THE EFFECTS OF NOISE ON THE PERFORMANCE OF SELECTED MENTAL AND MOTOR TASKS IN CHILDREN

By
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D E D I C A T E D

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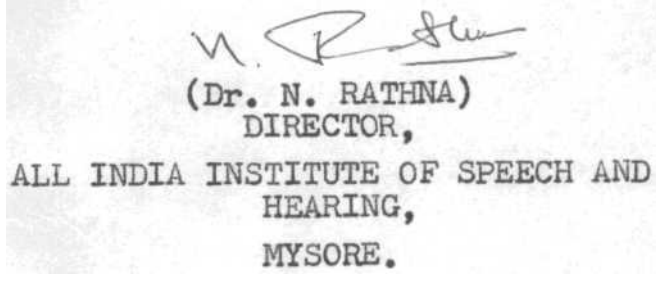
MY B E L 0 V E D P A R E N T S

C E R T I F I C A T E

THIS IS TO CERTIFY THAT

the independent Project work entitled "THE EFFECTS OF NOISE ON THE PERFORMANCE OF SELECTED MENTAL AND MOTOR TASKS IN CHILDREN" is the bonafide work in part fulfilment of M.Sc. I Year in Speech and Hearing, of the student with Register Number



(Dr. N. RATHNA)
DIRECTOR,
ALL INDIA INSTITUTE OF SPEECH AND HEARING,
MYSORE.

C E R T I F I C A T E

THIS IS TO CERTIFY THAT

the independent Project work entitled "THE EFFECTS OF NOISE ON THE PERFORMANCE OF SELECTED MENTAL AND MOTOR TASKS IN CHILDREN" was done under my guidance.

Dr. (Miss) SHAILAJA NIKAM,
GUIDE
PROFESSOR & HEAD,
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D E C L A R A T I 0 N

This independent Project is the result of my own work undertaken under the guidance of Dr. (Miss) SHAILAJA NIKAM, Professor & Head, Department of Audiology, All India Institute of Speech & Hearing, Mysore, and has not been submitted earlier at any other University for any other Diploma or Degree.

Mysore,

Dated: REG.NO:

A C K N O W L E D G E M E N T

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C 0 N T E N T S

C H A P T E R - I

INTRODUCTION:

A simple definition of noise is that, it is an "unwanted sound". Noise is undesirable and is in itself of no use to man. Yet he has to live in the noisy environment. It is impractical to eradicate noise or take away man from its totality.

It is necessary for man to realize the effect of stimuli such as noise which he just ignores as being irrelevant. Thus we are left with only two alternatives, either we have to control the noise or pay a heavy price of the consequences. It is therefore very essential to know the adverse effects of noise, so that attempts can be made to control or minimize it.

According to W.H.O., noise effects are typically delineated into following categories:-

1. Physiological
2. Psychological
3. Sociological and
4. Psycho-acoustical.

In the present study more emphasis has been placed on psychological effects of noise, particularly on mental and motor abilities. Introspection reveals that noise affects human behavior besides his auditory and other physiological aspects. It is obvious from a consideration of the masking effects of noise that any task, be it mental (involving

primarily muscular activity and secondarily thinking) that requires the perception of auditory signals for correct performance, will be adversely affected by noise. It is obvious that the effects of noise on man's non-auditory systems, are sufficient to have significant effects on mental or motor - tasks that does not require audition for its performance. Sometimes noise serves as an arousal stimulus and therefore can enhance performance.

Attempts to show the effects of noise on performance of several tasks have yielded very few generalizable conclusions. Some studies report performance losses due to noise; but others have reported no such losses or perhaps an improvement or no effects. (Kryter, 1950; Oltman, 1964; Weinstein and Mackenzie, 1966; Houston and Jones, 1969; O'Malley and Poplawsky, 1971; Harris, 1972; Hartely and Adams, 1974; Hartely and Carpenter, 1974; O'Malley and Gallas, 1977; Ogden, Rieck and Coates, 1979; Kryter and Poza, 1980). One of the drawbacks of these studies in studying noise effects on performance is, most of them were conducted in laboratory conditions which often failed to depict the real life situation. Another disadvantage is most of the studies reported are on adults and can be criticized on a methodological basis. (Broadbent, 1961).

Need for the study: When one goes through the literature on the effects of noise on mental and motor task, studies carried out in this area in case of children is found to be limited. The results obtained in adults cannot be generalized to children for the following reasons:

It is possible that the adverse effects of noise are greater in case of children than adults, since they may not be as skilled as adults on both motor and mental tasks under even quiet conditions. Introduction of noise could further hinder their performance. In addition they may be more distractible to the introduction of additional stimuli such as noise. Also, they may not be adopted to the presence of noise as the adults may be. Thus the effects of noise may not be the same in children as in adults.

So the present study was designed to determine the effects of "speech-babble noise" on the performance of a mental and a motor task in children of age ranging from 9 to 12 years by using a "digit cancellation test" (which is a test of concentration involving less motor ability) and "tapping test" (which is a highly repetitive motor task). The main reason for using a "Speech-Babble noise" in this study was that this type of noise is often encountered in the daily life conditions.

This study aimed at answering the following questions:

1) Does the presence of noise significantly affect the performance of children on a mental task?

2) Does the introduction of noise significantly affect the performance of children on a Motor task?

3) Is there is significant age difference in the performance of the two tasks under quiet and in noise?

C H A P T E R - II

REVIEW OF LITERATURE

Several studies have been carried out to evaluate the effects of noise on mental and Motor tasks, particularly in adults. Literature available on the effects of noise on the performance of mental and motor tasks in children are scanty.

Some of the investigators have studied the effects of noise on the performance of mental task alone or motor task alone or both. But clear cut conclusions cannot drawn with regard to the effects of noise on behavior, especially on the performance of mental and motor tasks.

Studies on Mental tasks:

Studies on the effects of noise on the performance of mental task, using attention tests, reaction time tasks, memory tasks, have been conducted by several investigators. Some of them report improvement in the performance and some of them report decrement or no change in the performance of mental tasks under noise.

