THE DEVELOPMENT OF A BROADCAST-MASS SCREENING TEST OF HEARING

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Purpose of the Present Study

The purpose of the present study was to develop a hearing screening test, a single administration of which, would screen a large number of people even without the need for their coming to a speech and hearing center. It was intended that the test be of such a nature that it may be broadcast over the radio and all the persons listening to the radio may be screened out for any hearing impairments. This test would provide for an efficient tool for hearing screening which would not require any special equipment or testing environment and would test a large number of people in one administration of it. It would even be possible to test difficult-to-reach individuals by means of this test. Moreover, no trained personnel would be required for the administration of the screening test.

Brief Plan of the Study

A pilot study was done in which the test was administered to a group of persons simultaneously in a free-field condition. The subjects were seated at an equal distance from the speaker of a domestic radio, which was connected to the output of an audiometer and used as a free-field speaker. The stimuli used were pure tones and spondee-words. Each tone was presented several times and for each subsequent presentation the intensity level was reduced by 5 dB. Similarly, the intensity level was reduced by 5 dB for the presentation of each subsequent spondee-word. The subjects were instructed to count and note down the number of times they heard each tone and to write down the spondee words they heard. Intragroup comparisons were made to detect a person with impaired hearing. The test, after making some modifications in it, was broadcast from the Bangalore Station of All India Radio. One hundred and ninty five persons responded to a single broadcast of the test. All the persons who responded to the test by sending in their responses, were informed that an individual test of hearing would be given to them at a speech and hearing center. An individual sweep-frequency screening test was given to the individuals who responded to the request, to check the false negative and false positive scores.

Limits of the Study

(1) For want of time and money :
- the test was limited to the establishment of the procedure only,
- it was limited to the city population only,
- the test was limited only to the available subjects,

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- the test was limited to a trial in English language only, though in order to get a better response the test should be done in the regional language,
- the test was limited only to the educated population,
- the test was limited to only one broadcast from the AIR,
- the test was limited to the use of pure-tones only as stimuli-

(2) In a free-field type of hearing screening test, it may be difficult to catch a person with impaired hearing when one ear is perfectly normal. So the test was limited to screening individuals with bilateral hearing losses only.

Implication of the Study

This test will serve as a first stage filter, i.e., it would eliminate a large part of the population from the need of having an individual hearing test.

This test will be an entirely new technique in the battery of screening tests of hearing with the following advantages :

- no trained personnel are required for the administration of the test. Pre-recorded tapes can be broadcast from the radio,
- no special equipment is needed,
- no special testing environment is needed,
- a single administration of the test can screen out a large number of people, many times more than any other group screening test does.
- can reach people in far-off places too. It can reach all the people who have an access to a radio set,
- eliminates the need for testees going to the tester or vice verse.
- economical in terms of time and money,
- repetition of the screening test can be made without much expense. The same population can be covered several times reducing the false negatives and the false positives,
- Public education - the screening test broadcast on AIR would serve to awaken awareness and interest on the part of the general public in the prevention and treatment of hearing problems.

Methodology

Mass hearing screening through radio broadcasting appears to be a new venture in hearing screening attempts. As no literature is available regarding the present study, the final procedure for conducting this study was arrived at, by conducting some experiments and a pilot study.

Test Construction :

The problems which needed attention in constructing the test were :

1) Accounting for the volume control settings of the different radio receivers.

2) Determination of the intensity level of the stimuli presented over the radio.
3) Accounting for the environmental noise, and the distortion in the signal both due to the transmission and the reception process.
4) Accounting for the frequency characteristics and the quality of the radio signals in different receiver sets.
5) Fixing-up of one reference against which the responses of the subjects may be evaluated.

As the usual domestic radio sets are not provided with any sound intensity indicating meter, some indirect way of arriving at a suitable reference intensity level was indicated. Also, it may be appreciated, that, a control could not have been gained over variables, like environmental noises and the differences in the characteristics of signals received and reproduced by different radio receivers.

