SURVEY AND ANALYSIS OF COMMERCIALLY AVAILABLE SOURCES OF ACOUSTIC STIMULI. IN IDENTIFICATION AND REHABILITATION OF HEARING IMPAIRED CHILDREN (3-6 YEARS)

Register NO.M9004

AN INDEPENDENT PROJECT WORK SUBMITTED AS PART FULFILMENT FOR THE FIRST YEAR M.Sc.(SPEECH AND HEARING) TO THE UNIVERSITY OF MYSORE.

ALL INDIA INSTITUTE OF SPEECH AND HEARING: MYSORE - 570 006.

1991

To

APPA

AMMA

ANNA

CERTIFICATE

This is to certify that the Independent Project entitled: **"Survey and analysis of Commereially available sources of acoustic stimuli in identification and rehabilitation of hearing impaired children (3-6 years)"** is the bonafide work done in part fulfilment for First Year M.sc.,(Speech and Hearing) of the student with Register No.M9004.

Mysore
1991

Director
All India Institute of
speech & Hearing, Mysore.

CERTIFICATE

This is to certify that the Independent Project entitled: **"Survey and analysis of commercially available sources of acoustic stimuli, in identification and rehabilitation of hearing impaired children (3-6 years)"** has been prepared under my supervision and guidance.

Mysore
1991

Dr.(Miss) S.Nikam,
GUIDE

DECLARATION

This Independent Project entitled: "Survey and analysis of commercially available sources of acoustic stimuli, in identification and rehabilitation of hearing impaired children (3-6 yars) is the result of my own study undertaken under the guidance of Dr.(Miss) S.Nikam, Prof, and HOD, Department of Aodiology, and Director I/c. AIISH, Mysore and has not been submitted earlier at any University or Institution for any other Diploma or Degree.

Mysore.
1991.

Reg.No.M9004.

ACKNOWLEDGEMENTS

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Finally I am thankful to one and all who helped directly of indirectly in completing this project.

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PROLOGUE

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 neonates is a solution for detection of hearing impaired in developed countries. But in countries such as India the vast population makes this a difficult task. More over a majority of the infants are born at home.

In the urban population interview with parents help them to compare the language and other developmental milestones of normal hearing and hearing impaired children. Also public education programs which reveal information about the hearing disorders and high risk birth registers can be used to identify hearing impaired children.

Detection of hearing impaired children in rural population has been mostly through natural processes and is often late. Eventhough parents identify the problem, they do not know where to go and how to remedy it. This results in considerable communication gap between the child and the parents. The child also develops secondary disabilities

such as delay in development of spoken language, emotional disabilities and low information level. There could also be an altered parent-infant relationship.

Eventhough the number of centres providing evaluation and rehabilitation services for the hearing impaired are increasing gradually, they are by far too few in number, 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 profe-ssional now is to not only evaluate the child's hearing acuity but to also provide guidance to the parents and others in contact with the child, about the training techniques and the development of auditory language skills.

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

Bove, Fulgrath (1971) and Barr (1955) found that nolse makers were useful in identifying deafness in pediatric population. Noise makers seem to be the most accessible

tool available to test the hearing and so even we must try to emphasise the importance of determining the frequency components of the toys frequently used. Junker (1976) in BOEL test utilised silver bells fastened to a ring producing frequencies which were distributed between 4-12.5 Hz.

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.

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 musical toys have been used by audiologists. They are not only useful in identification but also in auditory training and in eliciting speech. Toys help children develop perceptual motor skills and therefore have a significant role to play in their training of these skills. Toys extend play, reinforce concepts, 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 mass scale, parents and other non-skilled workers can easily procure them. In addition, toys can be used with both normals and hearing impaired children extending their utility.

Hence, the present study aims at evaluating the effectiveness of commercially available sources of acoustic stimuli in the identification of hearing impaired children and to guide the parents in the rehabilitation of hearing impaired children between 3-6 years using these sources of acoustic stimuli which are actually noise making play materials.

SURVEY AND CLASSIFICATION

There are many sources of acoustic stimuli available commercially which are also play materials. A survey of these sources of stimuli was performed by obtaining catalogues from manufacturers all over India. They were then classified broadly based on the following factors:

1. Spectral quality of the acoustic stimuli - Based on the frequency as high (above 2000 Hz), mid or speech frequencies (500 - 2000 Hz) and low (less than 500 Hz), intensity as soft (less than 50 SPL dB) and loud {greater than 50 SPL dB).

2. The acoustic stimuli is musical or non-musical. Musical toys are those that produce a melodious and harmonious pitch which is pleasing to the ear. Eg. Toy Guitar, Piano.

3. Toys appropriate to various age groups. The preference to play materials varies with age. A child of 0-1 year prefers rattles, teethes etc. whereas l-2_years child prefers drum xylophone, hammer toys, pull along toys etc.

At 3-6 years the child is interested in competitive games, puzzles, toys with screw fittings etc.

4. Materils for mere play/developmental play material. Developmental toys help to enhance the child's motor

(eg. Building *toys,* toys with screw fittings), social and language ability (eg. toys for make believe and symbolic play - puzzles, colour game).

5. Electrical or non-electrical. Electrical toys are those that are actuated by electricity where the power source may be alternate current/direct current. Eg. Sleeping baby.

6. Materials with which they are made. This is important because the spectral quality of the acoustic stimuli varies depending on the material. Plastic, metal,cloth and wood are some of the materials which are used.

7. Quality of the play material. This may be sub-divided based on its durability, size, shape, attractiveness mobile or immobile, replaceable components or not and its availability.

8. Manufacturers of play materials. Eg. Leo toys, funskool toys.

9. Cost - Varies depending on the quality, durability, material with which it is made etc.

10. Special toys for special children. Many toys come with age appropriate level on the box. This is very useful

but for the child with delays, it's often more helpful to think about what the child can do, rather than his/her age. For children with hearing difficulties there are toys which are visually attractive and also containing a range of sound that are easily heard. Toys such as bubbles straws, piece pipe, help to develop the breath control which is necessary in forming speech.

METHODOLOGY

The study was carried out in two stages.

Stage-1:

Evaluation of the effectiveness of commercially available sources of acoustic stimuli in the identification of hearing impaired children (3-6 years).

Stage-II:

Selection of appropriate commercially available sources of acoustic stimuli for the identification and rehabilitation of the hearing impaired children (3-6 years).

Stage-I:

Subjects: 10 Auditorily trained hearing-impaired children aged 3-6 years were selected as subjects. Their hearing thresholds ranged from 55-90 dB SPL in frequencies 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz. When tested in a free field condition.

Equipment: The following equipment was used:

1) A computerised real time analyser (FONIX 6500)
2) Adiagnostic audiometer with provision for free field testing (Madsen OB-822).
3) 20 commercially available sources of acoustic stimuli.

Test environment: The test environment was isolated and sound treated. The ambient noise levels in the test room were within the permissible limits (less than 20 dB (A), Is: 1977).

Procedure: A survey of commercially available sources of acoustic stimuli was performed by obtaining catalogues from manufacturers all over India. Based on this, these sources of acoustic stimuli were classified broadly.

