ACOUSTIC CHARACTERISES OF NOISE MAKERS

Reg. NO.M9718

Independent Project submitted as part fulfilment for the fir year M.Sc, (Speech and Hearing), Mysore.

All India Institute of Speech and Hearing
Mysore 570006

1998

CERTIFICATE

This is to certify that this Independent Project entitled *ACOUSTIC CHARACTERISTICS OF NOISE MAKERS* is the bonafide work in part fulfilment for the degree of Master of Science (Speech and Hearing) of the student with Register No.M9718

Mysore

May, 1998

Dr.(Miss)S.Nikam

Director
All India Institute of Speech and Hearing
Mysore 570 006

CERTIFICATE

This is to certify that this Independent Project entitled *ACOUSTIC CHARACTERISTICS OF NOISE MAKERS* has been prepared under my supervision and guidance.

Mysore

May, 1998

Manjula P

Lecturer in Audiology
All India Institute of Speech and Hearing
Mysore 570 OO6.

DECLARATION

This Independent Project entitled *ACOUSTIC CHARACTERISTICS OF NOISE MAKERS* is the result of my own study under the guidance of Mrs.Manjula P., Lecturer in Audiology, Department of Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other diploma or degree.

Mysore

May, 1998 **Reg. NO.M9718**

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I extend my gratitude to ***Dr.(Miss)S.Nikam,*** Director, All India Institute of Speech and Hearing, Mysore, for granting me permission to carry out this project.

I don't have words to say !! How can I say just thanks - ***Atnnta and Anna,*** without your blessings I cannot stand in this world.

Suresh - thanx a lot lots of your constant encouragement.

Chinnu - I love you so much.

Sisters - Mari, Sowmya, without your cooperation how can I complete this work. Thanks you dears.

Also I extend my thanks to ***Rajalakshmi Akka*** for her greatjob.

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INTRODUCTION

The auditory channel is the route through which speech and language development normally takes place. Hearing-impairment is one of the most common cause for delayed or deviant development of speech and language. There is a direct relationship between the age of onset of hearing-impairment and the development of language skills. Early the onset of deafness, poorer is the langauge development. Hearing-impairment may also give rise to aberrant emotional behaviour, social adequacy, etc.

The adverse effects of hearing-impairment may be reduced by early identification and intervention programs so that the critical period for language acquisition is not missed.

Identification and assessment of hearing-impairment is one of the first and important steps in the rehabilitation of hearing-impaired. Establishing the precise degree, type and configuration of hearing impairment in each ear is of prime importance to decide the line of treatment, i.e. medical or audiological rehabilitation. Hearing screening procedures aim at identifying the hearing-impaired with little effort, expense and expertise. Hearing screening should be made available to neonates, infants, children to catch the hearing-impaired as early as possible. Cost effective procedures need to be developed and investigated for hearing screening. There are a vast number of procedures which for auditory screening -which make use of noise makers, objective procedures high risk checklists, etc. Calibrated noise makers will not only help during hearing screening programms but can also be used during the training programs for the hearing-impaired.

McConnell and Ward (1967) have stated that informal screening employing noise makers is a practical technique for discovering hearing-impairment in infants. Hearing-impaired children are not identified at an early age, the effects can be irreversible.

Barr (1955) discussed a preliminary hearing examination in which infants were exposed to sounds made by cowbells, tambournes, triangles, rattles, etc. at a distance of one half meter. The audio frequency spectrum and sound pressure were determined for each noise maker as a function of distance. It was reported that informal hearing tests can provide reliable information of auditory acuity "*.... in no case has a child proved to be more deaf than when first diagnosed",* this was opined by Barr (1955).

In a later investigation, Suzuki and Sato (1961) concluded that the startle response audiometry was a quantitative method for obtaining a reliable measure of the degree of auditory impairment, expressed in threshold value, for infants above three months of age. In accordance, Darley (1961) and Langenbeck (1965) stated that the presence of a hearing-impairment can be determined by causing a child to turn his head towards a source of intrinsically interesting sound.

Glorig (1965) stressed two important aspects of such a hearing testing. (1) that the quality of the sound is known by the tester (2) that lack of response is not confused with lack of hearing. Further O'Neill and Oyer (1966) emphasized that the determination of spectral components is desirable since some frequencies are more prominent in a complex sounds. Mendel (1968) indicated that the probability of infant response to acoustic stimuli is related to stimulus bandwidth. Responses were observed to occur more frequently when broad band stimuli were used. However, Moncur (1968) opined that definitive assessments of these responses reveal that normal-mild-moderate-severe-profound categorization, low versus high frequency involvement, and monaural versus binaural involvement were more difficult to observe and evaluable.

Due to economic attractiveness of testing and training the hearing-impaired with noise makers, the present study was undertaken to determine which of the commercially available devices could provide useful and valid information for assessment of auditory acuity and in auditory training of the hearing impaired children.

To identify and to train the hearing-impaired children, the equipment required is not only inaccessible but also expensive to most. The field of paediatric audiology has been cluttered with uncalibrated toys -which help only in screening (Weisenberg, 1971). The equipment used for screening can be of two types : (1) those used for informal testing and (2) those used for formal testing.

Noise makers are commonly used in informal testing. Bove and Flugrath (197f) and Barr (1955) found that noise makers were useful in identifying deafness in paediatric population, noise makers seem to be the more accessible tool available to test the hearing and hence, determining in their frequency composition is important. Junken (1976) in his BOEL test, utilized silver bells fastened to a ring, producing frequencies -which were distributed between 4 to 12.5 KHz.

Ewing and Ewing (1944) used noise makers like china Cup and metal spoon, toy xylophone, onion paper, tissue paper and rattles to get orientation response to auditory stimuli from infants. Calibrated noise makers can be used by anxious mothers as well as experienced audiologists. Simple toys such as drum, squeakers, bell, rattles and more sophisticated one and like electronic toys have been used by audiologists. They are not only useful in identification but also in auditory training and in eliciting speech. The change in acoustic characteristics of the toys will be imitated by children played with such toys.

Toys help children to develop perceptual motor skills and therefore have a significant role to play in their training of these skills. Toys extend play, reinforce concentrations, widen experiences and provide a reward which makes learning of new skills enjoyable and worth while. As toys are easily available and are produced on a large scale, parents' and other nonskilled workers could be trained and used to identify and train, both normals and hearing-impaired children, excluding their utility.