The test had to be one which was suitable for administration in a free-field condition because of the obvious reasons that no domestic radio is normally provided with headphones which has provision to switch on the signal to either ear.

These problems indicated that each testing situation would be different from every other in terms of the nature and the strength of the stimuli received. This called for an individual evaluation of each testing condition and made it impossible to have one fixed reference for normal hearing, against which the responses of the subjects may be compared.

To eliminate the above mentioned problems, to the extent it was possible to do, it was decided that the test be given to a group of persons simultaneously, who should sit in front of the speaker of a domestic radio receiver in the form of a semi-circle. The distance from each one of them to the speaker of the radio should be same. This situation permitted intra-group comparisons of the test performances and anyone who heard less than the best hearing person in his group was considered to have failed the test. So it eliminated the problem of determining the intensity levels at the receiving end and also overcame the problems of environmental factors and receiver characteristics, these being the common factors for one particular group of subjects.

The stimuli used were pure tones of frequencies 500Hz, 1000 Hz, 2000 Hz and 4000 Hz

Pilot Study

The conditions, thus arrived at, were made use of in conducting a pilot study. To make the comparisons within the group more meaningful, one more step was included in the test.

Fifteen presentations of 1000 Hz tone were made. One of the subjects (arbitrarily specified as the one sitting on the extreme left) was instructed to adjust the volume control of the radio in such a manner that he was just able to hear the tone.

The test consisted of presentation of tones from frequency 250 Hz to 8000 Hz. The initial presentation of each tone was made at a level of 20 dB above the presentation level of 1000 Hz reference tone. For each subsequent presentation the intensity level was reduced by 5 dB

till it became 25 dB less than that of the 1000 Hz reference tone. Spondee words were also used as stimuli for the pilot study and the presentation of these spondee words was done in a manner similar to that of pure tones.

The subjects were instructed to count and write down on a sheet of paper, the number of times they heard each tone. The spondee words also were to be written down immediately after the presentation of each word. The subjects were cautioned not to adjust the volume of the radio receiver under any circumstances once the test had started.

The output of a tape recorder was given to an audiometer, the output of which was connected to a common domestic radio receiver. The subjects were seated in front of the radio, in the form of a semi-circle. The tape recorder was used to give instructions to the subjects and to present the spondee words. The audiometer provided the pure tones of different frequencies at different intensity levels and also acted as an attenuator for the presentation of spondee-words. The domestic radio was used as a free field speaker. This situation simulated the situation of presenting the test over radio more closely than it would have been if a free-field speaker was used instead of a radio receiver.

Intra-group comparison of the responses was made to decide about the test negatives and the test positives. The subjects who heard any of the tones, more than two times less, than the number of times heard by the best hearing subject, for that tone, in that particular group, were considered to have failed the test.

The results of the pilot study were encouraging in terms of identification of persons with impaired hearing. But it was observed that even some of the sophisticated subjects found it difficult to follow the instructions of the test for making the initial adjustment of the volume control of the radio. It was, therefore, decided to eliminate that part of the test. The modified procedure consisted of presentation of different frequency tones in a decreasing order of intensity where the last presentation of each tone was made at a level 50 dB lower than that of the initial presentation.

The modificiation of the test in this way did not affect its utility and it was still possible to identify a person with a loss of hearing when given this test.

Altogether, three hundred and forty eight subjects were tested in the pilot study. These included some general college going students, students of Speech Pathology and Audiology and some confirmed patients with hearing loss. The test, in the pilot study, identified one hundred and six patients with hearing loss, correctly. Three patients with unilateral hearing loss could not be identified. Sixteen patients could not follow the instructions to the test and hence they did not take part in the test.

Trial Broadcast

All India Radio, Bangalore was approached for making a broadcast of the test. It was desired to have a trial broadcast of the different frequency tones before the test was finally broadcast in a program for listeners.