Due to time constraints in obtaining these materials, 20 of them were chosen randomly irrespective of their spectra. Then, spectral analysis was carried out for these materials using a computerized real time analyzer (FONIX 6500). The acoustic stimuli were presented one meter away from the microphone. A print out of the spectrum was obtained. Among the 20 noise making play materials taken, ten were chosen in speech (500, 1000, 2000 Hz) and high frequency (3000, 4000, 6000 and 8000 Hz) range with the peak intensity of 60 - 80 dB SPL.

Table-1 indicates the peak frequencies and peak intensities of 10 noise making play materials.

A COMPUTERIZED REAL TIME ANALYZER (FONIX 6500)

NOISE MAKING PLAY MATERIALS USED IN THE STUDY

S.No.	Peak frequency in Hz	Peak intensity in dB SPL
1	500	72.2
2	1000	71.0
3	2000	72.7
4	2600	66.6
5	2900	79.2
6	3500	77.9
7	4200	62.9
8	6700	69.2
9	7400	60
10	7700	66.6

Table-1: Showing peak frequencies and peak intensities of ten noise making play materials.

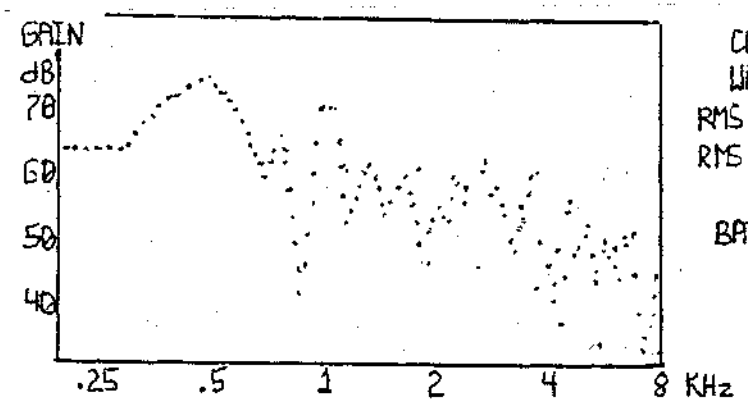
In evaluating the effectiveness of these materials in the identification of the hearing-impaired children (3-6 years) the following procedure was adopted.

Ten hearing-impaired children aged between 3-6 years who were auditorily trained were choosen as subjects. They were tested for their hearing acuity in a free field condition using a diagnostic audiometer. The children were comfortably seated at a distance of one meter from the loud

Toy-1

Peak Frequency 500 Hz

Peak Intensity 72.2dB SPL



COMPOSITE MODE
WEIGHTED GAIN
RMS SOURCE OFF
RMS OUT 76.7 dBSPL

BAT (1.5 V) 0.0 MA

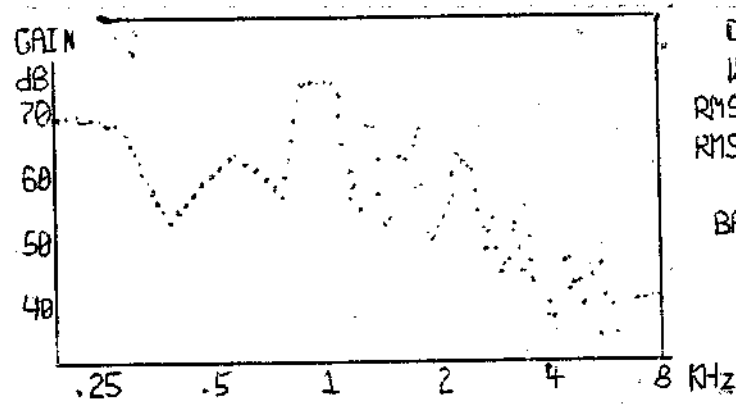
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	61.9	2000	53.4	3800	44.9	5600	51.9	7400	48.7
300	62.7	2100	55.5	3900	56.7	5700	41.7	7500	41.5
400	68.9	2200	54.2	4000	48.9	5800	50.5	7600	42.2
500	72.2	2300	59.1	4100	46.2	5900	48.9	7700	47.2
600	68.0	2400	58.2	4200	43.1	6000	50.4	7800	48.4
700	59.1	2500	52.0	4300	40.6	6100	52.3	7900	46.0
800	64.6	2600	34.3	4400	46.8	6200	45.4	8000	46.6
900	43.6	2700	60.8	4500	55.1	6300	44.2		

1000	67.6	2800	61.4	4600	56.1	6400	46.5
1100	68.1	2900	57.2	4700	48.9	6500	50.3
1200	63.2	3000	58.2	4800	50.8	6600	53.7
1300	59.8	3100	54.4	4900	44.8	6700	52.0
1400	61.2	3200	52.8	5000	52.8	6800	50.7
1500	53.9	3300	49.4	5100	52.8	6900	43.2
1600	56.3	3400	55.6	5200	49.8	7000	42.2
1700	59.5	3500	54.1	5300	46.8	7100	36.5
1800	53.5	3600	59.8	5400	37.5	7200	48.8
1900	47.3	3700	59.3	5500	45.8	7300	51.4

Toy-2:

Peak Frequency - 1000 Hz

Peak Intensity - 71 dB SPL



COMPOSITE MODE
WEIGHTED GAIN
RMS SOURCE OFF
RMS OUT 78.1 dBSPL

BAT (1.5 V) 0.0 MA

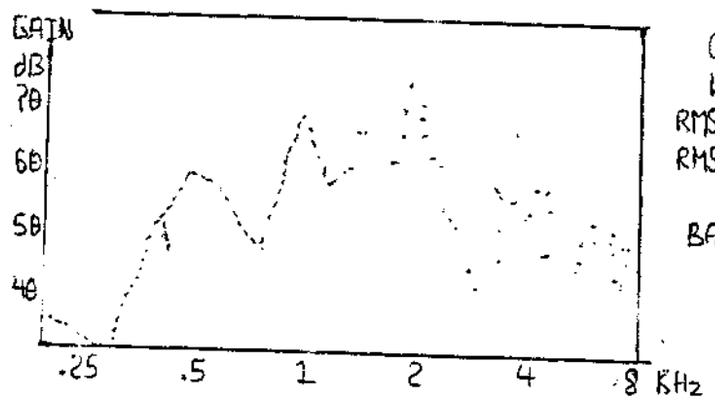
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	62.4	2000	51.0	3800	36.4	5600	43.3	7400	37.2
300	66.2	2100	54.4	3900	37.2	5700	24.9	7500	43.0
400	53.2	2200	56.0	4000	41.2	5800	35.0	7600	36.4
500	58.4	2300	61.9	4100	42.3	5900	42.4	7700	42.9
600	62.1	2400	61.2	4200	39.0	6000	42.3	7800	46.5
700	59.6	2500	59.6	4300	34.6	6100	42.3	7900	45.0
800	56.7	2600	54.7	4400	42.8	6200	42.2	8000	43.5
900	71.1	2700	49.6	4500	42.9	6300	31.1		