Hence, the aim of the present study was to:

Measure the acoustic characteristics of noise makers.

To show how these noise makers are useful in the detection of hearing loss in the paediatric population.

Also, to show how these noise makers will be useful for auditory training, i.e. in rehabilitation.

Also, to use the information to guide the parents and other personnel in selection of play materials in rehabilitation of the hearing-impaired child.

REVIEW OF LITERATURE

Identification and intervention steps are vital in the rehabilitation of the hearing-impaired children. Hearing-impaired children who are not identified at an early age may experience sensory deprivation, the effects of which can be irreversible. Hearing screening must be made available to all neonates and children to catch the hearing-impaired as early as possible to prevent the adverse effects. Determination of type, degree and configuration of hearing-impairment is of prime importance to decide the line of treatment, i.e. medical or surgical or audiological cost-effective hearing screening procedures are being developed and investigated for hearing screening. There are a number of procedures developed and investigated for hearing screening, such as use of noise makers, objective techniques, high risk checklists, etc.

The bridge to success in the management of hearing-impaired children is to catch them young, diagnose and provide adequate rehabilitative measures. Audiological screening of all the neonates is one of the solutions for detection of hearing-impaired in the developed countries. But in countries such as ours, the vast population and its economic condition make this a difficult task.

In the urban areas interview with parents help to compare the language and other developmental-milestones of normal hearing and hearing-impaired children. Also public education programmes which reveal information, about the hearing disorders and high risk register can be used to identify hearing-impaired children. Detection of hearing-impaired children in rural areas is often late. Even though parents identify the problem they do not know where and how to seek remedy for it This results in considerable secondary disabilities Teh as delay in development of spoken language, emotion, disabilities and low information level, etc.

There could also be an altered parent relationship. Even though the number of centers providing evaluation and rehabilitation services for the hearing-impaired are increasing gradually, they are by far too few in number of to meet the needs of the hearing-impaired. Therefore, the responsibility of training these children is on families and or other non-skilled personnel.

The job of the professional now is to not only evaluate the child's hearing acuity but to also provide guidance to the parents and significant others about the training techniques and the development of auditory language skills. Informal hearing screening employing noise makers is a practical technique for determining hearing-impairment in infants (McConnell and ward, 1967). Calibrated noise makers will help during hearing screening programmes for the hearing-impaired. Barr (1955) stated that in no case has a child proved to be more deaf than when first diagnosed by the reliable hearing screening procedures.

Darley (1961) and Lagenbeck (1965) have reported that the presence of a hearing-impairment can be determined by causing a child to turn his head towards the source of intrinsically interesting sound. Glorig (1965) has stressed two important aspects of such a hearing testing.

(1) 'that the quality of the sound is known by the tester", and
(2) "that lack of response is not to be confused with lack of hearing".

Further, it has been emphasized by O'Neill and O'yer (1966) that the determination of spectral components is desirable since some frequencies are more prominent in complex sounds. Further, discussion, by Mendel (1968) indicated that the probability of infant response to acoustic stimuli is related to stimulus bandwidth.

Responses were observed to occur more frequently when broadband stimuli were used. However, as shown by Moncur (1968), definitive assessments of these responses reveal that normal -mild - moderate - severe - profound categorization, low versus high frequency involvement and monaural versus binaural involvement were more difficult to observe and evaluate.

Paediatric audiology has been cluttered -with uncalibrated toys which help in screening children (Weisenberg, 1971).

The equipment used for screening can be of two types :

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Bove and Flugrath (1971) and Barr (1955) have found that noise makers were useful in identifying deafness in paediatric population. Noise makers seem to be more accessible tools available to test the hearing and hence determining their frequency composition is important. Junken (1976) in his BOEL test, utilized silver bells, fastened to a ring, producing frequencies which were distributed between 4 to 12.5 KHz.

Ewing and Ewing (1944) used noise makers like *china cup and metal spoon, toy xylophone, onion paper, tissue paper and rattles* to get orientation response to auditory stimuli from infants. Calibrated noise makers can be used by anxious mothers as well as experienced audiologists. Simple toys such as *drum, squeakers, bell, rattles* and more sophisticated ones like *electronic toys* have been used by audiologists. They are not only useful in identification but also in auditory training and in eliciting speech. The children while playing with toys producing noise will not only enjoy but try and imitate the pitches loudness variations produced these toys. Toys help children to develop perceptual motor skills and therefore have a significant role to play in their training of these skills. Toys extend play, reinforce concentrations widen experiences and provide a reward which makes learning of new skills enjoyable and worthwhile. As toys are easily available and are produced on a large scale, even parents and other non-skilled workers with minimum training can be used for testing/training, the normal and hearing-impaired children, extending their utility.

In screening or testing the hearing of infants there are a variety of responses that can be observed for the introduction of an acoustic stimuli, such as arousal/awakening changes in on-going activity orientation to source of sound, changes in breathing or sucking pattern, startle reflex, auropalpebral reflex (APR), Auditory Evoked Responses (AER) conditioned responses etc. Some of these responses (eg. APR) are more reliable of the responses (Froding, 1960) and are resistant to extinction (Eisenberg, Coursin and Rupp, 1966).

The reviewed studies reveal that, noise makers can increase the probability of obtaining a definitive assessment of infant responses by providing an indication of auditory acuity with reference to intensity, an evaluation of monaural versus binaural, involvement obtained through knowledge of dominant spectral components, etc.

Also informal screening employing noise makers is a practical technique for discovering hearing - impairment in infants (Mc Connel, and Ward, 1967). Measurement of frequency and intensity of the noise makers characteristics helps in assessing the auditory acuity in infants more precisely.

Also using the noise makers the tester is not limited by the position of the infant in relation to stationary sound speakers. Instead, he is free to move the acoustic stimuli to accommodate any movement of the infant during testing.

In case of neonates, infants and children, screening techniques are varied and they require the careful skill of the examiner. The presentation of the stimuli is done in a controlled fashion and the responses are evaluated carefully.

A calibrated noise maker serves as a stimuli for screening as well as auditory training as mentioned earlier. For converting a noise maker into a calibrated one, acoustic measurements are made to know their spectral (frequency) composition.

