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AUTHOR Meyer, Jo Ann; Wurster, Stanley R.
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ABSTRACT

For this study, a 5th and 6th grade team taught classroom of 66 children was chosen. Three equivalent groups of 22 children each were matched on the basis of a pretest in math. Each group was given a different noise level treatment: quiet (45-55 decibels), average (55-70 decibels), and noisy (75-90 decibels). A tape recording of actual classroom noise was used for the average and noisy treatments and a soundproof room was used for the quiet treatment. The noise treatments were randomly assigned to each group. Math computation and reading sections of the Metropolitan Achievement Test, Form G, provided the study tasks. Measurements of task attention were taken every two minutes using a criterion for task attention. An analysis of variance showed no significant difference in the groups either in task attention or in math and reading performance. (Author/MLF)

THE EFFECT OF THREE NOISE LEVELS ON TASK ATTENTION AND PERFORMANCE IN READING AND MATH WITH FIFTH AND SIXTH GRADE CHILDREN

by

JO ANN MEYER
GRADUATE STUDENT
ARIZONA STATE UNIVERSITY

AND

STANLEY R. WURSTER, Ed.D.
ASSISTANT PROFESSOR
ARIZONA STATE UNIVERSITY

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CHAPTER 1

INTRODUCTION

The acoustical environment of the classroom has become an issue of increasing interest to educators. Many of the new educational facilities that are being built today are using the open school concept or double classroom.

In many older school buildings walls have been removed to provide open spaces for team teaching and flexible grouping. In many cases these older buildings have no carpeting or acoustical tile. An individualized instructional program is often used where movement around the room by the children is necessary to find and check assignments and to use the various instructional materials. Activity type of instruction is also frequently used. All of these conditions contribute to a higher noise level than you might find in a single classroom or under a more traditional type of instruction. Does this increased noise level have a significant effect on children's task attention and performance?

Much of the existing research on the effect of noise on human performance has used adult subjects and laboratory conditions. The planning of teaching methods and educational facilities based upon these studies may be somewhat misleading. There is a need for more research in this area using a realistic school environment and children instead of adults.

The purpose of this study was to determine the effect of three noise levels on task attention and task performance during math and reading periods with fifth and sixth grade students using a realistic environmental setting.

Hypotheses:

(1) The three noise levels will have no significant effect on task attention during a math period with fifth and sixth grade students.

(2) The three noise levels will have no significant effect on task performance during a math period with fifth and sixth grade students.

(3) The three noise levels will have no significant effect on task attention during a reading period with fifth and sixth grade students.

(4) The three noise levels will have no significant effect on task performance during a reading period with fifth and sixth grade students.

A level of probability of .05 was accepted as significant for the purpose of this study.

REVIEW OF RELATED RESEARCH

The effects of noise on human performance has been an area of conflicting reports and research studies for over twenty years. Researchers such as Broadbent, (2) Jerison, (6) and Boggs and Simon (1) have reported detrimental effects of noise upon performance. Other researchers, such as McCarthy, (7) Slater, (11) Sanders, (9) and Park and Payne (8) have reported either questionable results or no evidence of a detrimental noise effect.

In an experimental study by Slater (11) on the effects of noise on pupil performance, it was found that there was no detrimental effect on their work. The subjects used were 129 male and 134 female seventh grade public school children. They were divided into eight groups by matching on the basis of a pretest, I. Q., socioeconomic status, and achievement. Each group had almost an equal number of males and females. The testing condition was randomly assigned to each of the groups. Three levels of noise were used: quiet (45-55 decibels), average (55-70 decibels), and noisy (75-90 decibels). The criterion of pupil performance was two written tasks. One consisted of the STEP Reading Test, Form 3. The other consisted of homework. Five groups had the test and three groups had homework assignments. The content of the homework assignments was not defined. There were two groups for each noise level, one with the homework assignment as their task and the other with the reading test as their task. Groups 7 and 8 were called the experimental sections and were tested on a soundproof stage instead of in a regular classroom. Group 7 was given the quiet level noise treatment and group 8 the noisy level treatment. Both of these groups were given the reading test as ...ir task.