In India, the radio transmission is amplitude modulated. The dynamic range in a radio broadcast is 40 dB. Even though the signal-to-noise ratio is better than 60 dB (with respect to full output), modulated signals below one per cent are not readily audible. However, very close to the transmitter, within about one mile area, even one half per cent modulated signals may be heard. So the dynamic range can be taken to be about 45 dB. The transmitted signal has a distortion of 1.1 per cent at 100 per cent modulation over the range of 30 Hz to 10 KHz. There is a volume compressor or limiter in the transmitter to compress the high intensity sounds. It comes into operation at 85 per cent modulation. Fidelity of reproduction is very good in broadcasting. Under ideal conditions 45 dB or even 50 dB variation in intensity can be detected in a broadcast but it is not certain if it can be heard in a domestic receiver. In commercial receivers automatic gain control (A.G.C.) acts on local signals (radio frequency above 10 microvolts per metre). This will however not affect the fidelity of the modulated signal (Venkata Raman, 1973).

A trial broadcast was made in which pure tones were given and the modulation was varied to different percentages. It was observed that the frequencies above 4000 Hz, viz., 6000 Hz and 8000 Hz could not be heard over a radio clearly. There was a lot of distortion at these frequencies and the signal-to-noise ratio was very low. This was found to be due to limitation in the common domestic receivers. It was then decided to drop out frequencies 6000 Hz and 8000 Hz along with 250 Hz which could have been unduly affected by low frequency environmental noises.

Recording of the Test

The test was pre-recorded on a magnetic tape. The recording was done by the experienced staff of the All India Radio, Bangalore.

The tape recording heads of the tape recorders at All India Radio (Ampex) normally operate on audio inputs of - 5V.U. (1 M.W. scores 600 ohms). They can take a 12 dB increase (resultant distortion will be 2.5 per cent). By adjusting the input to give distortion-free output at peak recording level, it may be possible to achieve a range of 50 dB of the input by suitable attenuators. The signals-to-noise ratio of the record/reply chain however is only 50 dB, which must be considered (Venkata Raman, 1973).

The test recording consisted of :

1) an introduction about the importance of hearing and hearing impairments,
2) instruction to the testees regarding the test,
3) the test proper,
4) instructions about sending the response sheets.

Procedure

After giving an introduction to the test, the listeners were given instructions about the nature of the test, and the necessary requirements for participating in the test, i.e., a minimum of

two persons should take the test at a time, from each radio receiver ; and all the persons taking the test should have a sheet of paper and a pen ready with them before the actual test begins. They were also instructed to keep their distance from the radio sets, same and constant till the test was over. And that they should let the volume control of the radio in the position in which it was when they heard these instructions. A two-minutes time was given to the subjects to carry out the instructions.

The test proper consisted of presentation of tones of, in the order of presentation, 1000 Hz, 2000 Hz, 4000 Hz and 500 Hz. The first presentation of the tone was made at the maximum broadcasting level. The subsequent presentation of the tone were made at lower and lower levels till the last presentation was 45 dB below the initial presentation of the tone. The intensity of the tone was reduced in decibel steps of the signal and the modulation percentage was kept undisturbed. The person at the transmitter was given special instruction to, not to boost up the weak stimuli.

The presentation of the first tone - 1000 Hz tone was repeated so that if some people failed to follow the instructions in the first attempt, they might try again. Other three tones were presented in the similar fashion. Althrough the test, it was insisted that the listeners do not change their position or alter the volume of the radio.

It was desired that the last presentation of all the tones should be too weak to be heard over domestic radio sets.

6, 9, 9 and 9, (six, nine, nine and nine) presentation of 1000 Hz, 2000 Hz 4000 Hz and 500 Hz tone were made respectively. The subjects were instructed to count and write down the number of times they heard each tone.

Only pure tones were used as stimuli in the final test and spondee-words were not used.

The transmission of the test was done under the supervision of the engineers of All India Radio, Bangalore.

Subjects

Announcement regarding the test, was made in newspapers and also in the preview of the programs over the radio.