In the present study, few commercially available noise makers were analyzed for spectral content and categorized into those generating low frequency, mid-frequency and high frequency sounds.

METHODOLOGY

An assorted twenty six noise makers were selected from the local market for the study. This included both mechanical and electrically operated toys made either of metal, plastic or wood.

The acoustic characteristics (frequency composition) of each of the noise maker was measured.

Selection of Noise Makers

The noise making toys were surveyed in the local market and toys making different types of noise were selected to include the following :

1. **Bango** Morocco
2. Bio Ice cream car.
3. Bus horn
4. Cow bell (big)
5. Cow bell (medium)
6. Cow bell (small)
7. Damaruga
8. Doll rattle
9. Flute
10. Hen rattle
11. Jingles (big)
12. Jingles (medium)
13. Jingles (small)

14. Karoake mushroom
15. Khanjira (membrane)
16. Khanjira (metal)
17. Mouth organ
18. Musical toy
19. Orion express train
20. Pitch pipes
21. Pooja bell (big)
22. Pooja bell (medium)
23. Pooja bell (small)
24. Space gun
25. Squeakers
26. Wooden rattle

TEST ENVIRONMENT

Measurement was carried out in a quiet laboratory, where the ambient noise levels were within acceptable limits.

Equipment for Frequency Analysis of Noise Makers

DSP Sonagraph model 5500/5510 (Kay Elemetrics) with accessories was made use of. The microphone of the system was connected to the input section of the main module. The instrument was tuned 'on' for a minute and allowed to warm-up. The block diagram of the instrumental set-up is depicted in Fig. 3.1

The analysis menu of the instrument was set appropriately for measuring wide band spectrograph and power spectrum from the Menu section of the control panel. For carrying out the measurement, a signal was given and input level was adjusted for correct recording of the signal. Wide band spectral measurement of each noise maker was done from a distance of 6 inches (at moderate levels of presentation) from the microphone of the equipment. The recording of the acoustic signal was stopped once the required power spectrum was displayed on the monitor of the equipment.

Frequency cursors were used, on the power spectrum and spectrograms, to measure the frequency concentration of the acoustic signals. After noting the main frequencies at which energy was concentrated in the signal, printouts were taken for each type of noise/signal analysed.

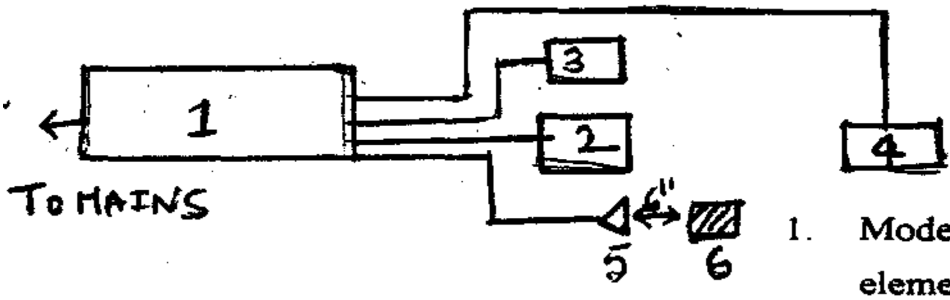
RESULTS AND DISCUSSION

Measurement of the frequency content of twenty-six noise makers was done. Those noise makers which had their energy concentrated in restricted frequency range were selected as those items which could be used for the hearing screening and for auditory training purposes. Table 4.1 a, b, c shows the frequency composition of all the twenty six noise makers.

Out of the twenty-six noise makers, nine were found to contain a dominant frequency component, which could yield useful information for hearing screening (Table 4.2 a, b, c). Based on the frequency measurement, these noise makers were classified as either generating signals in low (< 1000 Hz), mid (1000 Hz to 3000 Hz) or high (> 3000 Hz) frequency regions as shown in Table 4.2 a, b, c

The noise makers whose frequency and intensity are known can provide a practical tool for assessing auditory acuity of children. Also the acoustic stimuli provided by these noise makers were intrinsically interesting to children and were therefore more likely to evoke a response. With each calibrated noise makers, hearing loss can be assessed in terms of the approximate degree, monaural versus binaural involvement, etc. The tester is not limited by the position of the child in relation to stationary sound speakers. The tester is free to move the acoustic stimuli to accommodate any movements of the child during hearing testing or training.

The selected available sources of acoustic stimuli used in this study may be used by parents or even anganwadi workers with some initial training where hearing screening facilities are not available. If other calibrated toys are available to serve the same purpose, they can be used as alternatives.



1. Model 5500 (Key elemetrics) Main module
2. 5500 Key board control panel
3. Monitor
4. Printer (Model 5510)
5. Microphone
6. Noise makers.

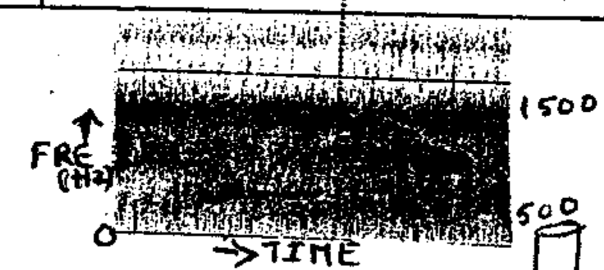
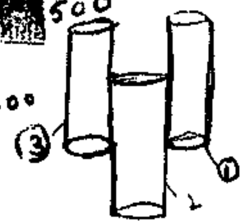
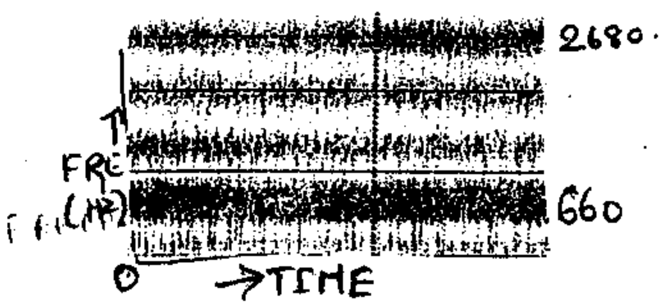
Fig. 3.1 : Instrumental Set-up for Frequency Measurement of the Noise Makers.