Effects of noise on attention tasks:

Oltman (1964) reported that, the performance of the subjects were better under noise (presented at a high but not painful intensity) than under no noise conditions on the

rod and frame test because of narrowed attention. The difference between the noise and the no-noise group on the color naming task although significant, was far less than that on the stroop test is an evidence that the difference on the stroop-test was not due merely to an increase in speed or vigor of responding caused by the noise.

In support to the above study, the effects of various types of noise (sound of trains, gibberish, electronic music) on stroop-test performance was investigated by Houston and Jones (1969). The subjects were specifically instructed to ignore the noise. They found that subjects assigned to the noise condition performed significantly "better" on the stroop test than did control subjects to whom no-noise was presented. They interpreted their results as reflecting an interaction between inhibitory processes. The authors (Houston and Jones, 1969) hypothesized that inhibiting a response to one source of distracting stimuli (the conflicting color names in the stroop test) regardless of the arousal effects of the noise used in their study. The non-significant difference on the color naming task was attributed by (Houston and Jones, 1969), to the fact that the task does not require the inhibition of a strong relevant response. Voluntary concentration on the relevant task would lead to the reduction in awareness of irrelevant peripheral stimuli.

O'Malley and Poplawsky (1971) attempted to investigate

the effects of intermittent noise upon attention span in two experiments i.e., by giving serial anticipation task and stroop-color-word test at four-levels of noise (no noise, 75 dB SPL, 85 dB SPL, and 100 dB SPL). Subjects were observed to perform better under noise (85 dB SPL and 100 dB SPL) than under quiet condition indicating a focusing (narrowing) of attention due to noise-induced arousal in both the experiments. The results are inagreement with other investigations conducted by Oltman (1964); Houston and Jones (1969); Houston (1969).

By using a non-interference test and two versions of the stroop-color-word interference test, to test subjects in loud noise and quiet, Hartely and Adams (1974) found that the brief exposure to noise was beneficial and decreased interference. Long exposure increased interference, suggesting a cumulative adverse effect of noise.

Noise can function as a distractor or a behavioral arouser. When 30 male under-graduate students were tested to find out the effects of white noise on four-attention tasks, subjects with low anxiety improved with noise while moderately anxious subjects' performance deteriorated with noise and the performance of highly anxious subjects remained same (Basow, 1974). These findings were also supported by several investigators. (O'Malley and Poplowsky, 1971; Warners and Hemistra, 1971)

Investigations were done on the effects of emotional arousal as induced by broad-band noise, upon breadth of attention by using four intensity levels i.e., no noise, 75 dB SPL, 85 dB SPL, and 100 dB SPL (O'Malley and Gallas, 1977). The tasks were stroop-color-word test, rod and frame test which require narrowed attention and third was Tsai-Partington Pathway test, required broader attention. Arousal level did not significantly affect the performance on the rod - and - frame test or the pathway test. A complex relationship between arousal level and stroop performance was obtained. It was found that the performance of the group exposed to 85 dB SPL noise was superior to that of the other group which did not differ significantly from one another (O'Malley and Gallas, 1977).

Investigations on the effects of continuous and time varied broad-band noise on the performance of a stroop-type color-word test and a related task in both low noise (65 dB A) and high noise (85 dB A) was conducted by Ogden, Rieck and Coates,(1979). They found that the median re-action time in the word-reading task were uneffected by either noise intensity or the time varied aspects of the noise. However, median reaction times in the color-naming task were significantly elevated in the 85 dB-A noise con-dition. Also reacti on - times in the high aperiodic noise condition, were significantly elevated relative to

the continuous and periodic noise conditions. Ogden, Rieck and Coates, attributed this to the arousal effect.

Effects of noise on reaction time:

Similar to the other studies, many studies on the effects of noise on reaction time tasks were carried out. The reaction time tasks were performed somewhat better in noise than in the quiet, condition, but a greater percentage of people showed better performance in quiet than in the presence of noise. This is inconsistency follows ofcourse, from the fact that one or two of the subjects contributed very heavily to the effor scores under noise, (Gramaldi, 1958).

Hartely (1974) tested subjects on five-choice test of serial reaction under intermittent, continuous broad-band noise and also while wearing ear protecting device under continuous noise. Performance was affected under both continous and intermittent noise condition. Gaps in performance during intermittent noise were approximately half of those in continuous noise. Errors were affected equally and adversely by both intermitt and continuous noise. Ear protection interacted with noise and time-on-task, reducing gaps in the noise in the first half but not the second half of the test. The improvement of performance when noise was intermittent was attributed to a reduction

in the monotony experienced during a long exposure to continuous noise. The value of ear-protection was attributed to a reduction in perceived loudness and prevention of temporary arousal following the onset of noise (Hartley, 1974).

Similar study was carried out by Hartley and Carpenter (1974), by comparing the performance of varieties of tasks with head phone and free field noise condition. It was found that the impairment of performance occured in both noise conditions, but indicated a tendency for head phone noise to have larger effect on gaps and for free field noise to have larger effect on errors, deprivation and to annoyance effects of noise. Harcum and Monti (1973) using visual and card-sorting task, found no effects of 100 dB SPL ambient noised per se., although cognitive variables in the testing situation affected both performance and ratings of disturbance.

In a similar manner, Wynn (1977) tried to examine the effects of 85 dB intermittent noise on recognition of visual stimuli by using random shapes. It was reported that, subjects were not immediately aroused upon perceiving a noise but after a short period of time elapsed (approximately 0.4 sec). Wynn also showed that (a) subject who heard a noise immediately before viewing each of ten-random shapes could later recognize more of those shapes than could subjects who either heard the noise during the visual display or heard no noise at all and (b) that the subjects who heard the noise

during the visual display could perform no better than those who heard no noise.

Effects of noise on cancellation tasks:

Sanders (1961) found no difference in errors made on cancellation test (subjects crossed out certain numbers and dots on sheets with many numbers and dots) between a steady noise condition 90 dB SPL (18 tones 85-1360 HZ) and the same noise varying interval from 65-95 dB SPL with an average level of 75 dB SPL. There was some indication of greater variability during the varying noise which would suggest agreement with the distraction arousal compensation hypothesis.