1000	71.0	2800	50.5	4600	44.6	6400	38.1
1100	70.8	2900	53.7	4700	44.9	6500	33.1
1200	56.0	3000	46.5	4800	44.9	6600	33.1
1300	66.0	3100	42.3	4900	42.5	6700	42.3
1400	65.3	3200	50.8	5000	46.3	6800	45.8
1500	48.9	3300	52.5	5100	49.5	6900	42.4
1600	61.6	3400	46.6	5200	45.8	7000	40.2
1700	61.7	3500	55.1	5300	40.9	7100	43.6
1800	64.8	3600	48.1	5400	38.6	7200	41.6
1900	51.3	3700	45.0	5500	42.3	7300	38.3

Toy-3:

Peak Frequency - 2000 Hz

Peak Intensity - 72.7 dB SPL



COMPOSITE MODE
WEIGHTED GAIN
RMS SOURCE OFF
RMS OUT 77.5 dBSPL

BAT (1.5 V) 0.0 MA

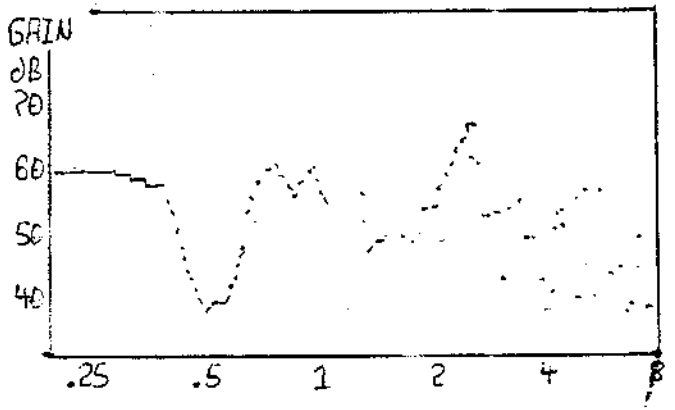
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	39.9	2000	72.7	3800	55.3	5600	47.7	7400	55.5
300	34.3	2100	66.9	3900	52.0	5700	41.5	7500	49.5
400	51.0	2200	61.6	4000	48.0	5800	50.3	7600	48.2
500	59.2	2300	60.7	4100	46.1	5900	52.8	7700	58.2
600	57.2	2400	54.6	4200	52.5	6000	53.4	7800	53.7
700	59.8	2500	53.1	4300	51.8	6100	48.3	7900	46.1
800	48.8	2600	52.3	4400	48.4	6200	43.9	8000	49.9
900	58.1	2700	52.9	4500	56.8	6300	39.2		

1000	67.8	2300	56.3	4600	54.7	6400	14.8		
1100	59.6	2400	37.2	4700	52.6	6500	43.6		
1200	57.2	2500	49.5	4800	52.5	6600	41.3		
1300	59.6	3100	52.3	4900	54.4	6700	51.7		
1400	64.8	3200	57.7	5000	57.6	6800	62.3		
1500	64.6	3300	56.3	5100	49.1	6900	63.0		
1600	55.6	3400	48.6	5200	43.7	7000	45.1		
1700	60.0	3500	52.0	5300	46.1	7100	42.4		
1800	68.3	3600	58.9	5400	47.4	7200	51.3		
1900	67.4	3700	64.6	5500	51.0	7300	56.8		

Toy-4:

Peak Frequency - 2600 Hz

Peak Intensity - 66.6 dB SPL



COMPOSITE MODE
WEIGHTED GAIN
RMS SOURCE OFF
RMS OUT 73.9 dBSPL

BAT (1.5 V) 0.0 MA

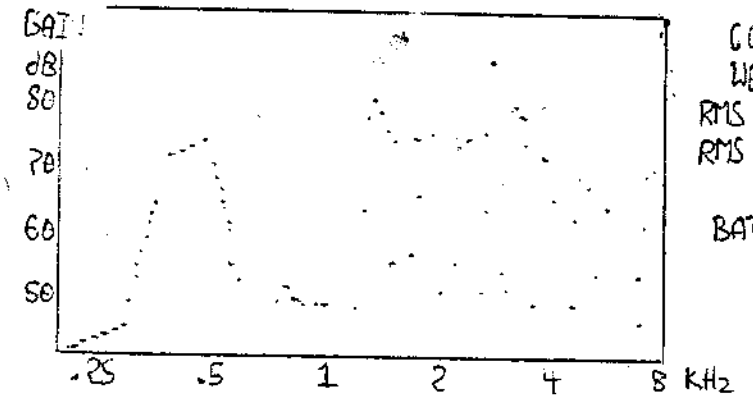
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	59.3	2000	54.4	3800	41.4	5600	45.5	7400	40.6
300	58.9	2100	54.2	3900	45.2	5700	51.8	7500	41.2
400	52.7	2200	56.8	4000	53.3	5800	56.7	7600	61.2
500	40.6	2300	58.4	4100	52.8	5900	54.9	7700	64.6
600	41.5	2400	61.4	4200	49.0	6000	45.1	7800	60.0
700	56.8	2500	66.2	4300	53.5	6100	47.1	7900	59.1
800	59.6	2600	66.6	4400	54.4	6200	45.6	8000	61.7
900	56.9	2700	55.3	4500	46.5	6300	46.8		

1000	59.3	2800	53.2	4600	51.5	6400	48.9		
1100	59.4	2900	53.7	4700	40.9	6500	49.6		
1200	60.5	3000	53.5	4800	42.5	6600	38.7		
1300	59.8	3100	45.2	4900	50.8	6700	42.0		
1400	48.4	3200	48.0	5000	48.9	6800	44.0		
1500	49.6	3300	53.9	5100	55.3	6900	47.5		
1600	46.5	3400	55.0	5200	56.7	7000	48.3		
1700	53.5	3500	51.2	5300	50.7	7100	54.4		
1800	47.2	3600	50.5	5400	39.2	7200	58.1		
1900	53.8	3700	48.0	5500	42.3	7300	54.8		

Toy-5:

Peak Frequency - 2900 Hz

Peak Intensity -79.2 dBSPL



COMPOSITE MODE
WEIGHTED GAIN
RMS SOURCE OFF
RMS OUT 88.6 dBSPL

BAT (1.5 V) 0.0 MA

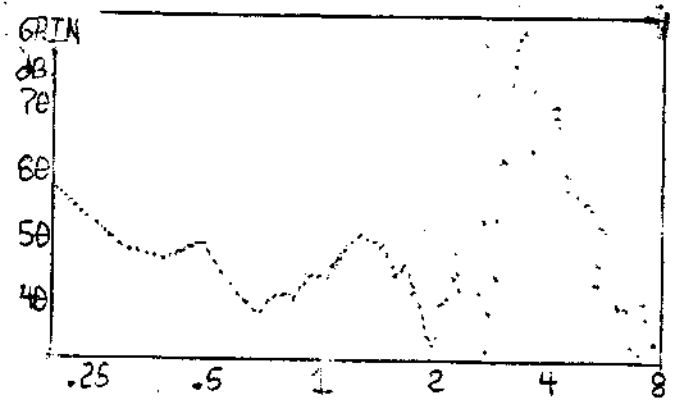
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	44.3	2000	66.2	3800	78.0	5600	64.7	7400	63.5
300	48.3	2100	46.9	3900	64.8	5700	65.9	7500	70.0
400	70.2	2200	42.9	4000	46.2	5800	49.9	7600	63.9
500	73.0	2300	72.1	4100	65.6	5900	26.2	7700	46.5
600	60.6	2400	73.2	4200	74.8	6000	49.6	7800	46.2
700	32.0	2500	59.3	4300	78.9	6100	56.5	7900	60.8
800	64.2	2600	53.6	4400	51.9	6200	51.7	8000	67.9
900	52.4	2700	74.4	4500	58.2	6300	40.8		