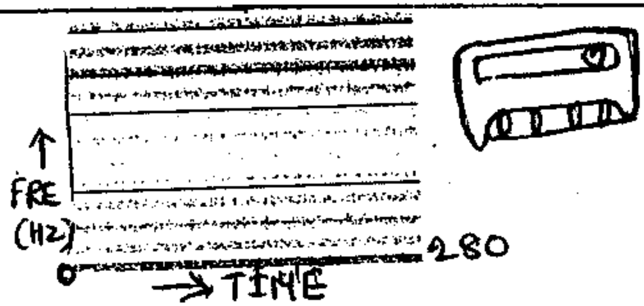
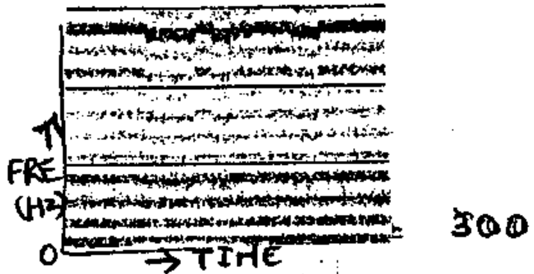
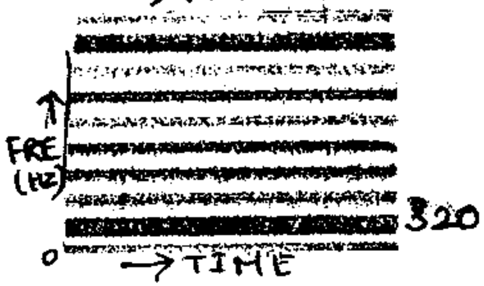
For the electronic battery operated toys, fresh cells were used during measurement.

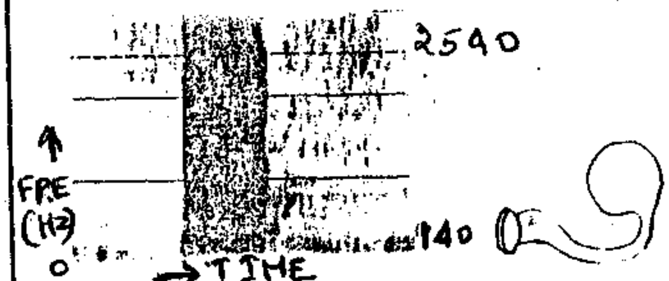
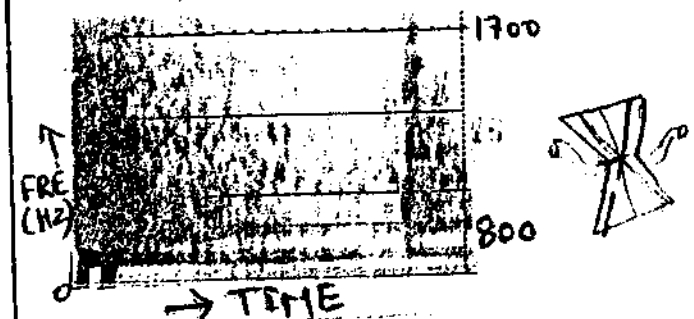
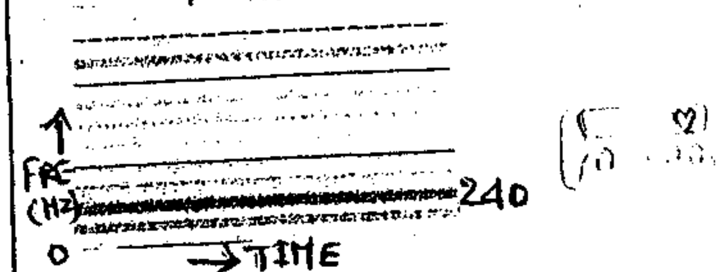
The frequencies at which energy was concentrated was tabulated for each type of noise maker. The noise makers were classified as generating signals either in the low (< 1000 Hz), mid (1000 to 3000 Hz) or high (>3000 Hz) frequency regions as in Table 4.1 a, b, c of Chapter 4.

The intensity of the noise makers was not measured as a lot of variables would affect the signal intensity, such as force of noise generation, distance from the measuring instrument, the voltage of the battery, etc.

Table 4.1a : Frequency content of noise maker generating low frequency (< 1000 Hz) signals

Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range (inHz)
1.	Pitch pipe 1		500	500-1500
	Pitch pipe 2		280	280 - 2000
	Pitch pipe3		660	660 - 2680

Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range (inHz)
	(b) Key2		280	—
	(c) Key 3		300	—
	(d) Key 4		320	—

Sl.No.	Name of the	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range (inHz)
2.	Bus horn		140	140 - 2540
3.	Damaruga		800	800 - 1700
4.	Musical toys (1-8 Keys) (a) Key 1		240	