The results showed that noise had no detrimental effect on the performance of the students, nor did it assist their performance. Slater concluded that children's tested performance on reading comprehension tasks is not affected by the peaks of noise which are typical of a normal school environment. (11:242)

McCarthy (7) did a study on the effects of a constant meaningless noise on high achievers in the sixth grade while learning a task requiring the use of short term memory. The sixth grade students from Milton Jr. High School, Milton, Pennsylvania who had the 80 highest mean scores on the Metropolitan Achievement Test Form D were randomly placed in groups of easy or difficult tasks and in one of the following decibel level groups of meaningless noise: 0, 40, 55, 70, 85.

The study was run for three days. Each day the subjects received a set of instructions in their homeroom. When they arrived at the testing room, the noise was already playing. After completing the learning task and test, the subjects returned to their original classes.

The learning tasks were taken from Archer's Meaningfulness of all possible CVC Trigrams. A tape recording of a constant white noise (meaningless noise) was used and earphones were used by the subjects in the 0 decibel level group to eliminate all noise.

The results showed that performance on both difficult and easy learning tasks was highest at the 55 decibel level for a constant white noise. This tends to indicate that students learn best with a moderate amount of noise (55 decibels) rather than no noise (0 decibels), or with an excessive amount of noise (85 decibels).

In an experimental study by Canon (3) two types of auditory stimuli were used; a social distractor (female voice telling a story) and an impersonal distractor composed of nonhuman sound effects. The sample population was twenty boys and twenty girls who were randomly selected from the fourth grade. One-half of the group of 40 students were socially isolated for a period of twenty minutes prior to working on a concept utilization task. This task consisted of finding an underlined symbol such as MN or Nn on a master card and then looking through the following three cards and marking the same symbol when it was found. The subjects were randomly assigned to either isolation or non-isolation for twenty minutes. There were ten males and ten females in each of the two groups.

The results showed that isolation preceding performance led to an increase in the disruptive effect of the social distractor. This was shown by an increase in task errors. However, the nonhuman distractor did not lower the performance of the isolated subjects. According to Canon, the subjects were paying more attention to the content of the human voice distractor than were those subjects who heard only impersonal sounds. (3:595)

In a causal-comparative study by D. Sanders (10) noise levels were measured and compared in different types of schools; kindergartens, elementary schools, and high schools. The sound level readings were taken during actual class periods while the teacher was not talking. Many readings were taken and a wide range of activities were represented in the different types of schools. He studied a total of 15 schools, comprising 47 classrooms. The noise levels in unoccupied classrooms were found to be higher than the recommended figure of 35-40 decibels. The mean noise level in an empty elementary classroom was 56 decibels. The readings taken in occupied elementary and high schools were found to be below 65 decibels for more than 60 percent of the time.

Sanders felt that much of this noise could be reduced by bringing attention to banging doors, the movement of furniture, and the unnecessary movement of children. He also found that kindergartens are considerably higher in noise levels (about 65 decibels for 71 percent of the time) than elementary and high schools. In all of the schools it was the noise from within the classrooms that was responsible for the high noise levels recorded.

A. Sanders (9) found in an experimental study that varying noise levels showed more effect on performance than a steady noise level. Sanders was studying the influence of noise on two discrimination tasks. Forty Air Force recruits served as subjects. The varying noise levels were as follows: one had randomly varied tones with extremes at 90 and 65 decibels and the steady noise was of 70 decibels intensity. Both types of noise were presented by headphones. The tasks were variations of two psychological tests frequently used in Holland, the Bourdon-Wiersma Cancelling Test and the Kraepelin Addition Test. Each test lasted half an hour. The subjects were randomly divided into four groups. Each group completed two tasks under the two noise conditions.

The findings indicated that the subjects could endure the varying noise for a time but that after a few minutes its effects began to show a detrimental effect on performance. This finding was in line with other research studies suggesting that changing noise is more harmful to performance than continuous noise.