A similar technique, by using a letter cancellation test was used by Bailey, Patchet and Whisell (1978). They tested 40 subjects, asking them to strike-out the letter "e" in a type written passage for nine-minutes under conditions of "no noise" or "continuous" 95 dB white noise or 95 dB white noise presented in "regular time pattern" or 95 dB white noise presented in an irregular time pattern. The noise conditions made no difference to the performance of the task except during the second or third minute interval of nine minutes period when patterened noise had an inhibitory effect on the volume of material scanned but a facilitatory effect on accuracy of performance.

The findings of Baily, Patchet and Whisell (1978) study

supports the observation made by McBain (1961), that with the exposure to noise (recorded Speech played in reverse), a significant improvement in performance in terms of errors made in the task was seen. In other words the number of errors were reduced in noise relative to the number obtained in the quiet, when performing a monotonous task hand printing of pair of letters. These findings were attributed to the arousal response in the presence of noise.

But Harris (1972) tried to determine whether high intensity broad-band noise (105 dB) has an effect on human performance when special conditions related to type of task, length of testing, and intensity of noise exposure are met. Three groups of twenty subjects were tested on a "serial search task". The first group was presented continuous broad band noise, the second received intermittent noise and the third served as a control group. It was found that, the group that performed with noise, produced approximately the same results. There was no significant difference between the effects of intermittent and continuous noise on performance.

However, the findings of Poulton (1978) revealed that, the performance increased under noise and it seems to be beneficial increase in arousal when the noise is first switched 'on', which gradually lessons and falls below normal to produce decrement in performance when the noise is switched off.

Effects of noise on Arithmetic tasks:

Several studies have been conducted on the effects of noise on arithmetic tasks. Park and Payne (1963) attempted to find out the effects of noise on performing division problems in the presence of 98 dB - 108 dB SPL of noise and under condition of room noise. Under each condition, one group of subjects worked "easy" problems and another group worked "difficult" problems, intense noise produced no effect on mean number of problems correctly solved. Variability of performance was significantly greater with easy problems under intense noise conditions than under room noise conditions, although there was no difference with difficult problem. There was no evidence of decrimental in performance within the twenty minutes session attributable to noise level.

But these findings were contradictory to the results obtained in Woodhead's (1964) study on change in the performance of arithmetic task following a one-second burst of noise at 60 dB SPL. In comparison with quiet condition, the occurance of a brief noise produced a tendency to get the subsequent calculation wrong. When the noise occured during calculating period, the rate of work increased throughout the session from a rather slow start.

The performance on the mental task under noise can be completely affected if the subjects had to concentrate more.

Ishikawa and Aoki (1974) studied the effects of recorded car noise (80 phon SPL) on three mental tasks (successive multiplication, problem solving and four alternative reaction time tasks) using 145 College and high School students. The attitude of students on noise as revealed by questionnaires is that the students concentration was disturbed by noise. The result of the experiment also showed that noise interfered with the performance of each task to a certain degree.

In another study Benigus et al (1975) attempted to find out the effect of low frequency (11.5 - 350 HZ) noise on 27 male subjects in a numeric monitoring task with a noise level at moderate SPL (SO dB). More, numeric signals were missed during 'noise' than during the'control' runs. The effects of noise seem limited to monitoring - type task and to mental arithmetic (Loeb and Alluisi, 1971).

Effects of noise on memory tasks:

The effects of white noise on performance of a short-term memory task (repeating four digit numbers) was investigated in 9-11 years old boys. It was found that the increase in the noise level decreased the performance of younger children relative to that of the older subjects (Fenton, Alley and Smith, 1974).

Similarly on the tasks like proof reading and recall, no effects of noise was found. But subjects worked more

slowly initially, less steadily and more accurately under noise than quiet period (Weinstein, 1974). This contradicted the previous findings.

The effects that noise everts is observed to vary with the personality of the individual. Exposure to noise affects the performance on the mental task, more negatively in the more annoyed individuals than in the less annoyed individuals.

Arvidsson and Lindvall (1978) made an attempt to find out the effect of 85 dB(A) traffic noise on performance on an arithmetic test. The results indicate that the annoyance - inclined individuals in a community may constitute a special risk group that will suffer more from the adverse effects of community noise.

It was also found that the subjects with low anxiety improved with noise while moderately anxious subjects performance on mental tasks deteriorated with noise and the performance of highly anxious subjects remained same (Basow,

Studies on Motor tasks:-

Effects of noise on various types of Motor tasks have been studied by several investigators. But clear cut conclusion cannot be drawn regarding the effects of noise on motor tasks.

Weinstein and Mackenzie (1966) noted a faster performance on the Minnesota rate of manipulation test under white noise (100 dB) than under quiet. This result was attributed to noise-induced arousal.

Similarly the effects of sound on creative performance was carried out by Kaltsounis (1973). He compared the scores on simple creative task (ex: Figure completion) of fifteen male, fifth graders under four-sound conditions (Quiet, Speech, Music and Industrial noise). Subjects performed better under music condition than the industrial noise condition.

Effects of noise on Psychomotor tasks:

When one goes through the studies on the effects of noise on Psychomotor tasks, some of them indicate improvement others show a decrement or yet others report of no change in the performance of psychomotor task.

Ohwaki (1960) found no significant effects of interrupted noise of 60 and 80 phons on psycho-motor test. (Pursuit rotor and finger dexterity) but some degrading effects of the 80 phon noise on a group doing mental word formation. However, selection and matching of subjects assigned to the different control and experimental groups may have contributed to some unknown error to the test. Psychomotor performance was initially superior under, 80 dB

of noise but later the performance was superior in silent condition. Presumably the noise was initially arousing, aiding performance but later it became distracting, hindering the performance (Ohwaki, 1960).

It was observed that, 85 dB(A) turboprop air craft noise had no significant effect on psychomotor performance (Pierson, 1973). The findings of Fierson (1973) can be supported by the observation made by Kryter and Poza(1980) that, no increase in physiological stress or in errors in task performance during the noise as compared to the quiet test segment. When the subjects were exposed to alternative conditions of quiet and noise (computer line printer noise at 100 dB A) while performing a demanding, rapidly paced psychomotor task for eight minutes.

Effects of noise on both mental and motor task:

Some investigators have studied the effects of noise on both mental and motor task and have compared the effects.