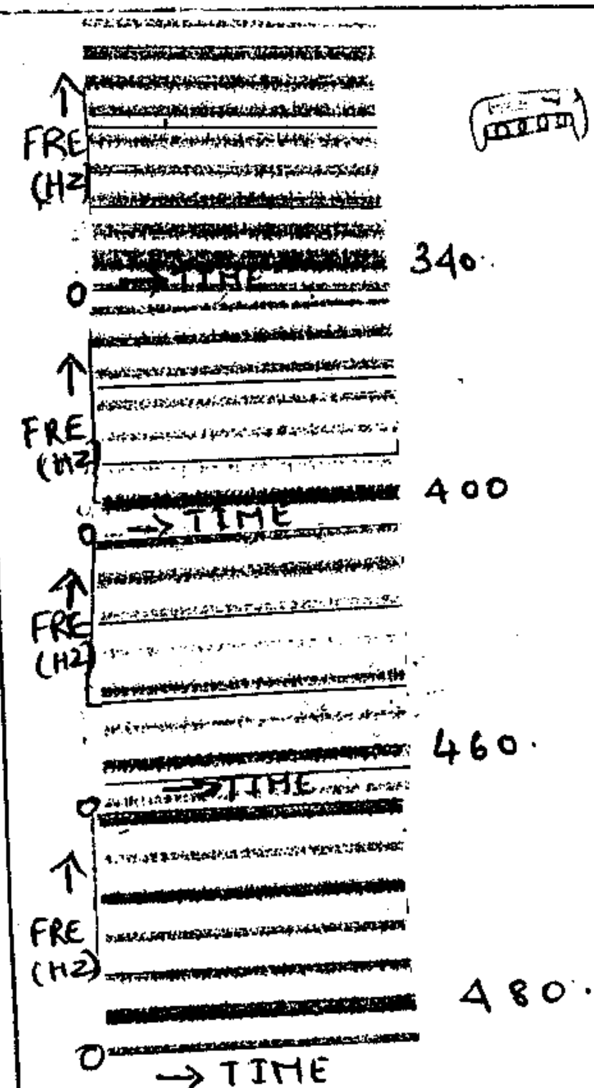
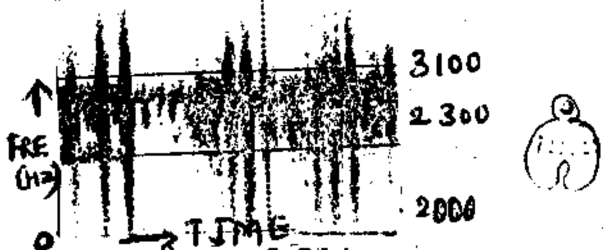
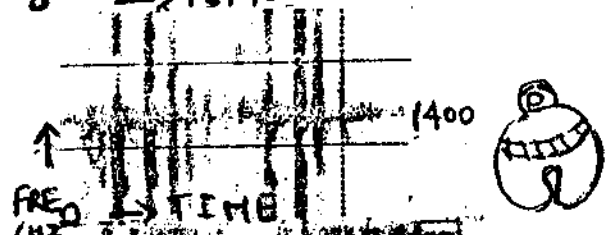
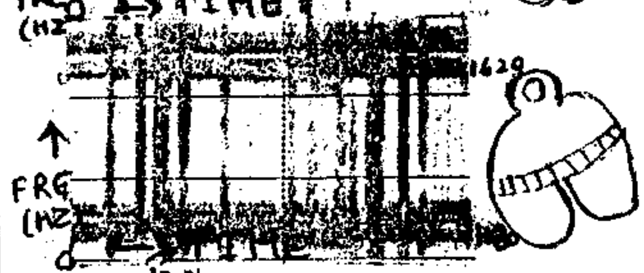
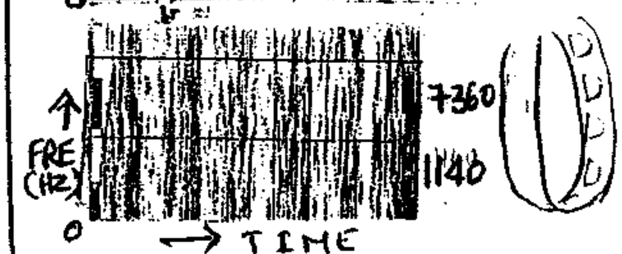
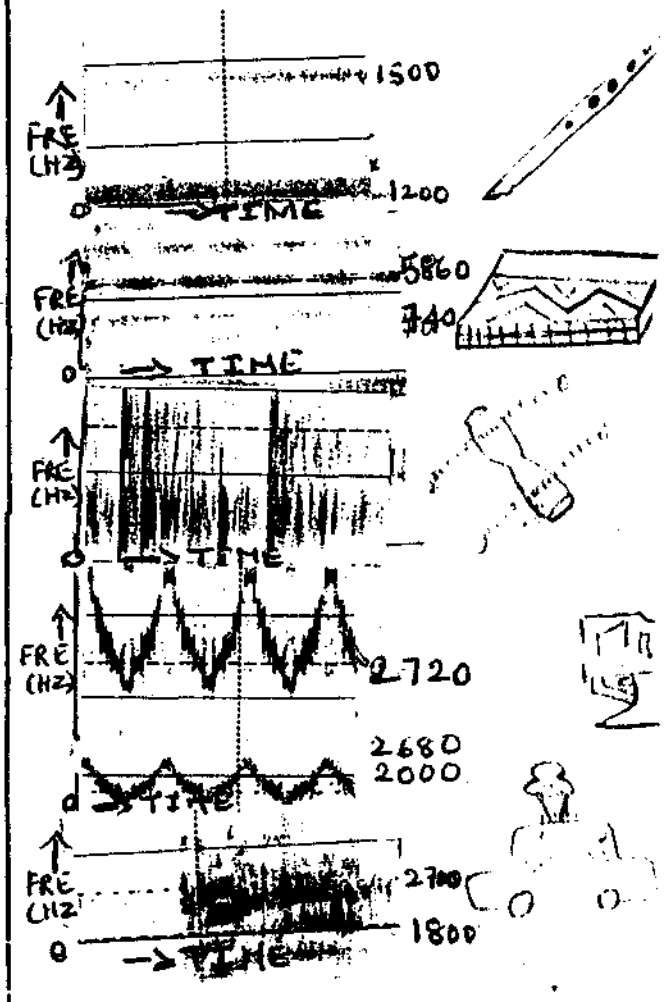
Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range (inHz)
	(e) Key 5		340	—
	(f) Key 6		400	—
	(g) Key 7		460	—
	(h) Key 8		480	—

Table 4.1b: Freuency content of noise makers generating mid frequencies.(1000 -3000 Hz) signals

Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range (inHz)
1.	Small Cow bell		2300	2000-3100
2.	Medium cow bell		1400	1300 - 2400
3.	Big cow bell		1380	1380-1620
4	Me. tal khanjira		2500	1140 - 7360

Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range (inHz)
5.	Flute		1400	1200- 1500
6	Mouth organ		2200	740 - 5860
7.	Rattle (Wooden)		2560	2560 - 3580
8.	Space gun		1. 2680 2. 2000 3. 2720	440 - 3680 1100 - 2400 2500 - 4500
9.	Bio Ice cream car		1900	1800 - 2700