1000	51.3	2400	83.3	4600	63.0	6400	52.4
1100	39.2	2900	79.2	4700	63.4	6500	61.5
1200	37.0	3000	66.1	4800	64.2	6600	62.1
1300	70.7	3100	52.3	4900	43.1	6700	49.5
1400	79.0	3200	74.7	5000	53.5	6800	39.2
1500	73.4	3300	81.0	5100	66.5	6900	51.3
1600	24.8	3400	73.2	5200	66.8	7000	64.4
1700	51.2	3500	37.0	5300	55.7	7100	67.8
1800	73.4	3600	51.4	5400	44.1	7200	55.3
1900	77.8	3700	75.7	5500	51.2	7300	40.1

Toy-6:

Peak Frequency - 3500 Hz

Peak Intensity - 77.9 dB SPL



COMPOSITE MODE
WEIGHTED GAIN
RMS SOURCE-OFF
RMS OUT 61.1 dBSPL

BAT (1.5 V) 6.8 MA

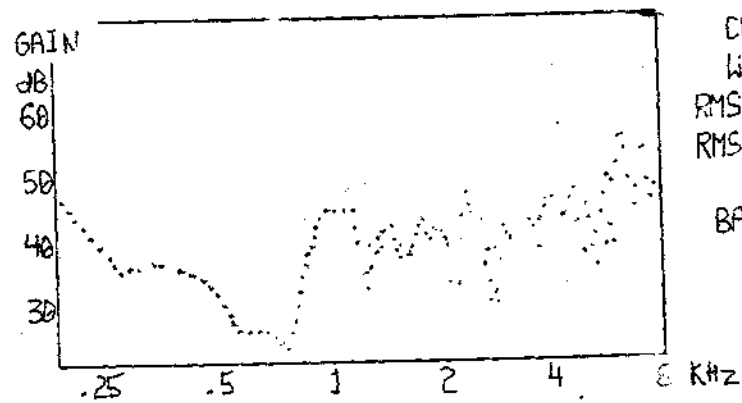
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	57.7	2000	35.3	3800	61.0	5600	52.3	7400	34.6
300	49.8	2100	42.7	3900	57.2	5700	52.5	7500	37.8
400	48.2	2200	43.8	4000	60.5	5800	52.1	7600	23.8
500	49.9	2300	48.9	4100	69.7	5900	49.6	7700	33.9
600	44.6	2400	44.3	4200	67.2	6000	37.5	7800	19.6
700	41.0	2500	53.1	4300	65.8	6100	45.4	7900	36.4
800	43.5	2600	34.3	4400	60.5	6200	42.8	8000	29.7
900	43.5	2700	53.7	4500	59.6	6300	51.5		

1000	46.5	2200	36.7	4600	57.5	6400	46.3
1100	45.9	2900	45.8	4700	65.8	6500	41.7
1200	49.3	3000	61.0	4800	57.5	6600	47.7
1300	52.1	3100	61.7	4900	56.5	6700	33.2
1400	50.7	3200	69.2	5000	54.9	6800	34.3
1500	50.5	3300	73.8	5100	50.4	6900	41.7
1600	44.9	3400	77.7	5200	55.4	7000	32.5
1700	48.2	3500	77.9	5300	45.0	7100	42.8
1800	43.5	3600	62.7	5400	47.8	7200	41.2
1900	40.4	3700	70.4	5500	53.2	7300	32.5

Toy-7:

Peak Frequency - 4200 Hz

Peak Intensity - 62.9 dB SPL



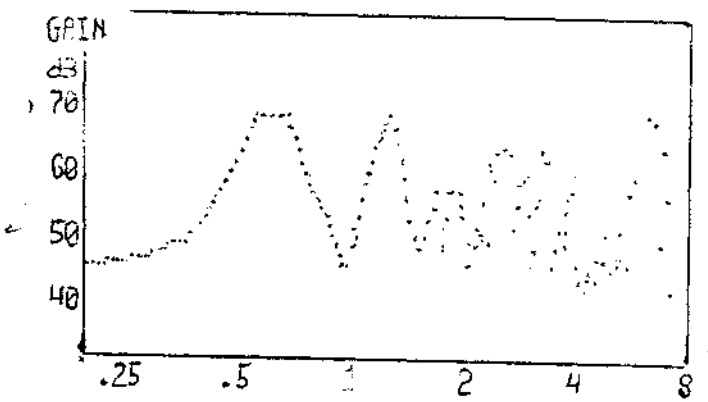
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	47.2	2000	42.8	3800	43.6	5600	46.7	7400	44.6
300	37.0	2100	40.3	3900	45.8	5700	50.9	7500	45.8
400	35.2	2200	29.5	4000	44.4	5800	48.6	7600	43.4
500	36.6	2300	46.7	4100	56.0	5900	42.5	7700	49.1
600	28.6	2400	46.8	4200	62.9	6000	48.2	7800	53.4
700	28.8	2500	43.7	4300	55.3	6100	49.1	7900	53.4
800	27.2	2600	45.5	4400	44.1	6200	49.3	8000	49.6
900	37.5	2700	32.8	4500	35.1	6300	56.4		

1000	44.6	2800	35.6	4600	45.8	6400	53.7
1100	44.3	2900	33.0	4700	46.9	6600	52.5
1200	44.3	3000	42.7	4800	39.4	6600	49.8
1300	34.3	3100	41.2	4900	24.1	6700	44.9
1400	41.2	3200	26.4	5000	38.2	6800	45.6
1500	42.5	3300	25.0	5100	43.4	6900	38.5
1600	37.9	3400	27.8	5200	39.5	7000	48.6
1700	39.8	3500	43.0	5300	41.5	7100	52.3
1800	43.3	3600	42.3	5400	37.1	7200	45.2
1900	40.0	3700	39.7	5500	44.1	7300	41.5

Toy-8:

