AN EXPERIMENTAL STUDY OF THE EFFECTS ON ATTENDANCE TO A VISUAL TASK WHEN AUDITORY MASKING IS USED IN A VARIABLE ENVIRONMENTAL SETTING

A DISSERTATION

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We hereby recommend that the dissertation prepared under our supervision by E. Elizabeth Walters entitled An Experimental Study of the Effects on Attendance to a Visual Task When Auditory Masking is used in a Variable Environmental Setting.

be accepted as fulfilling this part of the requirements for the Degree of Doctor of Philosophy

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Chapter I

The Problem and Procedure

In almost every classroom there is at least one student who has difficulty in completing assignments due to his inability to focus his attention to the learning task in the classroom setting. He may be able to complete his assignments at home or in a one-to-one situation but he has great difficulty when the environment presents conflicting stimuli. In extreme cases a student may be unable to work anywhere except in the most controlled environment. It would seem that to date most classroom teachers have not only been unable to provide such an environment but with "open classrooms" becoming more prevalent the problem is even more acute.

While it is true that visual stimuli may be controlled by screens, little has been devised for auditory control save carpeting the floors and soundproofing clinic rooms. These measures provide some control but are expensive, and seldom found in the regular classroom. An inexpensive, practical means of providing some control of auditory input without completely closing off the auditory canal would be a useful adjunct to the instructional program.

Statement of the Problem

The problem was to devise a means of alleviating the detrimental effects of a noisy environmental setting which, for distractible students, is inconducive to learning.

It was the primary purpose of this study to measure the effects on "attendance to a visual task" when auditory masking was used to screen out meaningful sounds.

In order to determine the relative efficiency of the experimental treatments, the relationships between the dependent variables (attendance to a visual task under various experimental conditions) and the following independent variables were explored: a) intelligence, b) mental age, c) chronological age, and d) Key Math Scores.

A secondary purpose was to formulate a method of predicting treatment effect through statistical analysis of the independent variables.

Hypotheses

1. There is no significant difference between raw gain scores obtained by a subject in Treatment One (visual task without auditory input) and Treatment Two (visual task with meaningful background noise).
2. There is no significant difference between raw gain scores obtained by subjects in Treatment Two (visual task

with meaningful background noise) and Treatment Three (visual task with meaningful background noise and auditory masking).

3. There is no significant difference between raw gain scores obtained by subjects in Treatment Two (visual task with meaningful background noise) and Treatment Four (visual task in the classroom setting and auditory masking).
4. There is no significant difference between raw gain scores obtained by a subject in Treatment One (visual task without auditory input) and Treatment Three (visual task with meaningful background noise and auditory masking).
5. There is no significant difference between raw gain scores obtained by a subject in Treatment One (visual task without auditory input) and Treatment Four (visual task in the classroom setting and auditory masking).
6. There is no significant difference between raw gain scores obtained by a subject in Treatment One (visual task without auditory input) and Treatment Five (visual task in the classroom setting).
7. There is no significant difference between raw gain scores obtained by a subject in Treatment Two (visual task with meaningful background noise) and Treatment Five (visual task in the classroom setting).

8. There is no significant difference between raw gain scores obtained by a subject in Treatment Three (visual task with meaningful background noise and auditory masking) and Treatment Five (visual task in the classroom setting).

9. There is no significant difference between raw gain scores obtained by a subject in Treatment Four (visual task in the classroom setting and auditory masking) and Treatment Five (visual task in the classroom setting).

10. There is no significant difference between raw gain scores obtained by a subject in Treatment Three (visual task with meaningful background noise and auditory masking) and Treatment Four (visual task in the classroom setting and auditory masking).

11. There is no significant correlation between intelligence, as measured by the WISC and Distractibility (expressed as a "difference score": $T_1 - T_2$).

12. There is no significant correlation between mental age as calculated by the WISC and Distractibility (expressed as a "difference score": $T_1 - T_2$).