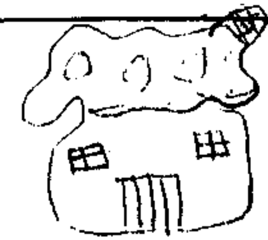
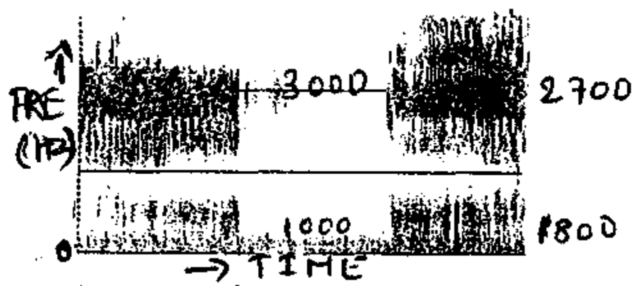
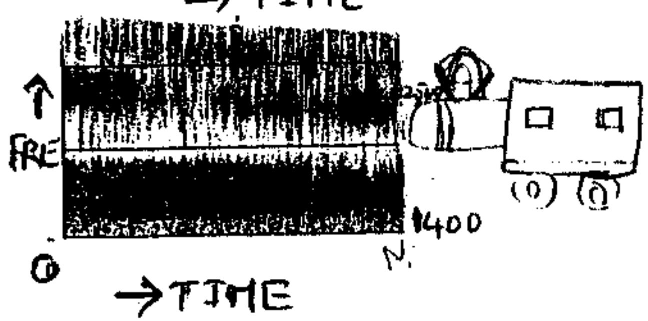
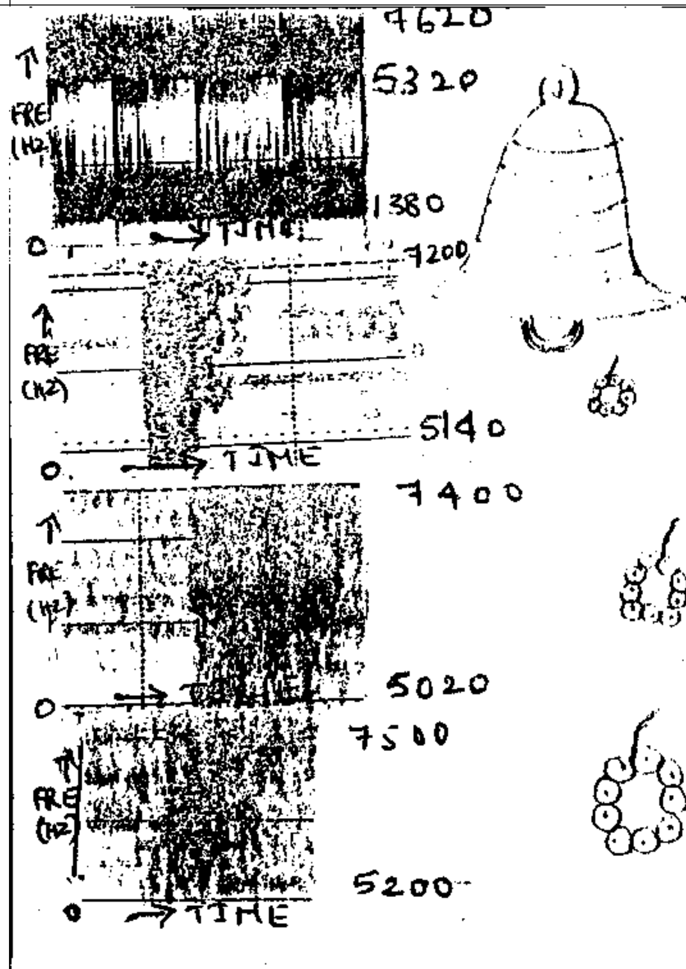
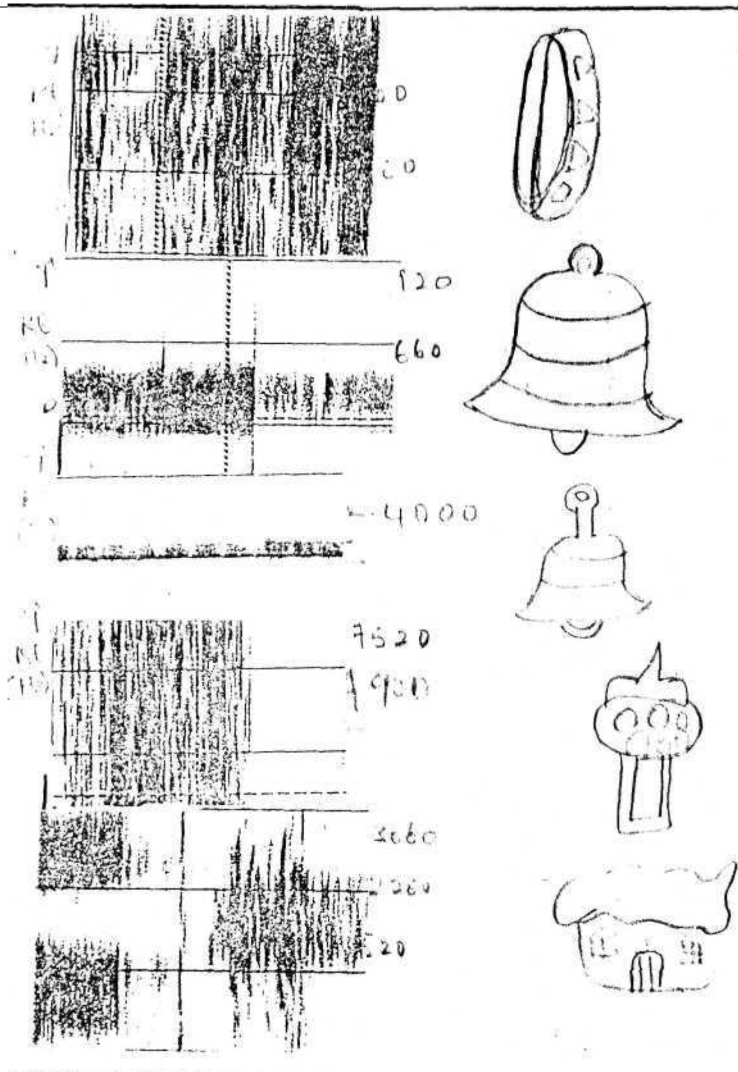
Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range (inHz)
10	Karaoke Mushroom a) Sheep		2000	1900 - 2700
	b) Cock		2500	1000 - 3000
11.	Orion talking train		1500	1400 - 2500

Table 4.1 c: Frequency content of noise maker generating high frequency (> 3000 Hz) signals

