

DEVELOPMENT OF ADVANCED AUDIOLOGICAL EQUIPMENT IN INDIA FOR THE IDENTIFICATION AND DIAGNOSIS OF THE DIFFICULT-TO-TEST CASES

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Considerable progress has been made in audiological testing methods in the past few years with the commencement of production of diagnostic audiometers in the public and private sectors in India. Though these audiometers are satisfactory for cases with simple auditory problems, their scope is rather limited with the difficult-to-test population. These audiometers require a voluntary participation of the patient and as such the responses are subjective in nature. There is a dire necessity for the development of low-cost indigenous equipment with which objective evaluations of hearing can be done. An attempt is made in this paper to explore the possibilities of development of such equipment. A few details of the work carried out in this direction at the B.M, Institute of Mental Health, Ahmedabad are also mentioned.

Basically the audiometric procedures can be divided into three categories.

Category I (a)

Routine pure-tone and speech audiometry in which the case is conditioned to give either verbal or motor responses.

Audiometers which are manual, semi-automatic, or automatic fit into this category. However, in using these audiometers, the responses given by the testee are subjective in nature.

Category I (b)

Under this category use of the available clinical audiometers with a few additional equipment which make the testee's responses relatively more objective can be mentioned. These include the Reaction Time Audiometer, Signal Detection Audiometer etc.

Category II

Under this, audiometers which depend on eliciting reflexes can be mentioned. These include the Psycho Galvanic Skin Response (PGSR) Audiometer, Psycho Voltaic Skin Response (PVSR) Audiometer, Evoked Response Audiometer (ERA), Averaged Evoked Response Audiometer (AERA), the Impedance Audiometer, etc.

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Category III

Under this category are included instruments which measure reactions of the auditory analyzer itself viz., Direct Measurement of Cochlear Microphonics, etc.

In the present study, difficult-to-test cases include (a) infants, (b) the deaf and the multiply handicapped individuals, (c) individuals claiming compensation as a result of accident or injury in which they lost part of or total hearing, (d) hysterical cases who feign hearing loss to gain some benefit other than monetary, (e) the mentally retarded cases, (f) cases with emotional problems (excessive anxiety, fear, depression etc.) and those with loss of reality problems (psychotic etc.).

These cases present problems in testing because their voluntary participation in the test situation is required and they are not in a position to do so. The responses are dependent in many respects upon the readiness or refusal of the examined person to respond. They may also lack motivation or the necessary insight into their problems and as such the routine pure-tone and speech tests in the category of I (a) are not feasible with them. Other methods have to be considered.

At present only few centres like the All India Institute of Medical Sciences, New Delhi, B.Y.L. Nair Hospital, Bombay, Post-graduate Medical Research Centre, Chandigarh and, All India Institute of Speech and Hearing, Mysore, are having relatively sophisticated equipment with which auditory function can be tested to a reasonable extent objectively.

There is no doubt that considerable research work has been done and is still being done at our public enterprises viz., Bharat Electronics, National Physical Laboratories, Indian Telephone Industries etc., as well as private enterprises viz., Arphi Inc., Singh Trading Co., etc., in the development of audiometers, hearing aids, auditory trainers etc. However, with a direct participation of the audiology and speech pathology centres mentioned above, in the design, development, modifications and standardization of the new equipment Audiology and Speech Pathology are bound to progress very rapidly.

Also, every year new speech and audiology clinics are being opened in various parts of the country. Most of these are equipped with minimum audiological testing equipment like an audiometer. It must be a familiar experience for everyone working in these centres to come across difficult-to-test cases. Though the research centres mentioned above are in a comfortable position to deal with these problems even the rest of the clinics could be helped to overcome this handicap if equipment is designed in India with the guidance of the few well established research centres. This will result in considerable reduction of the gap in theory and practice existing between the Western countries and India and also considerable saving in our foreign exchange.

Equipment

Category I

If the three categories of audiometers mentioned earlier audiometers in I (a) are manufactured in India excepting for the automatic and semi-automatic ones. In the I (b) category are included Reaction Time Audiometer and Signal Detection Audiometer.

Reaction Time Audiometer

One of the chief difficulties in interpreting audiograms of difficult to test subjects is to evaluate how well they are motivated to respond. It would seem desirable to assess motivation in the audiometric testing situation independently of the procedures designed to test hearing itself. Reaction time i.e., the time elapsing between presentation of stimulus and the subject's response can be used to evaluate motivation since rapid responses occur only in motivated individuals.

Non-verbal children can be expected to respond to visual stimuli like normal children of the same age unless lack of motivation or severe ' CNS ' damage is present. A child who responds rapidly and consistently to supra threshold visual stimuli and not at all to auditory stimuli is probably not perceiving the sound. If a child responds fast to light and slowly to sound, it is possible that he is motivated but that the sound is near his threshold since reaction time is known to increase markedly when stimulus intensity approaches threshold. Similarly this audiometer could be used to diagnose functional hearing loss cases and other difficult-to-test cases also.

Signal Detection Audiometer

In conventional audiometry the subject's decision as to the presence or absence of the sound is not controlled. By applying the theory of signal detection to the conventional audiometry and plotting the ' Receiver Operating Curves' (ROC) thresholds can be obtained precisely

Category II

Orientation Reflex Audiometry:

Psychogalvanic and psychovoltaic skin response audiometers are dependent on the principles of (1) Fere as developed by Bordley and Hardy (1947) and (2) Manfredi (1952) respectively. By means of these audiometers responses to the acoustic stimulus can be reliably and objectively recorded without having to resort to the patient's answers.

The Veterans Administration (of U.S.A.) has specified that in examination of every case in which a compensable disability would result from accepting the patient's voluntary thresholds a GSR test must be performed at least at one frequency in each ear. If this procedure reveals a functional hearing loss, the

GSR testing should be performed for all the speech frequencies in each ear. And it is also valuable in early diagnosis of hearing loss in children. These are only a few of the uses in which PGSR could be used.

Evoked Response and Averaged Evoked Response Audiometers

These two would require the use of an EEG and a computer in addition to the audiometer and as such they are very expensive and not viable at this stage.

Category HI

Direct measurement of cochlear microphonics would involve the development of refined techniques of introducing the electrodes into the auditory analyzer and equipment for measuring the small potentials generated.

At the B. M. Institute of Mental Health, Ahmedabad we have a speech and audiological clinic, a post graduate training programme in speech and hearing and a clinically oriented research programme. Under this research programme Reaction Time Audiometer, Signal Detection Audiometer as well as psychogalvanic and psychovoltaic Skin Response audiometers are planned and they are in various stages of design, development and fabrication. For lack of time the technical details are not presented here but we certainly welcome other centres to share our efforts in this regard.

A direct participation of the few speech and hearing centres with research facilities will help in hastening the process of development of our field as a whole. Through the central services of Indian Speech and Hearing Association these low cost equipment designs etc., and the technical know-how can be provided to the other speech and hearing centres. Also when the research centers have standardised the procedures the details can be passed on to the public and private enterprises for production depending on the feasibility.

Summary

Need for the development of advanced audiological equipment indigenously at low cost for assessing the difficult-to-test cases has been pointed out. A direct participation of the Audiological Centres where research facilities are already available in such development was stressed. After standardization of these designs and the methods of assessment, through the coordination of ISHA and public and private enterprises these expertise and technical know-how can be made available to the other speech and audiological clinics.

Acknowledgements

I am grateful to the Director, B. M. Institute of Mental Health for encouraging and providing me the facilities for developing and adapting these new

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audiometric techniques. I am also grateful to my colleagues and my students who have been very cooperative and are participating to various degrees in these projects.

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