To make certain that a good number of people respond to the test some individual letters giving information about the test were sent to some of the co-operative families (so designated by listener Research Programs data). Personally known families were informed about the broadcast of the test. Some persons who were known to have some hearing impairments were also informed regarding the test.

All these people constituted the subjects for the study.

Collection of Responses

The subjects were instructed to send the responses of the whole group collectively to the All India Institute of Speech and Hearing, Mysore-6, by post or by hand.

Determination of output levels of stimuli over Radio

It was attempted to determine the radio output levels for different tones at Bangalore as well as at Mysore. A sound-pressure level meter with an Octave band filter was used for noting down the levels of the tones heard over the radio. Since the microphone of the sound pressure meter was kept in front of the speaker of the radio in a free field condition, the difficulty in recording the low intensity signal is apparent.

Table I shows the sound pressure level values for different frequencies recorded in Bangalore.

Sound Pressure Level of Speech during instructions. = 74 dB

Sound Pressure level of Pure tones in the test :

TABLE I

FREQUENCIES		500 Hz	1000 Hz	2000 Hz	4000 Hz
Sound Pressure Levels (in dBs)	Maximum	80	70	75	65
	Minimum	50	40	40	30
	Range	30	30	35	35

Table showing SPL's of the pure tones used in the test (Measured using B & K SPL meter with Octave Band Filter).

Plan of Analysis

Criteria for fail: If a person heard any tone less than any other person in the group by two or more number of times.

If a person heard two or more tones than any other person in the group by one time.

All the subjects who responded to the test by sending in their score sheets were informed that an individual hearing test would be given to them to check the results of the test which was broadcast over the radio. Those who responded to the follow-up were given an individual sweep-frequency screening test. The individual screening test was given at frequencies 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 6000 Hz at a level of 20 dB H.L. (I.S.O. 1964) in acoustically treated rooms.

Agreement and disagreement frequencies for the two tests, chisquare values, critical ratio values and the significance levels were computed with the data obtained.

Analysis, Discussion & Results

Analysis -

One hundred and ninety five responses were received to the broadcast from AIR Bangalore. These included 113 responses from Mysore, 72 responses from Bangalore, and 10 responses from places other than Mysore and Bangalore.

The responses obtained were put into two categories :

(i) Those obtained from groups of persons, who took the test at the same time as was indicated in the test broadcast ; and

(ii) Those who responded individually to the test, either because when the test was broadcast, no other persons were available who could take the test along with them or that they failed to understand the instructions to the test completely.

For the analysis of responses of the subjects who fell in the first category, intra-group comparisons were made. The responses of each subject in a group were compared to the best responses in that group for the various frequencies. If, at any frequency, any subject responded two or more number of times less than the best response for that frequency in that group, he was considered to have failed the test. Also, if any subject responded one time less than the best responses of the group for two or more number of frequencies, he was considered to have failed the test.

The individual responses to the test were analyzed by considering the person having failed the test if, the response at any one or more number of frequencies was less than the actual number of presentations by more than two times.

This analysis led to 168 subjects passing the test and 27 subjects, as the test failures. To validate the obtained results, all the subjects of the study were informed that they were required to report personally for a further checkup. Seventy, out of a total of one hundred and ninety-five subjects reported for the followup. They were given individual, pure-tone, sweep-frequency type screening test as used by Dishoeck (1956), Gardner et al, (1953) etc. Frequencies were swept from 500 Hz, to 6000 Hz at a level of 20 dB HL (I.S.O. 1964). The individual screening test was done in an acoustically-treated room both at Bangalore and at Mysore. The subjects who failed to give responses at any frequency in either ear were considerd to have failed the individual screening test.