Broadbent (2) concluded in his study that the effect of noise on an intellectual task was quite apparent. Two noise levels were used: relative quiet (70 decibels) and noise (100 decibels). The volunteer subjects were divided into three groups randomly. One group performed the task in 70 decibels of noise on both days. Another group had 70 decibels of noise on the first day and 100 decibels of noise on the second day. The third group had 100 decibels of noise on the first day and 70 decibels on the second. The noise was defined as uninterrupted, equal energy per octave, machinery noise. (2:825)

The subject was to view a six digit number until he remembered it, then push a button and a four digit number would appear. His task was to subtract the second number from the first one and write down the answer. This cycle was repeated thirty times.

Broadbent found that in the first session the noise group was slower in solving the problems than the quiet group. A similar difference appeared the second day, but those who had previously worked in noise on the first day were much slower than those who had not. Therefore, Broadbent concluded that there may be harmful after effects from noise.

Three experimental studies by Jerison (6) researched the effects of noise on human performance. The performance that was studied was non-auditory and the subjects were paid volunteer male undergraduates. In all three experiments, the subjects were randomly assigned to two groups. Two noise levels were used: 80 decibels represented quiet and 110 decibels represented noise. On the first experiment the dependent variable was vigilance. The subjects were to monitor a panel of clocks and to press a response switch under a clock when its hand stopped through twice its usual excursion. Changes in alertness were found after one and one-half hours in noise, though none were found in quiet.

The second experiment involved complex mental counting. The subjects had to count three flashing lights and maintain separate counts for each light. The results showed that counting under the quiet condition first and the noise second helped them to maintain their original performance. Those who worked in the noise first showed a decline of performance.

The third experiment concerned time judgment. The subjects were to press a telegraph key when they judged ten minutes had passed. The results showed that under the quiet condition the subjects responded every nine minutes, and under the noise condition they responded every seven minutes. Jerison concluded that noise produced readily measurable changes in human performance.

Park and Payne (8) studied noise and its effects on the difficulty of task in performing division. The subjects used were forty male college students who were volunteers. They were divided into four groups on the basis of a five minute pretest in math.

Two of the groups worked easy (E) division problems and the other two groups worked more difficult (D) division problems. One E and one D group worked their problems at the same time at room noise level (50-70 decibels). The other E and D group worked their problems in noise of 98-108 decibels that was produced by an air horn. The variability of performance was significantly greater with easy problems under the noise condition than under room noise conditions. With difficult problems, there was no difference in performance between the two noise conditions. Park and Payne reported that these findings were not in agreement with previous research by Broadbent.

In an experimental study done recently by Finkelman and Glass (4) predictable noise and its effect on human performance was studied. The subjects were twenty-three volunteers from the undergraduate program of a university. The effects of differentially predictable noise on human performance was measured by means of a subsidiary task technique. The noise consisted of two levels: predictable noise and unpredictable noise. The unpredictable noise was of the same type as the predictable noise but it consisted of random duration and distribution throughout the tasks. The performance had two parts. The primary task was called compensatory step-function tracking and was similar to a vehicle steering simulation machine. The subjects were supposed to center a vertical line on the display. As a subsidiary task, they were required to recall a previously announced digit upon presentation of the subsequent digit. Each trial consisted of 60 random digits. The design consisted of nine conditions and each was presented two times.

The use of unpredictable noise resulted in performance degradation on the subsidiary task. Predictable noise in combination with only one of the tasks was not enough to occupy the full channel capacity of the subject, therefore there were no observable degradations in performance. Each subject was observed individually.

Boggs and Simon (1) did an experimental study on the effect of noise on tasks of varying complexity. They used 48 subjects who performed on 1 of 2 complexity levels of a 4 choice reaction-time task; and at the same time, performed a secondary auditory monitoring task. All subjects performed in both quiet and in noise. There were two levels of noise used: One called quiet and the other was an intermittent annoying noise.

The primary task was a four-choice reaction-time task in which subjects, after being alerted by a green warning light, responded as quickly as they could to the onset of one of the four red stimulus lights by pressing the appropriate button below it. In the complex condition there was no spatial correspondence between light and switch. Before the experiment began, they were told which button to push when each light came on. The researchers did not identify the population or define the noise in terms of decibels.