Peck Frequency - 6700 Hz

Peak Intensity -69.2 dBSPL



COMPOSITE MODE
WEIGHTED GAIN
RMS SOURCE OFF
RMS OUT 78.3 dBSPL

BAT (1.5 V) 0.0 MA

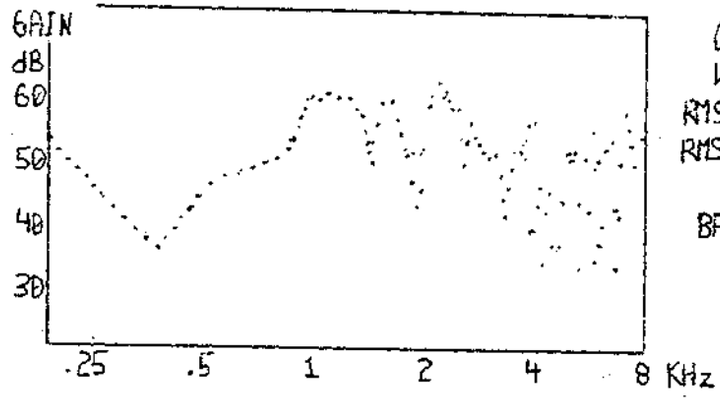
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	46.3	2000	57.0	3800	54.4	5600	56.3	7400	51.6
300	48.0	2100	47.3	3900	56.8	5700	60.7	7500	31.1
400	51.2	2200	52.5	4000	56.1	5800	59.1	7600	50.7
500	59.1	2300	50.5	4100	47.6	5900	69.2	7700	57.0
600	66.9	2400	60.3	4200	44.2	6000	74.0	7800	45.1
700	66.5	2500	58.1	4300	45.7	6100	69.7	7900	58.6
800	57.5	2600	62.3	4400	46.5	6200	54.4	8000	60.3
900	53.7	2700	61.9	4500	47.9	6300	62.9		

1000	45.3	2000	52.1	4000	45.5	6400	57.0
1100	55.5	2900	58.1	4700	48.0	6500	63.7
1200	62.7	3000	58.9	4800	51.4	6600	66.0
1300	66.9	3100	49.4	4900	47.0	6700	69.2
1400	61.2	3200	55.3	5000	42.5	6800	67.4
1500	51.2	3300	62.5	5100	47.5	6900	63.9
1600	49.0	3400	59.5	5200	48.6	7000	51.4
1700	57.1	3500	47.1	5300	52.1	7100	50.3
1800	49.4	3600	52.0	5400	50.1	7200	56.5
1900	57.2	3700	52.3	5500	47.3	7300	59.6

Toy-9:

Peak Frequency - 740 Hz

Peak Intensity - 60 dB SPL



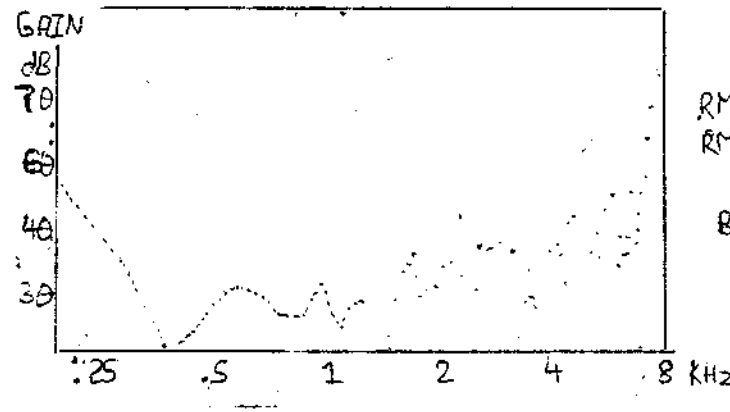
FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	62.5	2000	40.4	3800	51.0	5800	44.2	7400	60.0
300	43.7	2100	57.1	3900	54.8	5700	51.2	7500	60.3
400	37.9	2200	59.3	4000	54.3	5800	53.9	7600	58.3
500	44.3	2300	59.6	4100	41.2	5900	49.6	7700	53.7
600	47.3	2400	57.4	4200	46.7	6000	37.2	7800	48.2
700	48.6	2500	57.9	4300	36.7	6100	47.3	7900	48.7
800	49.6	2600	49.4	4400	43.6	6200	44.3	8000	54.4
900	51.9	2700	55.1	4500	46.1	6300	44.2		

1000	57.5	2800	54.9	4600	39.2	6400	48.2
1100	58.2	2900	52.3	4700	38.7	6500	52.3
1200	58.5	3000	50.8	4800	39.8	6600	50.5
1300	58.2	3100	50.3	4900	44.5	6700	38.0
1400	55.8	3200	54.1	5000	45.3	6800	46.6
1500	49.3	3300	47.9	5100	50.3	6900	45.8
1600	57.4	3400	42.5	5200	51.2	7000	47.9
1700	57.9	3500	46.3	5300	35.8	7100	57.0
1800	51.4	3600	51.6	5400	44.3	7200	50.3
1900	51.2	3700	51.5	5500	50.5	7300	56.0

Toy-10

Peak Frequency - 7700 Hz

Peak Intensity - 66.6 dB SPL



FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB	FREQ Hz	GAIN dB
200	46.6	2000	33.4	3800	38.4	5600	50.9	7400	66.1
300	38.3	2100	40.3	3900	38.2	5700	51.4	7500	61.8
400	23.9	2200	33.5	4000	45.6	5800	39.4	7600	54.1
500	38.5	2300	43.2	4100	39.4	5900	45.5	7700	66.6
600	33.3	2400	28.6	4200	37.9	6000	36.1	7800	65.4
700	31.9	2500	35.6	4300	34.2	6100	48.4	7900	62.9
800	29.3	2600	41.8	4400	42.1	6200	47.4	8000	59.7
900	29.6	2700	38.5	4500	43.2	6300	41.0		

1000	34.9	2800	38.7	4600	39.6	6400	39.1
1100	27.8	2900	39.1	4700	50.5	6500	51.7
1200	31.9	3000	21.8	4800	51.6	6600	52.5
1300	31.6	3100	32.9	4900	52.9	6700	41.2
1400	20.4	3200	27.5	5000	52.5	6800	41.8
1500	27.1	3300	26.7	5100	38.2	6900	52.1
1600	33.7	3400	30.1	5200	49.7	7000	48.4
1700	37.9	3500	32.5	5300	37.6	7100	48.2
1800	30.0	3600	30.1	5400	43.7	7200	57.4
1900	33.2	3700	39.4	5500	43.5	7300	62.7

Fig.1-10: Spectra of acoustic stimuli from ten noise making play materials used in this study.

speaker placed at 45^0 azimuth. Conditioned responses were obtained using narrow band noise (NBN) as stimuli in frequencies 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz.

The same children were tested using the ten selected sources of acoustic stimuli which were presented one meter away from the subject. Here the conditioned responses were either present or absent. The results were compared with audiometric threshold level. In both audiometric testing and testing with noise making play materials the stimulus, was presented five times and 50% response criteria was used,

Stage-II:

Subjects: Five hearing impaired and five normal hearing children in the age range of 3-6 years from middle socio-economic status.

Equipment: Ten selected noise making play materials used in Stage-I.

Questionnaire: The questionnaire used in this study is given in appendix.

Procedure: The ten selected noise making play materials were distributed among the five hearing-impaired and five normal hearing children in the age range of 3-6 years. The responses of these children to the noise makers were obtained

using a combined approach of questionnaire and interview. The parents of these children were interviewed by an audiologist who was familiar with the questionnaire. Thus it was ensured that proper answers were elicited. This information was used to guide the parents of the hearing impaired children (3-6 years) in the selection of play materials and activities for hearing screening and rehabilitation.

Thus this information would serve as a resource for selection, purchase and use of commercially available sources of acoustic stimuli, for paents of hearing-impaired children (3-6 years) in identifying and rehabilitating these children.

RESULTS AND DISCUSSION

The results of stage-I and stage-II are discussed separately.