No. of subjects who responded to the mass screening test	...	195
No. of subjects passed	...	168
No. of subjects failed	...	27
No. of subjects who responded to the follow-up	...	70

TABLE II

Showing the comparison of Mass Screening Test with the Individual Sweep Frequency Test

Mass Screening Test	Individual Sweep Frequency Test: PASS	Individual Sweep Frequency Test: FAIL
PASS	55 A 78.57%	4 B 5.71%
	A+D 61	
FAIL	5 C 7.14%	6 D 8.57%

Total N = 70

The results of the Mass Screening Test and the Individual Screening Test were compared for these 70 subjects. The data obtained is put in the form of a tetrachoric table in Table II. The table shows that 59 subjects passed and 11 subjects failed in the mass screening test.

Sixty Subjects passed the individual screening test and 10 subjects failed on the test. Out of 60 subjects who passed the individual screening test, 55 subjects passed the mass screening test and 5 subjects failed on the test. These five subjects constituted the false positives in the study. Out of 10 subjects who failed on the individual screening test, 6 subjects failed on the mass screening test also and the remaining four subjects constituted the false negative sco re

Cells A and D in the Table II show agreement between the mass screening test and the individual screening test. And the Cells B and C show the disagreement between the two tests. The total agreement figure (A + D) is 61 and the disagreement in terms of false nagative and false positive scores is 4 and 5 respectively.

While giving the criteria for the evaluation of the efficiency of group screening tests of hearing, Newby (1948) says that a minimum number of fifty subjects must be tested individually. And if there is 75-80% agreement between the two tests (A + D) and the cell B contains less than 5% of the total ears the group test may be considered reasonably efficient.

In the data presented in table II, A + D value is 87.14 per cent and the value in the cell B is 5.71 per cent. The total agreement value obtained is fairly satisfactory when evaluated against the criteria proposed by Newby (1948) but the false negative score is slightly higher than the criteria value suggested.

Di Carlo and Gardner (1953) utilized the following criteria for evaluating the efficiency of a group screening tests of hearing. Percentages in cells A+D should be more than 85 per cent and in cells B and C it should be less than 5 and 10 per cent respectively. Beeker (1951) also felt that a 15 to 20 per cent limit for errors seems to be a realistic limit.

Further analysis of the data is done in the way similar to the one used by Di Carlo and Gardner (1953).

Table III shows the distribution of 15 subjects, who failed in either or both of the mass screening test and the individual screening test, into various cells.

Table IV and V show the agreements, and disagreements between the two tests at the various frequencies tested. The values obtained satisfy the criteria suggested very well at all the frequencies except at 4000 Hz.

Even if the most stringent criteria are applied for evaluation, the mass screening tests seems to be very effective at the frequencies 500 Hz, 1000 Hz, and 2000 Hz. At these frequencies agreement between the mass screening test and the individual screening test is very high and the false negative and the false positive scores are very low.

TABLE III

Showing the distribution of individuals who failed the Mass Test into various cells.

Sl. No.	Subject	500 Hz	1000 Hz	2000 Hz	4000 Hz	Total
1	1	A	A	A	C	C
2	8	A	A	A	C	C
3	11	A	A	A	C	C
4	15	A	A	A	C	C
5	22	A	A	A	D	D
6	23	A	A	A	B	B
7	40	C	C	D	D	D
8	41	C	A	D	D	D
9	42	A	A	A	C	C
10	43	B	B	B	D	D
11	51	A	B	B	B	B
12	64	A	A	A	B	B
13	67	B	A	B	B	B
14	69	D	D	D	D	D
15	70	D	D	D	D	D
	A	9	10	8	–	–
	B	2	2	3	4	4
	C	2	1	–	5	5
	D	2	2	4	6	6

TABLE IV

Showing the distribution of individuals into various cells.

FREQUENCY		CELLS			
		A	B	C	D
500 Hz	N	64	2	2	2
	%				
1000 Hz	N	65	2	1	2
	%				
2000 Hz	N	63	3	-	4
	%				
4000 Hz	N	55	4	5	6
	%				

TABLE V

Showing the agreement between the mass Screening Test & Individual Sweep frequency Test and False negative and False Positive Score.