The effect of noise on attention was studied by Woodhead (13) 1966. She used seventy-two volunteer sailors for subjects. They were randomly assigned to four groups of 18 but tested individually. The subjects were to look at four letters from the alphabet; CRX and J and remember them. Then they were given a list of letters and instructed to cross off these letters whenever they appeared and to count the number of times each appeared. The directions given to two of the groups emphasized memorizing the number of letters. One of these groups was exposed to bursts of loud noises of 105 decibels and the other to average noise of 68 decibels. The directions given to the other two groups emphasized searching. These two groups were exposed to the same bursts of noise.

When the instructions emphasized searching, there were no significant differences between the noise levels. However, the two groups with the emphasis on memorizing showed some changes in responses. The direction of the change was for improved memorizing at the expense of searching. Woodhead concluded that it was possible for noise to induce a shift in the attention needed to respond equally often in two activities. When this happens, attention is likely to shift toward the preferred activity. (13:298)

SUMMARY

The studies by McCarthy (7) Slater (11) and Canon (3) all used children as subjects; however, only Slater used a task similar to that occurring in an actual classroom. None of these studies used the type of noise which children usually encounter in a normal school day.

While it might be interesting to prove that meaningless noise, transmitted by earphones, to subjects working in isolation chambers caused a deterioration in performance; it would not have much meaning for teachers whose children are not equipped with earphones, and who do not work in isolation chambers.

To be of value to educators, more research needs to be done in this area using a more realistic environment; for example, an actual classroom setting, tasks similar to school routine, and noise comparable to that encountered by children during school activities.

CHAPTER III

RESEARCH METHODS

Subjects: A combination fifth and sixth grade team teaching classroom at Emerson School in Mesa, Arizona was selected for the study. There were 29 fifth graders and 37 sixth graders for a total of 66 children. No distinction was made between the two grade levels by the two teachers.

The class consisted of 35 girls and 31 boys and their ages ranged from 10 years 7 months to 13 years 3 months. Their intelligence scores as measured by the Otis-Lennon Mental Ability Test ranged from 75 to 150. Their reading levels at the beginning of the school year as measured by the Gates McGinitie Reading Test ranged from 1.2 to 12.0. There were no children with hearing deficiencies.

Most of the students came from an average or above average level of income home. Many of the parents were college graduates and most of the children had attended Emerson School from the first grade.

Grouping: One week prior to the experiment, the Math Computation section of the Metropolitan Achievement Test, Form H, was given to each subject. The total number of correct responses on this pretest was used in a matching process to form three equivalent math groups of 22 subjects each.

The matching process was repeated a second time using the Reading section of the Metropolitan Achievement Test, Form H. On the basis of the total number of correct responses on the Reading pretest, three equivalent reading groups of 22 each were formed.

After the matching process, an analysis of variance showed there was no significant difference between the groups.

Task: The Math Computation and the Reading sections of the Metropolitan Achievement Test, Form G, were used as the tasks for the math and reading portions of the experiment.

The reliability of the Metropolitan Achievement Test was measured by use of the split half method. In carrying out tests on item analysis and standardization 50,000 pupils from 25 different school systems who had an IQ of 100 on the Otis-Lennon Mental Ability Test were used. Different geographic regions, size of schools and cities, and socioeconomic status were taken into consideration. The established content validity had been judged valid for the Mesa School District.

Noise Conditions: Sound pressure levels in A weighted decibels (dB A)* were used throughout the study. The following noise level conditions were used:

Quiet Noise	45 - 55 decibels
Average Noise	55 - 70 decibels
Noisy Noise	75 - 90 decibels

These noise conditions were selected to avoid exceeding the minimum and maximum limits which might occur within a school environment and are consistent with other group noise studies. (11) (7)

Each group received one noise level treatment. The noise levels were randomly assigned to the groups. A soundproof room in the school Media Center was used for the testing. The room itself combined with no talking or movement by the subjects provided the quiet level.