SI.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	—Frequency range (inHz)
1.	Big pooja bell		5320	1380-7620
2.	Small Jingles		7200	5140 - 7200
3.	Medium Jingles		6080	5020 - 7400
4.	Big Jingles		5640	5220 - 7500

SI.No.	Name of the Noise maker	Spectrum with diagram	- Dominant frequency (Hz)	~Frequency range (inHz)
5.	Khanjira (Metal)		6500	5280-6500
6.	Medium Pooja bell		5920	2660 - 5920
7.	Small pooja bell		4000	4000-4100
8.	Morocco		5800	4900 - 7520
9.	Karaoke mushrom a)cat		4000	2500 - 6500

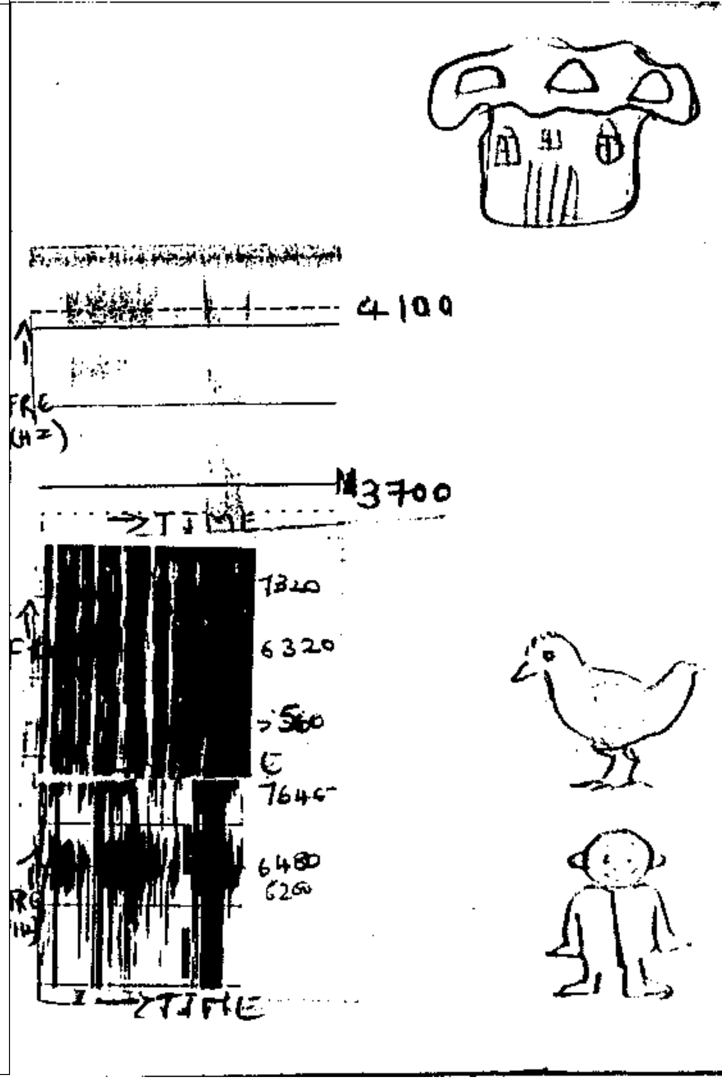
Sl.No. Name of the Noise maker	Spectrum with diagram	Dominant frequency (Hz)	—Frequency range (inHz)
b) Chick		5000	4300 - 6300
c) Cuckoo		3800	3700 -4100
d)Dog		2800	3700 - 4100
10. Henrattle		5360	5000 - 7320
11. Doll rattle		6480	6200 - 7640

Table 4.2a: Spectrum of the selected noise maker
Noise makers generating low frequency (< 1000 Hz) signals.