FREQUENCY	CELL		
	A+D	B	C
500 Hz	66	2	2
1000 Hz	67	2	1
2000 Hz	67	3	-
4000 Hz	61	4	5

Total 70

TABLE VI

Showing the Chi-square Analysis of the Data

Frequency	Cell	Observed Frequency	Theoretical frequency	Chi-Square	Degree of freedom	p. Value
500 Hz	AD	66	59	5.40	2	Between 0.10 and 0.5
	B	2	4			
	C	2	7			
1000 Hz	AD	67	59	8.22	2	Between 0.02 and 0.01
	B	2	4			
	C	1	7			

Frequency	Cell	Observed Frequency	Theoretical frequency	Chi-Square	Degree of freedom	p. Value
2000 Hz	AD	67	59	9.33	2	More than 0.01
	B	3	4			
	C	0	7			
4000 Hz	AD	61	59	0.64	2	Between 0.80 and 0.70
	B	4	4			
	C	5	7			
Total	AD	61	59	0.64	2	Between 0.80 and 0.70
	B	4	4			
	C	5	7			

TABLE VII

Showing Critical Ratio Analysis of the Agreement between the Mass Screening Test and the Individual Sweep-Frequency Test.

Frequency	Cell	Observed Percentage	Theoretical Percentage	Critical Ratio	p. Value
500 Hz	AD	94.2%	85%	2.09	more than 0.05
1000 Hz	AD	95.71%	85%	2.56	more than 0.02
2000 Hz	AD	95.71%	85%	2 56	more than 0.02
4000 Hz	AD	87.14%	85%	0.47	less than 0.10
Total	AD	87.14%	85%	0.47	less than 0.10

For finding out whether the results obtained are statistically significant or not, chi-square and critical ratio analysis were done to arrive at the level at which the results are significant (p. value).

Table VI shows the chi-square analysis of the data. Theoretical frequencies were computed on the basis of the criteria as used by Di Carlo and Gardner (1953). Chi-square values and p values were obtained for different frequencies and for the total test. The chi-square value for 500 Hz is found to be significant at 0.05 level. For the frequencies 1000 Hz and 2000 Hz, the chi-square values obtained are found to be significant at even higher level (0.01 level). But the significance level is low for 4000 Hz and the total test.

Table VII shows the observed and theoretical percentages of cells A+D. This refers to, the total agreement between mass screening test and the individual screening test value. 'p' value for the critical ratios obtained is 0.05, 0.01 and 0.01 for frequencies 500 Hz, 1000 Hz, and 2000 Hz and less than 0.01 for 4000 Hz and the test on the whole.

Discussion

The results of the mass screening test and the individual screening when put in the form

of a tetrachoric table show an agreement with the criteria suggested by Becker (1951) and Newby (1948).

When the statistical tests of significance are applied, it is observed that the values for the frequencies 500 Hz, 1000 Hz are highly significant statistically. But this is not true in case of 4000 Hz.

The test which was broadcast over the radio was pre-recorded on a magnetic tape. Due to some unknown reasons, the final tape recording which was used for broadcast was distorted. This was realised only when the test was already on AIR. The speech sounded quite unclear when received over a radio receiver.

It was found in the trial broadcast of the pure tones, that the signal to noise ratio for transmission-reception process of high frequencides was very low. Frequencies above 4000 Hz when transmitted and heard over a radio sounde very unclear with a lot of noise.

For a medium wave-broadcast, the areas receiving the broadcast are classified under primary and secondary zones. The reception of ground radio waves is better in the primary zone and it is affected in the secondary zone. Mysore seems to fall into the secondary zone for the broadcasts made from the All India Radio, Bangalore.

There are other factors which might have affected the reception of the Bangalore broadcast in Mysore. These include the fading of signals, because Mysore is near the skip-zone distance of the Bangalore broadcast and the increased numbers of transmitters operating at night time (Krishnamurthy, 1974).