A tape recording of actual classroom noise was made in advance and edited so there was no distinct sound that could be identified with any particular student or teacher. Using a Bruel Kjaer 2203 Precision Sound Level Meter and the testing room filled with 22 children who were

* DB A measures are the weighted or filtered acoustical measures which most closely approximate the human ear's frequency response.

not being used for the experiment, the decibel level of the room and the volume level of the tape recorder were calibrated. The researcher was assisted in the sound level readings by Robert Martin, an Audiologist, from the Speech and Hearing Department at Arizona State University. The noise conditions for each group are presented in Table I.

TABLE I TESTING CONDITIONS BY GROUP

Group	Task	Noise Condition	Day	Time
M1	Math	Quiet	Monday	8:30
M2	Math	Average	Tuesday	8:30
M3	Math	Noisy	Wednesday	8:30
R1	Reading	Quiet	Monday	9:30
R2	Reading	Average	Tuesday	9:30
R3	Reading	Noisy	Wednesday	9:30

Task Attention: Measurements of task attention were taken every two minutes using the following criteria: (5:138-139)

1. Eye attention
   a. Child's eyes must be on task or teacher when:
      1. Teacher talking to class
      2. Teacher talking to him individually or helping him
      3. Child doing an assignment at his desk

      Note: Eyes do not shift to folders, box, etc., during a task unless these are being employed during task. No loud noises or talking to others, but whispering to self permitted.
2. Head attention
   a. Child's head must be facing task when:
      1. Back turned to observer in study booth or at exploratory or order centers.

3. Body Attention

   a. Child must be sitting in chair quietly when:

      1. Hand up waiting for teacher

      2. All other waiting periods (e.g. when finished task)

4. General

   a. Child not credited when he calls out to teacher, talks to classmate during work period, or sits and plays with objects at desk.

   b. If leaves seat or room without permission, do not take frequency count until he returns.

   c. Child who holds pencil during waiting period is credited for attending unless he plays with it.

   d. Child is credited when looking at date on blackboard or any other words, etc., which teacher wrote there that are a part of the assigned task.

Research Design: There were three noise treatments used in the experiment. X_1 represents the quiet noise treatment of 45-55 decibels. X_2 represents the average noise of 55-70 decibels and X_3 represents the noisy level of 75-90 decibels. M O_1 represents the matched groups arrived at through a math and reading pretest. The following design was used:

M O_1	X_1	O_2
M O_1	X_2	O_2
M O_1	X_3	O_2

Testing Procedure: The experiment was carried out during the first and second periods on three consecutive days. Each testing period lasted twenty minutes. (Table I) Quiet and average noise conditions were run on the first and second days to avoid feedback of information from subjects [te]sted to those to be tested.

Before the testing began, tables and chairs in the conference room in the Media Center were arranged so that each subject was an equal distance away from the source of the noise. A floor plan showing the arrangement can be found in the Appendix.

The conference room in the Media Center was frequently used by this class for small group instruction. The names of the subjects for each testing period were called in the usual manner. For example: "Today, the following people will go to the Conference Room for math." Upon arriving in the testing room, instructions for completing the math or reading tasks were given. After the instructions, the noise treatment was started.

Measurements of task attention were taken on tally sheets every two minutes with the help of the other classroom teacher. A large clock on the wall with a second hand was the device used to designate when two minutes had passed. When individual subjects asked questions regarding the noise treatment, they were told to continue with their math or reading.

<u>Treatment of Data</u>: The means for the total number of correct responses for the math computation task and the reading task were computed. Analysis of variance was carried out to determine if there was a significant difference between the performance of the three groups in math. This was repeated for the three reading groups.

The number of times each subject attended to task during the twenty minute test period was totaled. The means for each group were computed and an analysis of variance was used to determine if there was a significant difference between the task attention of the three groups in math. The analysis of variance was repeated for the three reading groups.

CHAPTER IV

ANALYSIS AND RESULTS

An analysis of variance of task performance and task attention indicated no significant difference in either reading or math between the groups receiving different noise treatments. Table II summarizes the analysis of variance.