Broadbent (1958), Brewer and Briess (1960). Helper (1957), Loeb et al (1956), Miller (1957), Smith (1951), Plutchik (1961), Saul and Jaffe (1955), Sanders (1961), Park and Payne (1963), found that steady state or interrupted noise upto level of 120 dB or so had no overage discrenible effects on the performance of a wide variety of memtal and motor tasks, although some of these investigators

did find somewhat greater variability in noise than in quiet. Smith (1951) carried out a study on the effects of intermittent loudnoise on the performance of mental and motor task, by administering the number checking list test first, the name checking test second and the form bard test last. The intensity of the noise was 102 dB with the spectrum being essentially flat between 100 - 3000 CPS. The difference in the performance were quite consistent. In each test the experimental group attempted more items, got more item correct, and got more items incorrect, however, in the experimental group the percentage of accuracy was lower. It has thus been found that the effect upon short-term mental performance of burst or noise is to increase the quantity and decreases the quality of response. But these effects are of such magnitude that it is practically negligible (Smith, 1951).

The performance on vigilance task, mirror - tracing task and anagram-solving task was slightly poorer in intense background noise than in quiet conditions (Cohen et al 1966). All differences were statistically insignificant. It was also found that the poor performance also seemed to be characteristic of more introverted individual. Whereas those subjects classified by the personality tests by being normal, performed slightly better in the high than the low noise level (Cohen et al. 1966).

A study on the effects of noise (120 and 140 dB SPL) on mental and motor performance using a visual task and a handtool - dexterity test was conducted by Harris (1968). The noise via loudspeaker was presented equal at ear drums (the listeners wore ear-plugs in both ears) or unequal (the listeners wore ear plugs in both ears and a muff over one ear), these conditions were called symmetrical and asymmetrical respectively.

It was seen that exposure at 120 dB noise level, the symmetrical and a symmetrical exposure cause about the same degradation (time taken to complete) in the task. When the noise level was 140 dB, poor performance was seen in hand-tool dexterity test which involves more proprioceptive activity, than visual task which involves little proprioceptive activity.

It was concluded that symmetrical noise was more bothersome to the hand-tool dexterity task than visual task. But a symmetry of aural stimulation would appeared to have affected the mental test more than the task requiring some proprioceptive involvement. The general increase (which for unknown reason is greater with symmetrical noise) in errors on the mental task was off set by an increase in the number of tests completed (in agreement with the kind of result obtained by Woodhead). So that the number of correct items for the noise condition

remained about the same. The increase in time required to complete the hand-tool-dexterity test items appears to be manipulated at higher level of noise (Harris, 1968).

From the literature, it can be noted that clear-cut conclusion cannot be drawn with regard to the effects of noise on behavior, especially on the mental and motor performance, because of the following factors:-

(1) Difference in the sound level used by different experimenters (Broadbent, 1958, 1961; Park and Payne, 1963; Woodhead, 1969; O'Malley and Poplowsky, 1971; Kryter, 1970; Basow, 1974; O'Malley and Gallas, 1971) and the variations in terms of frequency of the noise used (Broadbent, 1958; Benigus, 1975; Key and Payne, 1981). According to Broadbent (1961), noise must reach approximately 90 dB before it affects non-auditory work. Noise with frequencies above 2000 HZ have a greater effect than low frequencies on the performance.

(2) Differences in the content and difficulty of the task; Performance depends on complexity of the task, and whether it involves more attention, or if it is monotonous task (Easterbrook, 1959). Easier tasks were less affected than more difficult ones. Greater the familiarity of the task, higher was vulnerability to noise (Broadbent, 1958; Jerison, 1959; Park and Payne, 1963; Mohon, 1972). The effect of noise

on repititive work may increase as the task loses it novelity and the power of absorbing attention (Wilkinson, 1963). Voluntary concentration on the relevant task would lead to reduction in awareness of irrelevant peripheral stimuli. The effects of noise appears to be limited to monitoring-type-task and to mental arithmetic (Loeb and Alluisi, 1971).

Sometimes even for a long monotonous task some types of noise can produce improvement in performance. This is probably due to increase in arousal. (Kirk and Hecht, 1963; Warners and Hemistra, 1972).

(3) Way of presenting noise, duration of testing under noise, continuous or interrupted noise or patterened noise, types of noise used (Ex: White noise, Air craft noise, Speech noise, etc.) (Smith, 1951; Broadbent, 1958; McBain, 1961; Weinstein and Mackenzie, 1966; Harris, 1972; Hartely and Adams, 1974; Theologous, 1974; Benigus, 1975; Wynn, 1977).

(4) Differences in the instructions given: Deceptive instruction may be necessary in studies of noise (Harcum, 1973).

(5) Incentives given or not: Wilkinson (1963) found that noise impaired performance when incentives were high.

Hence, most of the time the results are contradictory.

C H A P T E R - III

M E T H O D O L O G Y

The study was designed to investigate the effects of noise on a mental and a motor task in children.

Subjects:- Sixty children, in the age range of 9-12 years were taken. They were divided into three age groups, each group containing 20 children (10 males and 10 females).

The 'First' group consisted of children aged 9-10 years. The 'Second' group included children in the age range of 10-11 years and the children aged 11-12 years constituted the 'Third' group.

The subjects had to meet the following criteria in order to be selected for the study:

(1) Subjects had to have normal hearing in both the ears, through air conduction in the frequency range of 250 HZ - 8000 HZ at octave intervals. The subjects were screened at 20 dB HL (ANSI, 1969) in the above said frequency range. For this purpose, a portable audiometer (Maico MA-27) was used with TDH-39 ear phones embedded in MX-41/AR ear cushions. The audiometer was calibrated to ANSI (1969) standards.

(2) Subjects had to have an IQ of at least 90 as determined on the Seguin Form Board (S.F.B.) and Developmental

Screening Test (D.S.T.).

Materials:-

(1) Digit Cancellation Test: It is a test of concentration. Here, numbers from 1-9 are arranged in a random order in rows. The subjects had to go through each row and cancel the number "9" with a pen as he/she read along. The subject was asked to follow the rows horizontally and work as fast as he/she could, under both quiet and in noise conditions. This test was used to find out the difference in the performance of a mental task under quiet and in noise.

