtained average values for the group at all the frequency levels are presented in the group audiogram for both the ears. The mean audiogram for the group for both the ears was well within the normal range. The range

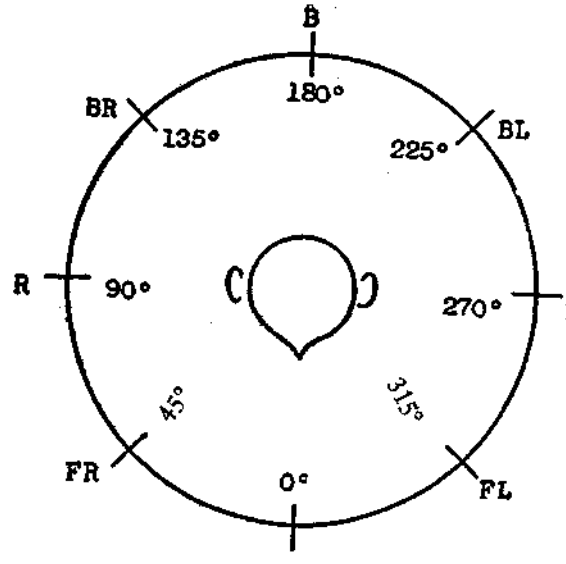

FIG. 2. Fixed head position in sound cage

of scores at any frequency level was as per expectation. Because of high frequency lossin only two cases from 2K-SK, the group audiogram shows a slight dip at those levels. This is seen in Fig. 3.

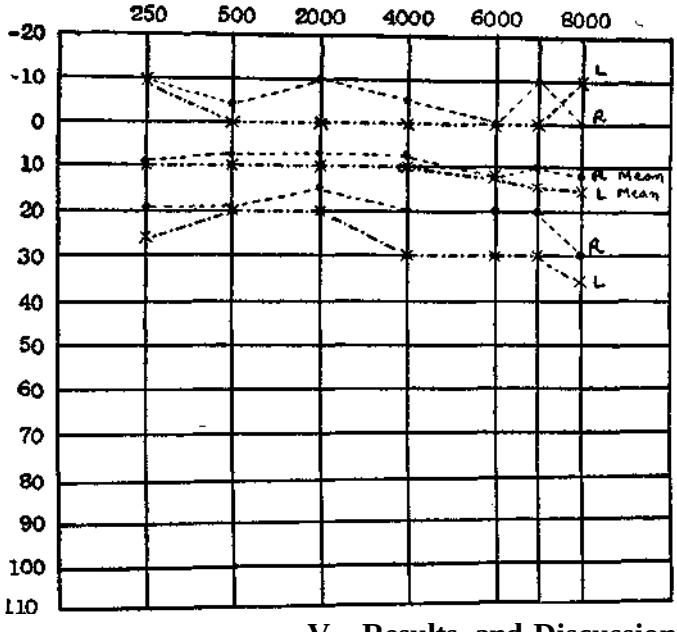

FIG. 3. Audiogram showing minimum, maximum and average thresholds of hearing

V. Results and Discussion

Table 1 presents the obtained results in terms of number of correct localizations and percentage of correct localizations under the 2 Experimental Conditions.

In the table, the results have been presented in the decreasing order of localisation. It can be clearly seen that the directions Right, Left, Front, Right.and Front maintained the top 4 rank positions under both the experimental conditions. Auditory loclizations were better when the subject did not wear the helmet. The average percentage of correct localizations was 64 percent under without helmet wearing and 54 percent under helmet wearing conditions. It is apparent that auditory localization becomes impaired or distorted by about 10 percent when the subject wears helmet.

TABLE 1. Per cent of Correct Localisations

W. O. H				W. H.			
Direction	Total No. of presentations	No. of correct localisations	% of correct localisations	Direction	Total No. of presentations	No. of correct localisations	% of correct localisations
R	150	138	92.00	L	150	135	90.00
L	"	128	85.30	R	"	127	84.60
FR	"	121	80.60	FR	"	100	66.60
F	"	100	66.60	F	"	88	58.60
BR	"	100	66.60	FL	"	81	54.00
FL	"	89	59.30	B	"	68	45.30
B	"	81	54.00	T	"	62	41.30
BL	"	81	54.00	BR	"	62	41.30
T	"	66	44.00	Bot	"	54	36.00
Bot	"	54	36.00	BL	"	38	25.30

Below in Table 2 are provided the obtained results for the four main directions *Right, Left, Front* and *Back* for both the experimental conditions. Under each major direction, the results obtained from the immediate adjacent directions are also added.

The percentage of correct localization is smallest for sounds coming from the Back direction under both experimental conditions. The difference in percentages between helmet wearing and non-helmet wearing conditions are worth considering for sounds coming from the back direction and right direction A difference in percentage of 21 per cent for the back direction and 16 per cent in the right direction can be observed. The inference is that auditory localization becomes impaired by about 21 per cent for the sounds coming from the back and by

3. The directions Bottom, Back-left, Back-right, Back and Top are relatively more difficult in auditory localization.

4. The sounds coming from the major directions of Right, Left, Front and their immediate adjacent directions are more likely to be localized correctly. The sounds coming from the back directions are the most inaccurately localized. There is a 21 per cent fall in accuracy of auditory localization for sounds coming from back directions under helmet wearing conditions.

5. There is a small difference in auditory localization ability in favour of men under both the experimental conditions, which may not stand for a true sex difference.

6. There is a significant positive correlation in auditory localization between helmet wearing and non-helmet wearing conditions.