Stage-I:

Table-2 indicates the hearing threshold levels obtained through audiometric testing in ten hearing inapaired children in the age range of 3-6 years. The thresholds range from 50 - 90 dB SPL in both speech (500, 1000, 2000 Hz) and high frequency (3000, 4000, 6000, 8000 Hz) range.

S.NO.	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
			(in dB SPL)				
1.	80	75	70	65	70	80	80
2.	70	70	65	70	80	75	85
3.	85	75	90	90	90	90	90
4.	80	75	80	65	80	75	70
5.	60	80	80	80	90	90	85
6.	60	65	70	55	60	65	50
7.	75	75	90	85	80	90	90
8.	75	80	80	65	80	75	80
9.	70	70	70	50	75	75	60
10.	75	70	70	50	75	75	60

Table-2; Showing audiometric threshold levels for narrow band noise stimuli in ten hearing impared children.

Table-3 reveals the response's from the same ten hearing impaired children to ten selected sources of noise making play

Materials. Here the response to acoustic stimuli is either present or absent.

S.No.	500	1000	2000	2600	2900	3500	4200	6700	7400	7700
	(in Hz)									
	72.2	71.0	72.7	66.6	79.2	77.9	62.9	69.2	60	66.6
	(in dB SPL)									
1.	+	-	+	+	+	+	+	+	-	-
2.	+	+	+	-	+	+	+	+	-	-
3.	-	+	-	-	-	-	+	-	-	-
4.	-	+	+	-	+	+	-	-	+	+
5.	+	-	-	-	-	-	-	+	+	-
6.	+	+	+	+	+	+	-	+	+	+
7.	+	-	-	-	+	-	-	-	-	-
8.	+	+	-	+	+	+	-	+	-	-
9.	+	+	+	+	+	+	+	+	+	+
10.	-	+	+	+	+	+	+	-	+	+

Table-3: Showing responses to noise making play materials in same ten hearing impaired children.

+ - indicates the presence of response

- - indicates the absence of response

Figure-1 is the result of comparison of responses given in Table-2 and Table-3 at each frequency. One to non-availability of noise making play materaials the peak frequency of these materials could not be exactly matched with that of audiometric test frequency. So the nearest frequency in audiometer was compared. That is the peak frequencies of noise making play materials 2600, 2900,(3500 and 4200),6700 7400 and 7700) were compared with audiometric test frequencies

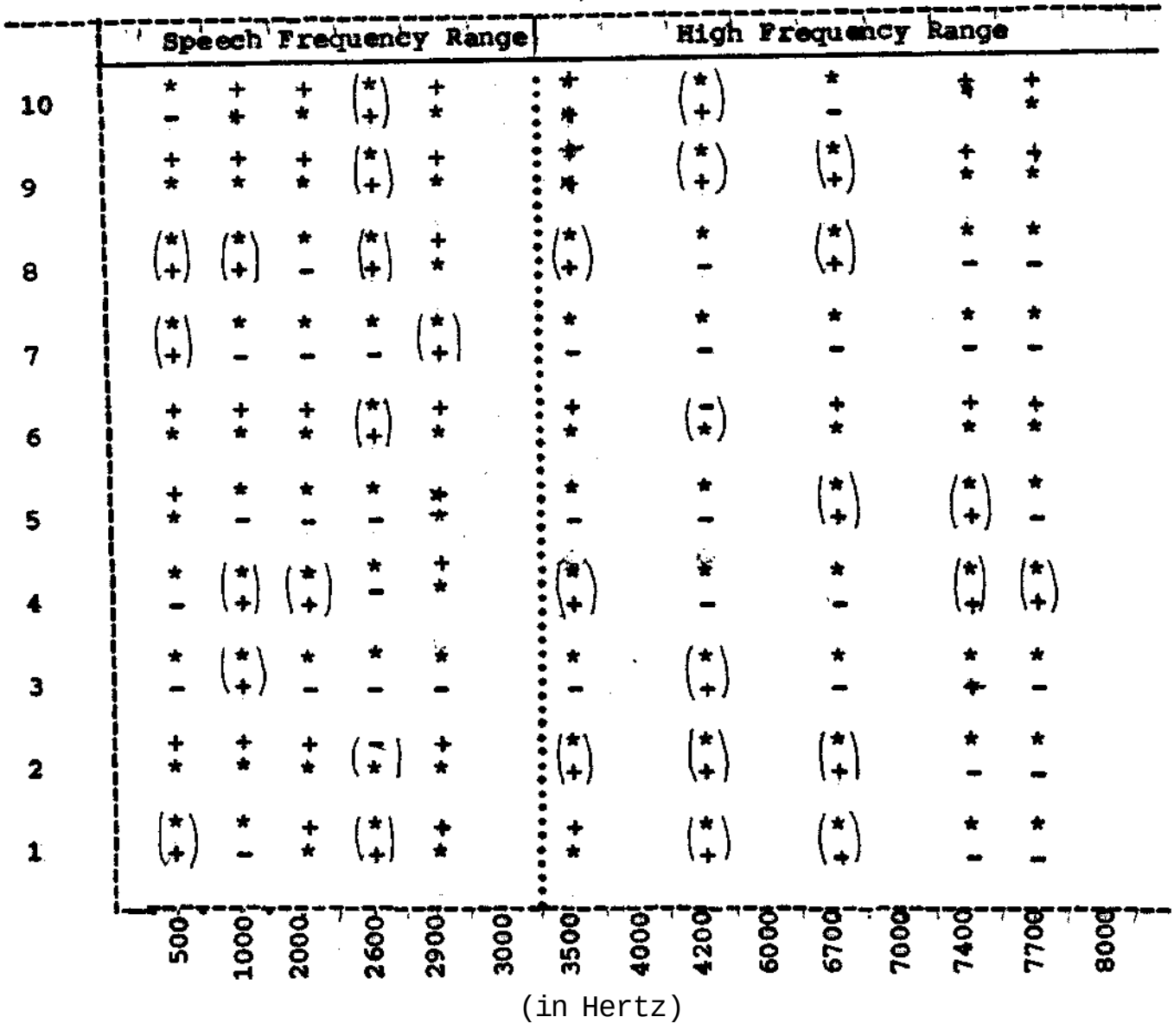


Figure-l: Shows the comparison between audiometric responses and responses to noise making toys in 10 (ten) hearing impaired children.

Similarly $\frac{*}{-}$ indicate the absence of response to stimuli from toy which is above or below the audiometric response respectively.

$\frac{+}{*}$ / $\frac{-}{*}$ - Indicate responses to stimuli from toy which do not coincide with audiometric responses.

2000, 3000, 4000 and 8000 Hz respectively. In the Figure audiometric responses were taken as a reference point (* markings) and the responses to noise making play materials (+/- markings) were marked. Consider at 500 Hz, 70 dB SPL is the audiometric test response and the response to noise making play material is present at 72.2 dB, it is indicated as $\frac{+}{*}$ ie. the stimulus from the noise making play material is above the audiometric threshold level and the response is present. In the same case* if the response to noise making play material is absent then it is indicated as $\frac{-}{*}$ • Similarly if the stimulus from noise making play material is below the audiometric threshold level and the response is present, the indication is $\frac{*}{+}$, if the response is absent, the indication is $\frac{*}{-}$.. so $(\frac{-}{*})$, $(\frac{*}{+})$ are not valid responses. These responses are given in brackets. Thus the figure gives an idea about the number of responses to noise making play materials correlating with the audiometric test responses.