(2) Tapping Board:- A tapping board with a stylus connected to digital counter was used. It worked on D.C. supply. The subjects had to hold the stylus like "holding a pen" and go on tapping with the stylus under both quiet and in noise conditions. The number of tappings were displayed in the digital counter. This test was used to find out the difference in the performance of a motor task under quiet and in noise.

A stop watch (Racer-Angleo-Swiss) was used to keep the time alloted to each subject.

Noise:- "Speech-Babble Noise" was used in this study. Three male speakers and 3 female speakers were asked to read the passages in their respective languages. The speakers were

asked to read the passage aloud and to maintain the level of reading as monitored on the VU-Meter of the tape-recorder. Recording was done in a sound treated room with all speakers standing in a semicircle in front of the microphone at a distance of about 2 feet.

This choral reading was recorded on a cassette tape, using a cassett deck (Cosmic, CO-88 XD) with a microphone (Philips LBD-8202). The noise was recorded for a duration of about 15 minutes.

The average level of the noise was then determined, using a graphic level recorder (B & K 2305). Any deviations in the peak, were within ± 2 dB with reference to average level of the noise. A 1000 HZ tone was recorded at the beginning of the tape at the average level of the noise.

The output level of the noise from the tape recorder at different volume settings was determined using a cassette tape recorder (Sony cassette corder, TC 95 A) and the same tape recorder was used to present the noise during the data collection.

The output noise level was measured using a sound level meter (B & K 2209) with a condensor Microphone (B & K 4144) along with an adaptor (DB 0962) for one inch Microphone at a distance of 3 ft from the tape recorder kept at the same height from the ground in front of the

Microphone. A noise level of 85 dB was emitted by the tape recorder at a volume setting of "3".

Test Procedure:-

To begin with, the subjects were screened for hearing and intelligence. Those children who passed in screening were included in the study.

Then the performance of each child was studied on the two tasks, i.e., Digit Cancellation Test (Task-I) and Tapping Test (Task-II) under quiet and in noise condition. The two tasks under quiet and in noise were presented in a random order. A quiet room in the School served as the testing site. Each child was seated on a bench before the desk, comfortably. The tape recorder was kept at a distance of 3 ft from the child directly in front of him/her. The tape recorder was kept at the ear level of the subjects.

The volume setting of the tape recorder was kept at "3" which corresponded to a level of 85 dB SPL.

Task - I: Each subject was given a type written "digit cancellation test". The subject had to go through each row and cancel the number "9" with a pen, as he read along. Each subjects had to carry out the task under quiet and in noise conditions for two minutes. The stop watch was switched 'on' to keep the alloted time. The first minute performance was considered as practice trial and the second minute

performance was considered for scoring.

Each subject was instructed separately for the two experimental conditions viz., in quiet and in the presence of noise.

Instructions Riven for Task-I:

Under "Quiet" condition:

"Some numbers are given below. Please go through each row and cancel the number "9" as you read along. Please follow the rows horizontally and work as fast as you can. When I say "start" you should start cancelling the digits. And when I say "stop" you should stop cancelling the digits. In between a marking will be made and you should continue to cancel without stopping and keep in mind that you should not work in a reverse order".

Under "Noise" condition:

"Some numbers are given below. Please go through each row and cancel the number "9" as you read along. Please follow the rows horizontally and work as fast as you can. There will be some noise, coming from the tape recorder. Do not attend to it and ignore that noise. When I say "start" you start cancelling the digits and when I say "stop" you should stop cancelling the digits. In between a marking will be made and you should continue to cancel without stoping and also you should not work in reverse order".

Task - II : Each subject was made to sit comfortably on the bench and the tapping board was placed in front of him over the desk within his reach. Then the subject was asked to tap with the given stylus. The digital counter was kept facing the tester, so that the subject was unaware of the digital display. Each subject had to carry out the task in quiet and under noise conditions for two minutes. Since the first minute performance was considered as practice trial, the second minute performance was considered for scoring. Each subject was instructed separately for the two experimental conditions viz., under quiet and in presence of noise.

Instructions given for Task-II:

Under Quiet:- "This is a tapping board. Please hold the stylus like you hold a pen and go on tapping continuously as fast as you can. When I say "start" you should start tapping immediately and when I say "stop" you have to stop tapping".

Under Noise:- "This is a tapping board. Please hold the stylus like you hold a pen and go on tapping continuously on the tapping board as fast as you can. There will be some noise from the tape recorder while tapping. Do not attend to it and ignore that noise. When I say "start" you should start tapping immediately and when I say "stop" you should stop tapping.

Scoring:-

Task-I: Scoring for the digit cancellation test was done by computing the correct scores and the error scores. In computing the correct scores, the number of 9's correctly cancelled was taken into consideration. In case of error scores, the wrong cancellations and the number of 9's un-cancelled were taken into consideration. Since the first minute performance was considered as practice trial, scoring was done only for the second minute performance. The number of attempts made by the subject refers to the total number of digits scanned and cancelled by the subjects.

Task-II: Here the number of tapping per minute were noted down which was displayed in the counter. Since the first minute performance was considered as practice trial, scoring was done only for the second minute performance.

T A B L E - I

Means and standard deviation (S.D.) of the correct scores obtained on the digit cancellation test (Task-I) under Quiet and Noise conditions by the three groups.

AGE	QUIET		NOISE		LEVEL OF SIGNIFI-CANCE
	Mean "C_Q"	S.D.	Mean"C_N"	S.D.	
	24.8		27.8		P<0.05
10-11 years	30.2	5.4 6.8	32.6	5.86 5.88	N.S.
11-12 years	35.5	6.81	36.8	7.23	N.S.

NOTE: N.S. is, statistically insignificant.

P<0.05 is, statistically significant at 0.05 level.

C_Q = Correct scores under Quiet.

C_N = Correct scores under Noise.

T A B L E -II

The range in the error scores obtained on the digit cancellation test (Task-I) under Quiet and Noise conditions for the three groups

AGE	QUIET "E_Q"	NOISE "E_N"
9-10 yrs	0-7	0-7
10-11 "	0-14	0-5
	0-9	
11-12 "		0-9

NOTE: E_Q = Errors under Quiet.

E_N = Errors under Noise.