13. There is no significant correlation between Key Math Scores and Distractibility (expressed as a "difference score": $T_1 - T_2$).

14. There is no significant correlation between Chronological age and Distractibility (expressed as a "difference score": $T_1 - T_2$).
15. There is no significant correlation between intelligence as measured by the WISC and Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$).
16. There is no significant correlation between intelligence as measured by the WISC and Treatment Effect #2 (expressed as a "difference score": $T_3 - T_2$).
17. There is no significant correlation between mental age as calculated by the WISC and Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$).
18. There is no significant correlation between mental age as calculated by the WISC and Treatment Effect #2 (expressed as a "difference score": $T_3 - T_2$).
19. There is no significant correlation between chronological age and Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$).
20. There is no significant correlation between chronological age and Treatment Effect #2 (expressed as a "difference score": $T_4 - T_5$).
21. There is no significant correlation between Key Math Scores and Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$).

22. There is no significant correlation between Key Math Scores and Treatment Effect #2 (expressed as a "difference score": $T_4 - T_5$).

23. There is no significant correlation between Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$).

24. There is no significant correlation between Treatment Effect #2 (expressed as a "difference score": $T_4 - T_5$) and Distractibility (expressed as a "difference score": $T_1 - T_2$).

25. There is no significant difference between Distractibility (expressed as a "difference score": $T_1 - T_2$), Treatment Effect #1 (expressed as a difference score: $T_3 - T_2$) and Treatment Effect #2 (expressed as a difference score: $T_4 - T_5$).

Procedure

Sample

Description of the population. The setting for the study, Lewisville, Texas, had, in 1973, a population of 20,000 with the ethnic ratio of .85% American Indian; 3.5% Negro; .3% Oriental; 3% Spanish American; and 92.4% Caucasian in the public schools. The Lewisville Schools had an enrollment of 5,216 for the year 1972-73. There were approximately 1,000 third- and fourth-grade students in the regular and special education classes in the school year, 1973-74.

Sample selection. A randomly selected sample of 60 subjects was drawn from a restricted population of 175. The following criteria were used to select the population.

1) Enrollment in a third- or fourth-grade class of the Lewisville Independent School District.
2) Score 60 or above on the Wechsler Intelligence Scale for Children (WISC).
3) Referral by their teachers as having exhibited specific behaviors which, for the purposes of this study, was known as "distractibility" (Appendix A).

No subject was excluded from the study for having been retained for one or more grades. Neither was he excluded for age, sex, or ethnic origin.

Tasks

Abstract visual tasks utilizing computational math materials were selected for each subject on an individual basis. The method of selection involved the administration of the "operations" subtest of the Key Math Test (KMT). The KMT is an individually administered diagnostic math test. As such, it has behavioral objectives for each item listed in the manual and also instructional objectives for clusters of items (Appendix B).

The math materials for the tasks were matched as to the type and level of computations item for item. Sixteen levels of materials were prepared for each level from pages of computational math materials published by the Hayes Publishing Company (Appendix C). The five equivalent pages were constructed by re-arrangement of the problems on the page.

Pre-test of Materials

Matching task and subject. The materials were pre-tested in two stages. The first stage was to ascertain the most appropriate level of math material according to the scores obtained on the KMT. The "Operations" subtest of the KMT was administered. After scoring to find the basal level, which was actually three consecutively correct responses each at a different level of difficulty, it was used to select the appropriate math materials.

Task difficulty and consistency of response. Tasks for all three basal levels were tested for consistency of response. Since the score was to be the number of problems completed accurately in five minutes, it was necessary that the pupils work to capacity on all five papers. The second and third levels of the basal score proved to be mentally fatiguing to the students. The lowest level of the basal score was determined to be the most appropriate level for testing since the students worked consistently on all five parallel tasks.