TABLE II. RESULTS OF SIGNIFICANCE TEST FOR TASK ATTENTION AND TASK PERFORMANCE FOR READING AND MATH

Dependent Variables	Group 1 Mean	Group 2 Mean	Group 3 Mean	F* Ratio
Reading Performance	27.27	28.18	29.14	.22
Reading Task Attention	8.27	8.09	8.27	.06
Math Performance	20.77	20.77	18.95	.43
Math Task Attention	9.14	8.68	8.95	.71

* 2/63 Required for .05 level, 3.15
** 2/63 Required for .01 level, 4.98

The four dependent variables for the study were task attention and performance in math and task attention and performance in reading. Group 1 Mean in the table above refers to the mean score of the group receiving the quiet noise level (45-55 decibels) treatment. Group 2 Mean refers to the mean score of the group receiving the average noise level (55-70 decibels) and Group 3 Mean refers to the mean score of the group receiving the noisy level (75-90 decibels) treatment.

The findings of this study indicated that noise had no effect on children's attention and performance on written tasks requiring reading comprehension and math computation of a limited duration of time. The null hypotheses were accepted. These results supported the findings of Slater (11) who also used a classroom environment for her study.

CHAPTER V

SUMMARY AND CONCLUSIONS

Over the past twenty years very little research has been done concerning noise in the classroom. And yet noise has become an ever present part of our lives. The purpose of this study was to determine if three levels of noise had an effect upon children's task attention and performance during reading and math periods with fifth and sixth grade students and using as realistic a school environment as possible.

A fifth and sixth grade team teaching classroom composed of 66 children was chosen for the study. Three equivalent groups of 22 children each were matched on the basis of a pretest in math. The matching process was repeated using the total correct responses from a reading pretest. Thus each subject was tested twice, once in reading and again in math. Each group was given a different noise level treatment: quiet (45-55 decibels), average (55-70 decibels) and noisy (75-90 decibels). A soundproof room in the school Media Center provided the quiet level treatment. A tape recording of actual classroom noise was used for the average and noisy treatments. The noise treatments were randomly assigned to each group. Math Computation and Reading sections of the Metropolitan Achievement Test, Form G, provided the tasks for the study. Measurements of task attention were taken every two minutes using a criterion for task attention.

An analysis of variance showed no significant difference in the groups either in task attention or performance in math and reading. The null hypotheses were accepted.

At the fifth and sixth grade level, children's attention and performance on written tasks, requiring reading comprehension and math computation, of the limited duration of a class period in length, are not affected either positively or negatively by noise which is typical of a normal school environment.

This implies that double classrooms, open area schools, and other types of schools where there is noise present are accomplishing their goals. Schools need not be quiet in order for education to be taking place.

One of the weaknesses of this study was that it had to be conducted near the end of the school year. The subjects had spent almost an entire year in a double team teaching classroom and had become accustomed to at least an average level of noise. Sound level readings taken in the classroom during a reading period measured 55 decibels and during a math period 65-70 decibels. H. R. Smith says that kids quickly learn to tune out extraneous noises in the environment. (12:80)

It is recommended for further research that a similar study be conducted to study the effects of noise on performance over a longer period of time. Future studies could also explore the effects of varying noise levels and the effects upon tasks of a different nature. A study in which individual children were allowed to choose the kind and level of noise they felt they could work under best would also be of value. There are many possibilities open to research concerning noise in the classroom.

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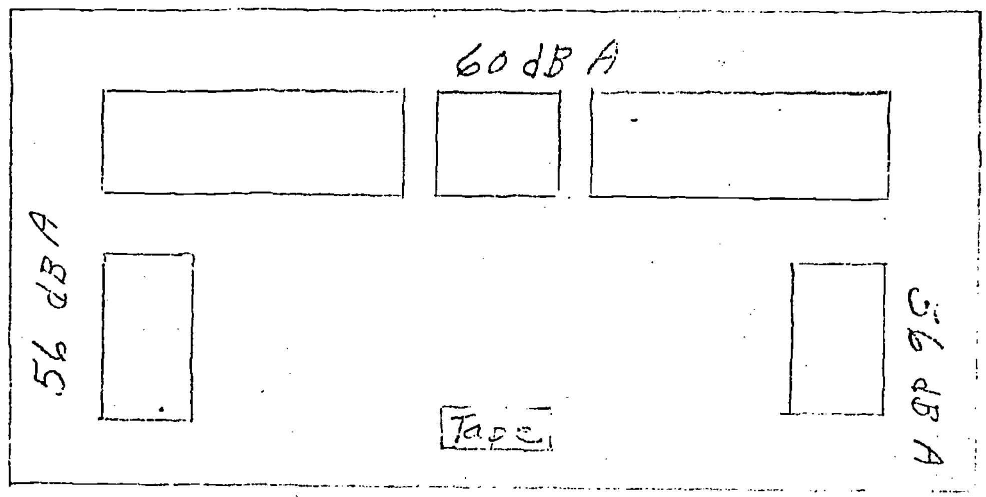
APPENDIX