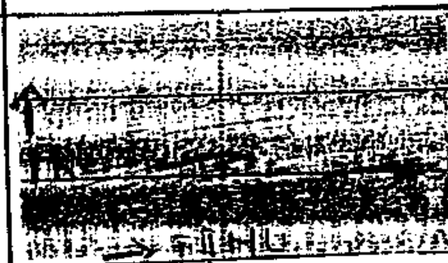
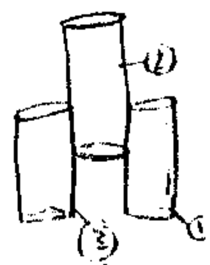
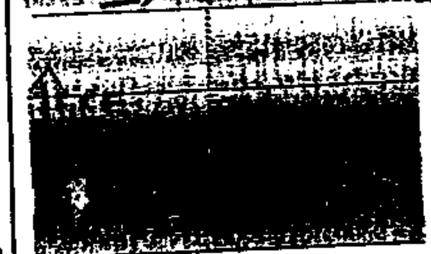
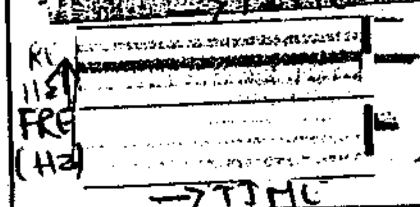
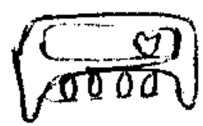
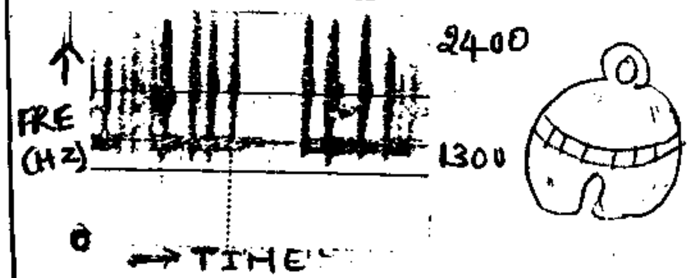
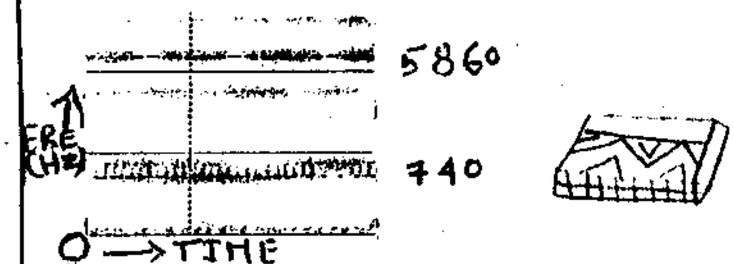
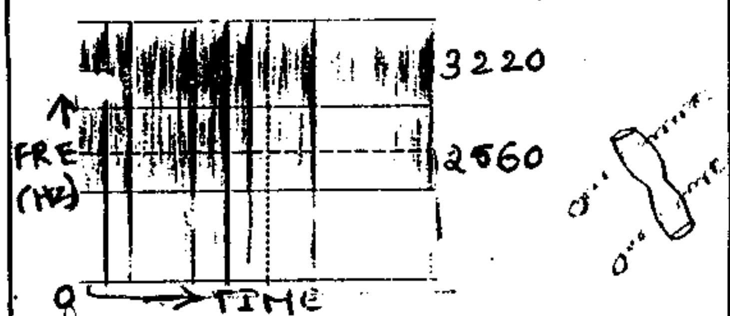
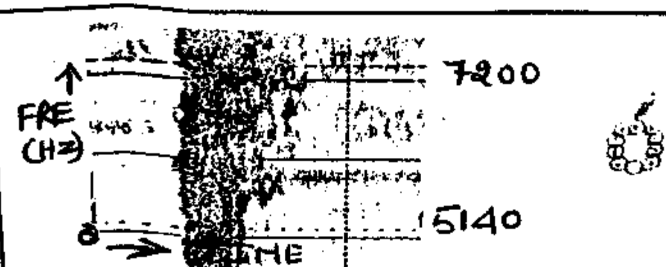
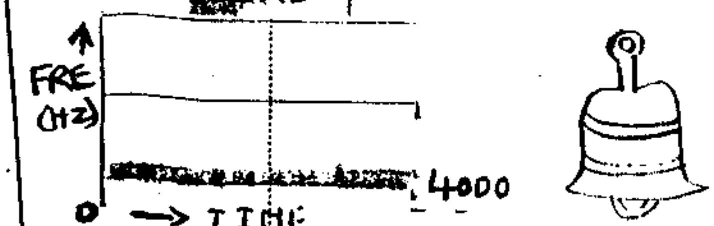
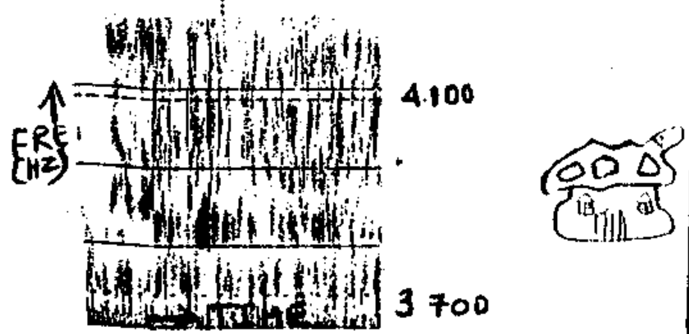
Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range or hormonics inHz)
1.	Pitch pipe 1	 	500	500 - 1500
2.	Pitch pipe 2		280	280 -2000
3.	Karaoke mushroom (Dog)	 	800	800 - 1700
4.	Musical toy	 	8 keys;240,280, 300, 320 340, 400, 460, 480	

Table 4.2b: Spectrum of selected noise makers o^nid frequency (1000 - 3000 Hz) signals

Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range or hormonics inHz)
1.	Mediumcow bell		1400	1300 - 2400
2.	Mouth organ		2200	740- 5860
3.	Rattle (wooden)		2560	2560 - 3220

4 2c Spectrumjof selected ix^^ise maker generating high frequency (> 3000) signals

Sl.No.	Name of the Noise maker	Spectrum with diagram	~ Dominant frequency (Hz)	~Frequency range or hormonics inHz)
1.	Small jingles		7200	5140 - 7200
2.	Small pooja bell		4000	4000 - 4100
3.	Karaoke mushroom a) Cuckoo		3800	3700 - 4100
	b) Dog		3800	3700 - 4100

Once the child is identified, the next step is to refer him to an audiologist and get him fitted With an appropriate hearing aid and provide rehabilitation, if medical or surgical intervention is not helpful. These noise makers are also helpful in the auditory training activities, aimed at helping the aurally handicapped become more alert and proficient in attending to the sounds of speech or otherwise discriminating one from another and effecting an increase in retention of sounds.

The same noise makers could also be used as a source of acoustic stimuli to auditorily train the hearing impaired child.

The aim of auditory training is to make the child aware of the presence of sounds and their discrimination.

The frequency at which the hearing is better may trained first and then training -with other frequencies. This way the calibrated noise makers help in choosing the order of training with toys for auditory training. The noise makers will also induce and reinforce the production of different frequency and intensity variations by the child while playing with it. . "

Further recommendations

Play materials (easily available, low cost) which are easily available in different regions or locations could be collected and subjected to similar measurements and analysis.

Data can be collected to see the efficiency of these noise makers by doing the informal screening and auditory training.

Intensity measurement may also be done and the effects of varying intensity/distance of presentation on frequency response may be investigated.

Periodical re'evaluation of the play materials could be done to assess the reliability of their out put in the long use.

SUMMARY AND CONCLUSION

Acoustic characteristics of 26 noise makers/toys were measured and compared, in order to investigate the use of commercially available toys for hearing screening and aural rehabilitation.

Nine of the twenty six noise makers were found to contain a dominant frequency component which could be used in paediatric audiological evaluations and rehabilitation.

Noise makers can increase the probability of obtaining a definitive assessment of infant responses by providing an indication of auditory acuity with reference to intensity, evaluation of monaural versus binaural involvement obtained through mobility of the sound source, and a determination of frequency involvement through knowledge of dominant spectral components.

These noise makers provide a tester with portable calibrated acoustic stimuli with a known frequency characteristics and which are intrinsically interesting to infants. They are an attractive and inexpensive source of tools for assessing infants auditory acuity and for auditory training.

A knowledge of calibrated noise makers would provide guidance to parent^ and other non-professional workers to identify a hearing problem and in the selection of play materials in rehabilitation of the hearing-impaired child and to suggest a few activities for the same. The noise makers, with different frequency and intensity compositions and variations, would induce such variations in the vocal imitations by the child and thus experiment with his own voice and articulatory systems.

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