To obtain the percentage of valid responses in speech and high frequency range each valid response was assigned a

number of 'one' and each invalid responses a number of 'zero' Number of valid responses were computed. Inspeech frequency range valid responses were 36/50 and in high frequency range it was 33/50. The percentage for each was calculated using the following formula:

$$\frac{\text{No.of valid responses}}{\text{Total responses}} \times 100$$

The results indicated that at speech frequency range 72% of the time the responses given for noise making play materials and audiometric test responses are coinciding. In high frequency range the coincidence is about 66%. The bar diagram (Figure-2) reveals this information.
Thus, it can be concluded that noise making play materials are useful in identification of hearing impaired children in the age range of 3-6 years.

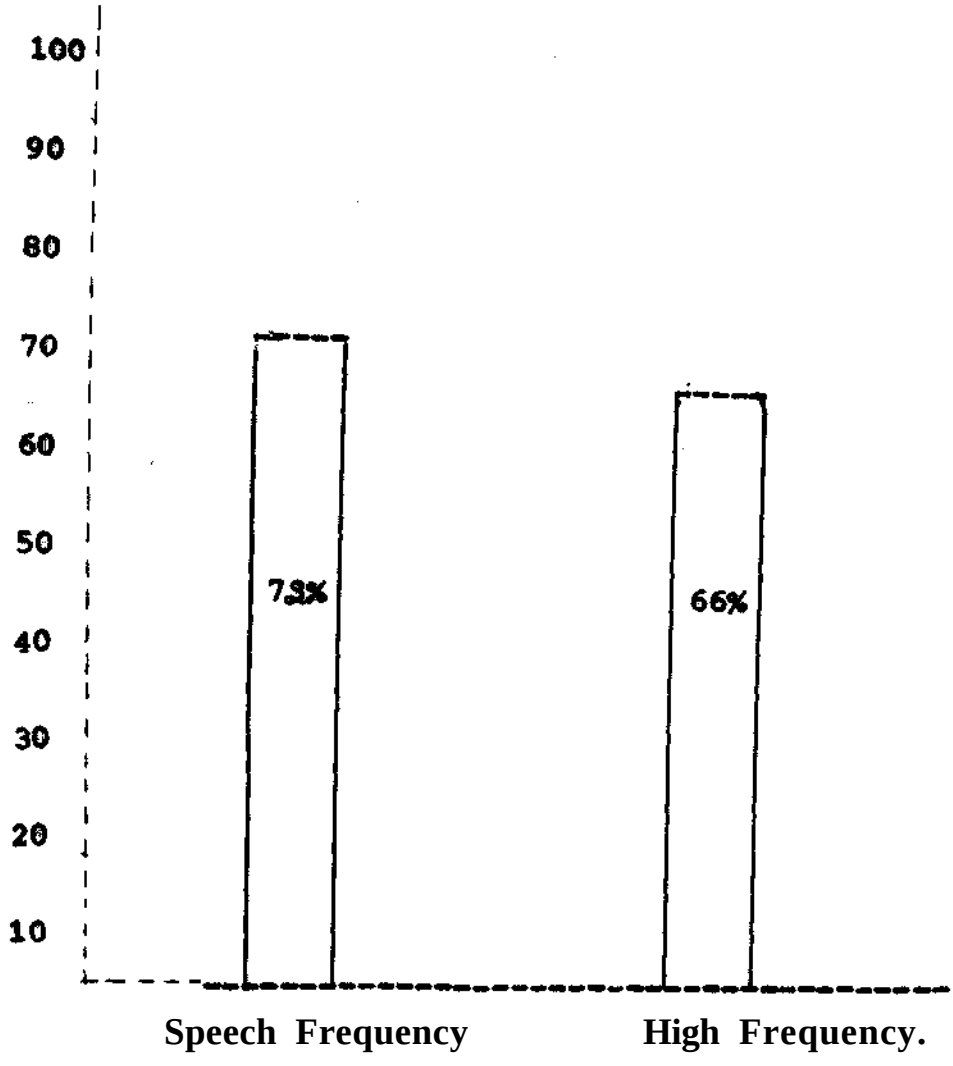


Figure-2: **Showing the coincidence between audiometric and noise making toys responses.**

Stage-11:

The information obtained through a combined approach of questionnaire and interview was analysed to identify the materials for screening and rehabilitation of hearing impaired children with age ranging from 3-6 years.

It was found that children of this age group prefer to play with movable attractive toys which produce sound and/ a light flash and they were used for imaginary play. These children did not reject any toys but rattles and squeakers were not preferred much.

The duration of play extended from 10 minutes to 30 minutes and play was mainly with peers and siblings.

The toys have been used by the parents to teach colours, shapes, sizes etc. in this age group.

Between normal hearing and hearing impaired children not much difference was found in all the above mentioned aspects. In hearing impaired children it was found that they did not give much importance to the sound that was produced, rather light flash was given importance. This might be due to the fact that they could not hear and enjoy

the sounds. Thus, apart from using the toys to teach colours, shapes, sizes etc. the parents of hearing impaired children used it for auditory training also.

Eventhough there are many toy manufacturing companies parents did not prefer any particular company. But durability, safety and educability of the toys were considered while purchasing them keeping the child's interest also in mind.

"Play is a way of learning to live,
not a way of passing time".

What can parents do?

Once you identify that your child is hearing impaired, you must consult an audiologist nearby. The child is then fitted with a suitable hearing aid. Hearing aid is nothing but an instrument which amplifies the surrounding sounds, so that your child can hear, the sounds, When it is worn. Along with furnishing the child with a hearing aid, you hare to systematically train your child to use it. This is a job for you as parents have to do. The hearing aid will not do it by itself. The child will not use the hearing he has unless someone trains him to do so. Therefore give the child auditory training, that is, train the child to hear the sound.

Auditory training includes teaching the child to be aware of sounds present in the surroundings and then to discriminate different sounds ie to differentiate one sound from the other. Now the child knows what a particular sound is and where it is from. you should train your child for both verbal and non-verbal sounds where verbal sounds are speech sounds and non-verbal sounds are other environmental sounds. The noise making play materials can be effectively made use for this purpose. Here are some examples.

Piece pipe is a versatile blown instrument set with different parts that make variety of sounds.

Xylopiano - This strong, tuneful little instrument is a clever coimbination of a piano and a xylophone.

Junior xylophone, sexaphone, toy guitar, musical pink lady can also be used.

If the child has learned to listen to the sound, you should teach the child to understand them to substitute words in his mind for absent, persons, objects, events. A child of 3-6 years is very sociable. He 1earns to play with rather than just being in the same room. At this age toys which demand the manipulation of buttons, buckles, press studs and laces and so on are very useful. They also help in imaginary play. At this age a child's imagination is reaching out beyond the eonfines of the domestic environment and straying into monster infested territory, with airports, hospitals and circuses providing the more down to earth aspects of make believe world's which extend to outer space.