It is important to note that the disagreement between the mass screening test and the individual screening test at 4000 Hz was more in the responses received from Mysore than in the responses received from Bangalore. It may be hypothesized that if the broadcast in Mysore is bolstered up by a relaying station such descripencies in responses would not arise. Inspite of the distortions present in the test during its broadcast, it is likely that it was heard acceptably in Bangalore. But the reception was very adversely affected in Mysore. And, as the signal-to-noise ratio at high frequencies is less, 4000 Hz tone might have been affected more than other frequencies.

Another factor which might have affected the results at 4000 Hz in Mysore, may be a wrong response by one individual in the group. For example, if in a group of eight subjects, one subject reported to have heard the 4000 Hz tone nine times. Out of the remaining seven subjects, five subjects heard the tone eight times and two heard it seven times. According to the criteria used in the test, these two subjects who responded seven times responded two times less than nine, the best response in the group.

But it is probable that the subject who responded nine times responded wrongly, by guessing the last presentation of the tone. The fact might have been that the tone was heard only

seven or eight times in that situation. But because the tones of 1000 Hz were heard nine times, this subject expected to hear the 4000 Hz tone also nine times and gave a wrong response. This might have led to an increase in the false positive score and hence this would have affected the results at 4000 Hz.

It was then realised that it was a mistake to have presented 1000 Hz, 2000 Hz, and 4000 Hz tones, all for nine times each. The better thing would have been to present different tones unequal number of times, it would have prevented any guessing on the part of the subjects while counting the number of times they heard each tone.

As pointed out earlier, the mass hearing screening test was developed in such a way so as to screen out persons with impaired hearing when their one ear functioned perfectly normally. This is exactly what happened in the case of two subjects who had unilateral hearing losses at 4000 Hz. These two individuals passed the screening test, at all the frequencies but failed the individual screening test at 4000 Hz in one ear. They were labelled as false negatives. But, because this is an inherent limitation in the test to find out individuals with unilateral hearing loss, these cases may be excluded from the analysis to evaluate the efficiency of the mass screening test. When these two cases are excluded from the analysis, the false negative score comes down to two from four. This makes the test to be highly efficient even at 4000 Hz.

It is interesting to note, however, that mass screening test identified one subject with hearing loss when, in one ear, his hearing was perfectly within normal limits. It is difficult to explain, how this could have happened in a free-field type of test situation like the one made use of in this study.

When the test was broadcast, it was desired and indicated to the broadcasting authorities that the last presentation of each tone should be so weak that it might not be detected by the common domestic receivers. But, in the actual observation, it was found that even the weakest stimuli in the test were heard clearly, at least in Bangalore. This might have lead to missing the cases with mild hearing losses. Even though this is not the limitation of the test it might have contributed in the evaluation of the efficiency of the mass screening test. It is felt that a few more decrements could be profitably added to the test.

RESULTS : Mass screening test satisfies the criteria for the effectiveness of a group test of hearing as suggested by Newby (1948), and Di Carlo and Gardner (1953).

Chi-square and the critical ratio analysis, of the date points to the high significance of the observed results of comparision of mass screening testing with individual screening test. This indicates that the mass screening test is fairly valid technique for conducting hearing screening.

Mass screening test appears to be an efficient group screening test. In one administration of the test it screened one hundred and ninety five subjects which seems to be the largest number

ever reported to have been screened in one administration of the test. It is evident that, there really is no limit to the number of responses can be obtained if such tests are routinely administered. It is also apparent that many more people would have listened but for some reason or the other did not respond.

The total time taken for the administration of the test, including the instructions to the subjects and a two-minute-gap given for fetching a pen and a sheet of paper is twelve minutes.

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" Take care of the sense, and the sounds will take care themselves "

The Dutchess in Alice's
Adventures in Wonderland
Chap. IX by Lewis Carroll.

" To know that we know what we know, and that we do not know what we do not know, that is true knowledge ".

Thoreau, Walden (Quoting Confucius)