T A B L E -III

Mean number of attempts and the mean correct scores obtained from the digit cancellation test (Task-I) under Quiet & Noise conditions for the three groups:

AGE	Q U I E T		N O I S E	
	ATTEMPTS	Mean "C_Q"	ATTEMPTS	Mean "C_N"
9-10 years	26.6	24.8	29.1	27.8
10-11 years	33.2	30.2	34.8	32.6
11-12 years	38.3	35.5	39.8	36.8

NOTE: C_Q = Correct scores under Quiet.

C_N = Correct scores under Noise.

T A B L E -IV

Means and standard deviation (S.D.) of the tapping scores obtained on the tapping test (Task-11) under Quiet and Noise conditions by the three groups:

A G E	QUIET		NOISE		LEVEL OF SIGNIFI-CANCE
	Mean "T_Q"	S. D.	Mean "T_N"	S. D.	
9-10 years	239.6	47.1	243.4	37.6	N.S.
10-11 years	266.3	34.9	274.8	35.7	P < 0.05
11-12 years	273.5	33.4	283.9	30.9	P < 0.05

NOTE: N.S. is, statistically insignificant.

P< 0.05 is, statistically significant at 0.05 level.

T_Q = Tapping scores under Quiet.

T_N = Tapping scores under Noise.

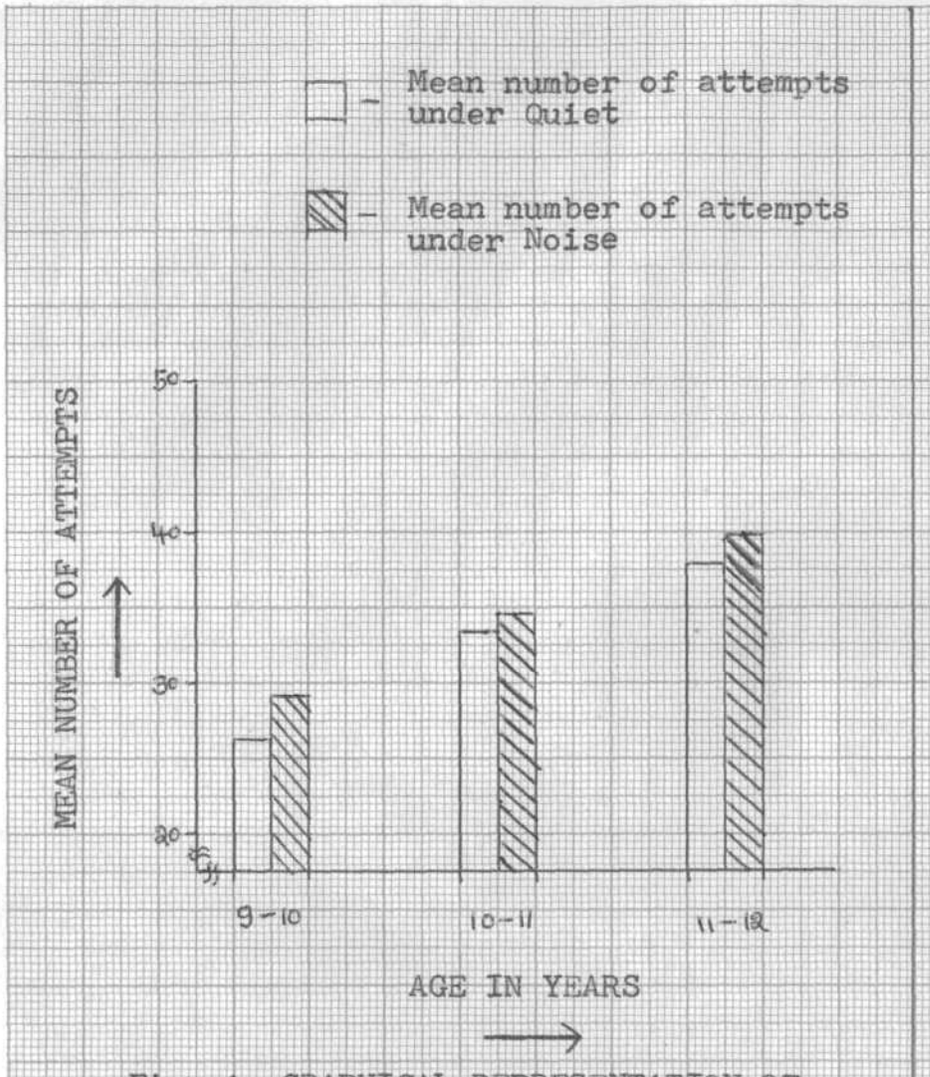

Fig: 1. GRAPHICAL REPRESENTATION OF NUMBER OF ATTEMPTS MADE UNDER QUIET & IN PRESENCE OF NOISE FOR THE THREE GROUPS.