APPENDIX A

ROOM ARRANGEMENT AND DECIBEL LEVEL



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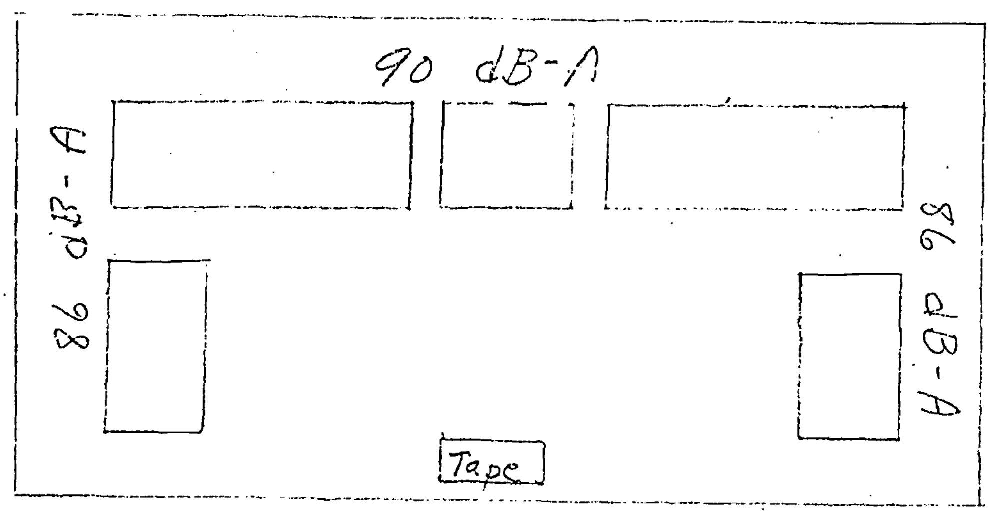

Volume Level 7

APPENDIX B

Matching Data

Math Groups

M1	M2	M3
39	28	30
33	34	33
30	30	32
26	27	26
24	23	22
24	28	28
23	23	23
20	23	21
19	19	19
17	17	17
17	16	16
16	16	16
15	15	17
15	15	13
14	14	14
13	11	9
12	11	13
10	10	11
8	7	6
21	22	22
12	17	20
5	5	6

Reading Groups

R1	R2	R3
39	39	39
34	33	33
36	42	41
36	36	36
37	37	36
31	31	31
29	29	35
28	28	28
27	27	27
25	26	27
24	24	24
23	23	22
21	20	16
20	19	19
18	18	19
17	15	17
15	15	15
14	13	13
14	14	14
12	16	9
9	9	8
6	5	8

APPENDIX C

Raw Test Scores

Math Groups

M1 Q	M2 A	M3 N
39	20	22
37	35	26
31	33	19
26	32	33
27	23	22
19	25	29
23	27	27
15	17	13
27	25	15
24	20	17
19	18	25
14	22	16
10	15	23
21	21	18
16	20	14
14	9	5
13	25	23
17	11	14
14	12	13
29	22	14
10	8	12
12	17	17

Reading Groups

R1 Q	R2 A	R3 N
40	42	37
34	42	39
40	42	44
41	38	34
36	37	36
34	30	39
31	28	39
36	26	40
31	28	27
35	39	29
19	39	28
33	29	21
28	21	23
24	27	19
28	25	24
21	19	19
15	22	24
17	14	19
22	14	24
12	28	31
16	14	33
7	16	12