To teach different concepts of language and to improve imaginative play you can use such games as "clever connections" - It is a game with colorful pictures. You have set of cords

in which each belongs to one of the classifications. You can have classifications such as vehicles, animals, objects. The object of the game is to relate cards within the right groups. A bear will match up with a lion, or car with a train, for instance and the result is an absorbing and thought provoking game.

"Rainbow Tower" is an another game in which "tower" is a vertical stick onto which coloured beads can be threaded in a particular order. A new bead is added when the right colour is thrown on the dice, encouraging the child to practice colour identification.

"The game of lady bird" is a counting game based on finding out how many lady birds are hiding under leaf cards.

Tigsaw puzzles such as dressing puzzle, alphabet puzzle,number puzzle, help to develop language, extend child' s concentration and the child's attention span. They also demand skills in matching shape, colour and size.

Thus, your child' s understanding ability of language can be improved by object-object, object-picture, picture-picture, picture/object-verbal matching.

Then you should train him to mimic the sound of the word and to say the word when he is thinking about the object or event. To elicit speech from your child different toys can be used.

When you teach the child to speak start with monosyllabic word (pa, ta) then go on to multisyllabic words and then sentence. Here activities such as associating a speech sound when a toy moves or imitating the sound which the toy makes are useful. When a sound is produced you explain to your child how to produce these sounds/words, show him the placement of tongue, tips either directly or in the mirror. Let him imitate you. Place the child's hand on your throat when you say the sound. Let him feel the vibration, This will help him learn to voice. The game with the toy wiggles, the worm in the apple is useful for eliciting speech from hearing impaired children. As you talk to the large red, plastic apple, wiggles the warm comes out of apple until it'seyes light up. If your child imitates the sounds meaningfully, then you are able to say that the child talks and use language.

Table-4 gives the abilities of a 3-6 years old child. So while choosing the materials and activity for auditory training and speech therapy for your child, keep the abilities and interests of the children at different ages as your reference.

When a child can	Provide	To encourage
	By 3 years	
Begin to get dressed alone.	Simple dressing up items. cloths, hats and accessories•	Make-believe play, dressing skills, body image games.
Assembles toys with screw together.	Toys with screw fittings.	Practice, so that more advanced construction toys are possible.
Begin to copy simple figures and draw.	Chubby crayons and thick pencils.	Interest in drawing, can then introduce templates and other tracing activities.
Begin to match 2 or 3 primary colours and name them.	Matching games using colours Colour snap, colour matching dominoes.	To group together things which are 'same' and 'different'.
Enjoy picture book, recognizing fine details. Match form pictures.	Simple picture lotto.	To discriminate details.
Pour water from one cup into another.	Various containers for water play. Include funnel, and water/bath toys.	Improving the control of both hands and eyes together.

When a child can	Provide	To encourage
	3- 4 years	
Push and pull large toys while walking and running. Ride tricycles.	Scooters and barrows tricycle and pedal cars.	Agility and balance. Confidence ability.
Throw, catch and kick ball.	Foot ball, games involving	Muscular strength.
Show agility in climbing.	bat and ball. Access to climbing frame, ropes etc	
Cut with scissors.	Materials for cutting, sticking.	Fine hand movements, creative play.
Copy and trace shapes.	Wooden templates, tracing activities.	Refinement in use of pencil & crayon.
Sort and compare materials string beads.	Threading beads and sorting materials.	Fine observation of details. Fine finger movements.
Complete more complex jig saws.	Increasingly difficult puzzles.	Distinguishing simple shapes & colours. Problem solving & development of speech.
Show awarenss of numbers.	Number dominoes and simple games involving dice and counting.	Understanding numbers and simple games with rules.
Draw a simple person.	Paints, paper, brushes	Being creative.

When a child can	Provide	To encourage
Make believe and show imaginative play especially with others.	Play group or other group experience. More varied. "dressing-up", small objects for "pretend" - small dolls, people. Larger props for group domestic play shops.	Development of language and co-operation. Planning more elaborate games and acting our real life situations.
	4-5 years	
Skip, hop	Skipping rope and hop-scotch mat.	Better control of muscles and limbs strengthening of muscles. singing games, balance.
Copy shapes and letters.	Magnetic letters, Letter shaps. Chalk black board. Tracing maze patterns.	Recognising letters and simple spelling. More precise control in writing.
Plan and build constructively	Layout and creative kits. playmats. farms, zoos garages train, layouts.	Practice in planning construction- use of language to plan and explain actions - to self and others.
Understand the rules of games - become competitive.	Simple competitive games- snakes and ladders, draughts, noughts & crosses, racing games, hide and seek.	Practice in winning and losing, strategy - taking position of the other persons.

After five Years the child is capable of doing most of jumping, running, drawing.

Table-4: Showing the abilities of a child at different ages (3-6 years).

EPILOGUE

The present study was aimed at:

1. Evaluating the effectiveness of noise waking play materials in the identification of hearing impaired children between 3-6 years, and
2. To guide the parents in selection of these materials and activities in rehabilitation of these children.

Ten noise making play materials with the peak frequency of 500-8000 Hz and with the peak intensity of 60 - 80 dB were chosen after spectral analysis. Ten hearing impaired children aged between 3-6 years were screened using these noise making play materials and using audiometers. The responses were compared.

Later these ten noise making play materials were distributed to five normal hearing and five hearing impaired children. A questionnaire was distributed along with these materials. The parents were asked to observe the play of their children with these materials and complete the questionnaire. The parents were also interviewed to cross check the information contained in the questionnaire.

The findings of the present study are -

1) Noise making play materials are useful in the identification of hearing impaired children aged between 3-6 years.

2. The information obtained through questionnaire and interview was utilised in guiding the parents in selection of materials and activities for rehabilitation of these children.

Limitations and Recommendations:

Play materials available in different regions could be collected and subjected to similar measurements and analysis.

Periodical reevaluation of the play materials could be done to assess the reliability of the output.

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APPENDIX

QUESTIONNAIRE

Name of the Child:

1) Name the toys which your child favoured to play with?

2)You child liked to play with the toy because of its-

- **attractiveness**
- **sound it makes**
- **it is Movable**
- **it produces a light flash**
- **others (specify)**

(Tick wherever appropriate)

3) Was any toy rejected by your child. ***Yes/No.***

4) If yes, the reason could be

- **he/she has outgrown the toy**
- **he/she is too young for the toy**
- **he/she does not have the dexterity to manupulate/ operate the toy**
- **Others (specify).**

(Tick wherever appropriate)

5) Your child played with the toy for

- **10 minutes**
- **more than ten minutes (specify)**
- **less than 10 minutes**

6) your child played with the toy

- alone
- with his siblings
- with peers of his age
- with an elder person (specify)

7) Was the toy used to teach

- colours
- numbers
- shapes
- body parts
- others (specify)

8) If you intend to buy a new toy for your child, would you prefer

- a toy of the child's choice
- educable toys
- others (specify)

9) What criteria would you use to choose the toy

- cost of toy
- attractiveness of toy
- durability of toy
- noise it makes
- others (specify)

10) Would you prefer any particular manufacturing company and why?