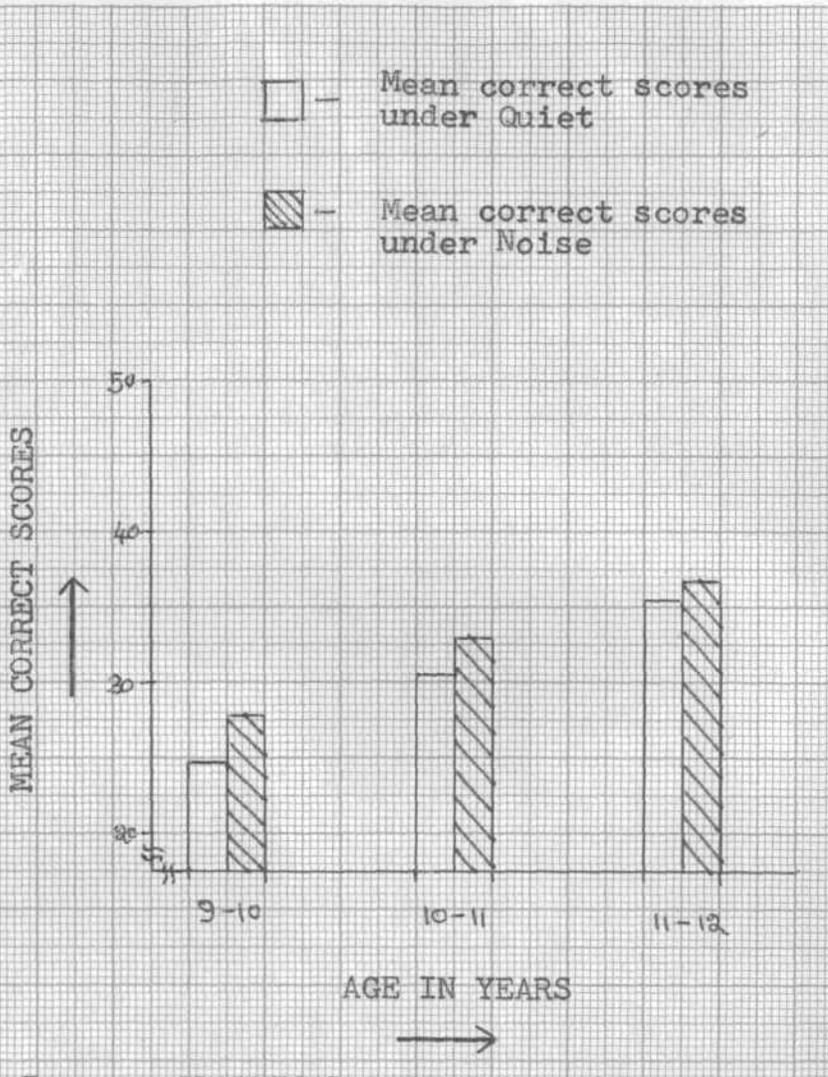

Fig: 2. GRAPHICAL REPRESENTATION OF MEAN CORRECT SCORES UNDER QUIET AND IN PRESENCE OF NOISE FOR THE THREE GROUPS.

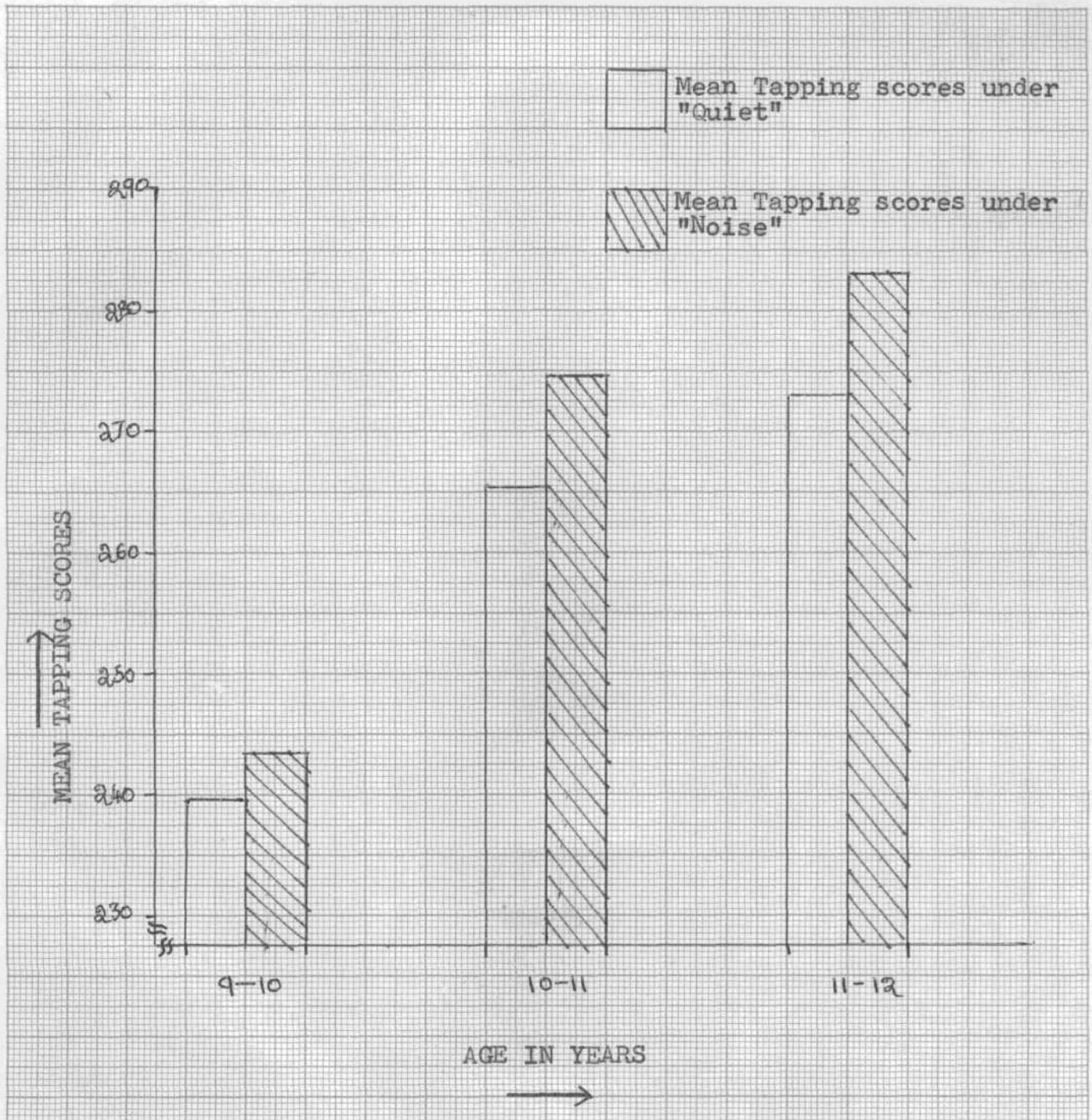

Fig: 3. GRAPHICAL REPRESENTATION OF MEAN TAPPING SCORES UNDER QUIET & NOISE CONDITIONS FOR THE THREE GROUPS.

C H A P T E R - IV

R E S U L T S AND D I S C U S S I O N

R E S U L T S :

Task - I: The mean correct scores, their S.D. and the ranges in the errors obtained from the digit cancellation test under quiet and noise condition for different age groups are shown in Table-I and Table-II respectively. Statistical difference in the performance between under quiet and in noise for each age group is also presented.

Then, the mean number of attempts made (i.e. the total number of digits cancelled) and the mean correct scores under quiet and noise condition for different age groups is also represented in Table-III. The results obtained are also represented graphically.

Task - II: Table-IV summarizes the mean number of tapping and their S.D. obtained from the tapping test under quiet and noise for different age groups.

Statistical difference for the performance between quiet and noise for each age group is also presented. The results are also represented graphically.

By looking at the Tables I, III and IV it can be observed that, the general performance on both the tasks is increased under "noise" condition for all the 3 age groups. This is also represented graphically.Wilcoxon signed rank test was used to determine the significance of difference between the scors under quiet and Noise coditions (conovers,

In Task-I, the difference in the performance under "quiet" and "noise" condition was statistically significant ($P < 0.05$) in the 9-10 years age group, but was not significant in the

higher age groups.

If can be observed from Tables III and II respectively, that the mean number of attempts made and the mean correct score under noise condition is greater than that of quiet, and also the errors committed under noise is less when compared to quiet condition for all the 3 age groups. Another observation that is made from Table-III is, with increase in age, the performance increases under Doth the conditions. In other words there is increase in the number of attempts made (i.e., the total number of digits cancelled), the correct score and increase in errors committed with increase in age under both quiet and noise conditions.

The difference in the performance on Task-II under quiet and noise condition was statistically significant ($P < 0.05$) in the 10-11 & 11-12 years age group, but not in the first group.

From the Table-IV, it can be observed that the number of tappings under "noise" is "greater" than that in "quiet" condition for all the 3 age groups.

Another observation that can be made from perusing Table-IV is, with increase in age, the performance increases under both the conditions. In other words, there is increase in number of tappings done with increase in age, under both quiet and noise conditions.

Thus, from the results obtained, it can be said in

general that, there is a greater improvement in the motor task under noise (Task-I, which is a highly repetitive motor task) than in mental task (Task-II, which involves much of mental ability than the motor ability).

D I S C U S S I O N : The results obtained in the present study points out that there is a general increase in performance in both mental and motor tasks, under "noise" in all the three age groups, which can be attributed to noise - induced arousal which is also reported by many investigators. (McBain, 1961;0ltmann, 1964; Weinstein and MacKenzie, 1966; Poulton, 1978; Ogden, Rieck and Coates, 1979)

In case of Task-1 (Digit Cancellation Test), the performance increased under noise than in quiet conditions in all the three age groups but significant improvement was seen in 9-10 years old group but not in the older age groups, in terms of number of attempts made and the number of digits cancelled correctly. This improvement can be attributed to the arousal reaction. It was also noticed that the number of correct cancellation done is more in noise, with errors made remaining the same under both quiet and in noise conditions.

Increased arousal has lead to superior performance on the digit cancellation test which requires the subject to concentrate on the task. Increase in emotional arousal causes a narrowing of attention. This also supports the findings of other investigators (Oltman, 1964; O'Malley & Poplowsky, 1971).

It can also be noticed that, there is no difference in errors made under both quiet and in noise condition in 9-10 and 11-12 years old groups. But the range of error scores is high under quiet particularly in 10-11 years old groups, and the reason for this is one or 2 subjects contributed heavily to the error scores under quiet. There is some indications of greater variability in performance under noise condition which would suggest agreement with distraction arousal compensation hypothesis (Sanders, 1961).

The absence of significant difference in the performance of mental task in the higher age groups under quiet and noise can be attributed to -

1) the simplicity of the task. Easier tasks are known to be less affected by noise than more difficult ones.(Broadbent, 1955);
2) noise level used might have been low to bring about a significant effect (arousal);
3) duration of testing was short and therefore no effect was observed;
4) amount of motivation, anxiety in subjects i.e., personality characteristics can also be attributed to the no effect on performance.

Now coming to the Task-II, (tapping test which is highly." repititive motor task, does not involve much mental ability) there is increase in the performance under "noise" in all the three age groups, but significant improvement in the performance

was seen in higher age groups i.e., 10-11 and 11-12 year old children.

Here, noise has not caused interference, rather it has facilitated the performance in motor task. This increase in performance in highly repititive motor task which is a monotonous task, can be attributed to noise - induced arousal, and these findings extend support to other investigations. (McBain, 1961; Weinstein and Mackenzie, 1966)

Noise may carry greater quality of urgency and continue to act as an arousal stimulus. The introduction of noise might have caused more anxiety in children which resulted in better performance in both mental and motor tasks. But this does not support the findings of Barrett (1950); Shambaugh (1950) and Smith (1974); Bailey, Patchett and Whisell (1978).

The absence of significant effect of noise on motor ability in 9-10 years age group can be attributed to some of the reasons as said earlier like simplicity of the task, noise level used, duration of testing, amount of motivation, anxiety in subjects, personality aspects of the individuals.

Usually "arousal" is viewed as necessary for good performance and therefore the noise could be beneficial to performance Noise can thus be 'beneficial' if it is arousing and stimulating, and 'deletrious' if it is distracting, over-arousing, or startling.

Another aspect that can be brought to notice is the

increase in performance of motor and mental task (under both quiet and in noise) with respect to increase in age. This can be attributed to their maturity.

In conclusion, it can be said that 'noise' facilitated more on the performance of motor task than the mental task in children.

C H A P T E R - V

S U M M A R Y A N D C 0 N C L U S I 0 N

Noise is an unwanted sound which is undesirable and is of no use to man.Studies on the effect of noise on mental and motor tasks in children are limited. The effects of noise may not be the same in children as in adults.

So the present study aimed to determine the effects of "Speech Babble noise of 85 dB SPL on the performance of a mental task (digit cancellation test) and a motor task (Tapping test) in children. Sixty children who had normal intelligence and normal hearing age ranging from 9-12 years were divided into 3 age groups (9-10, 10-11 and 11-12 years). The two tasks in quiet and under noise conditions were randomly presented to the subjects.

The results in the present study indicated that performance in the mental and motor tasks increased under noise condition in all the 3 age groups which was attributed to the noise-induced arousal. The greater variability in the performance under noise condition can be attributed to the distraction - arousal hypothesis (Sanders 1961).

In case of mental task the improvement in the performance is because of emotional arousal which results in narrowing of

attention. Whereas in the case of motor task, noise may carry greater quality of urgency and continue to act as arousing stimuli.

In conclusion, it can be said that noise facilitates more in the performance of motor task than the mental task.

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