<u>Equivalence of materials.</u> The second stage of pretesting consisted of testing the materials for equivalence. A different group of children were used from those used for testing for appropriate levels. The math test was administered as before and the materials were selected for each child accoring to the lowest level of his basal score. The tasks were administered under quiet conditions with a five-minute respite between tasks.

Scores from the tasks were determined by the number of problems accurately completed by the subject in five minutes multiplied by the assigned weight. Weights were determined according to the number of computations involved for each problem.

Given the criteria of appropriate level of difficulty and equal environmental conditions, the tasks were said to be equivalent when the subject's inter-task scores varied no more than 2 raw score points.

It was found that when level of difficulty had been set accurately, the number of computations varied little between tasks. When scores varied more than 2 score points, the level of difficulty was adjusted downward and equivalence was then noted.

Method

Individually prescribed visual tasks were utilized to measure the effect of the experimental treatments on the dependent variable, attendance to a visual task.

T_1 = visual task + quiet background

T_2 = visual task + meaningful background noise

T_3 = visual task + meaningful background noise auditory masking

= visual task + classroom setting + auditory masking

T_5 = visual task + classroom setting

For each subject the procedure was the same. The "Operations" subtest of the Key Math Test was administered on an individual basis. An appropriate type and level of math materials was selected by utilizing the basal score obtained.

Five equivalent pages of math materials were prepared for each level of math computations. The five equivalent pages were utilized in random order in the experimental treatments.

Headphones and cassette tapes were used for introduction of masking. A special "talk through" type of headphone was used which allowed directions to be given without removal of the headphones.

Quiet background. "Quiet background" was defined for this study as "no experimental manipulation of auditory input in the laboratory setting." No attempt was made to eliminate noises altogether. However, the laboratory setting was the same for each student. The laboratory setting was a portable trailer which was moved from school to school during the experimental study.

Meaningful background. "Meaningful background noise" was recorded in a third-grade classroom and presented in Treatments Two and Three by use of a reel-to-reel tape recorder at approximately 55 to 65dB. The same background noise was used for all subjects for Treatments Two and Three.

Auditory masking. Auditory masking is non-meaningful noise, sometimes referred to as "white noise." It was presented through special earphones which did not block sound. This allowed the background noise to be heard by the subject and also for noises in the classroom setting to be heard. The level of "white noise" was variable because it was controlled by each subject to his own degree of comfort.

Classroom setting. "Classroom setting" refers to the subject's own classroom. It was assumed that there would be some auditory interference and that by using the "white noise" to mask it in T_4, the task score in that setting would be significantly different from the scores from T_5 where no auditory masking was used.

Treatment order. All subjects received all treatments. The order of experimental treatments varied within all possible combinations with one exception. Treatment Four

(T_4) was not given in first position. The nature of the experiment was such that if directions and training had been done in a classroom, it would have been a disrupting element and hence would have invalidated the experiment. However, since the subject had already learned the procedure in the laboratory setting, he was able to enter the classroom and with a minimum of disturbance to others, do the task in the prescribed manner.

The treatments for each subject were administered within one day, and for the entire sample, within four weeks. In order to control variables; Treatment One (T_1), Treatment Two (T_2), and Treatment Three (T_3) were in a controlled laboratory setting. Treatment Four (T_4) and Treatment Five (T_5) were in the subject's own classroom, and for reasons stated previously; T_4 was presented in either the second, third, fourth, or fifth position.

<u>Criterion Scores.</u> The subject's score for each visual task was determined by multiplying the number of problems correctly solved in five minutes time by the number of computations needed for each problem. Hence, five problems such

$\begin{array}{r} 22 \\ \underline{+14} \end{array}$ would each require two computations. Five problems such (2 x 5 = 10, score of 10)

as $\begin{array}{r} 1 \\ \underline{+3} \end{array}$ would each require 1 computation. (1 x 5 = 5, score of 5)

The investigator expected that a distractible student would score highest in Treatment One, and lowest in Treatment Two or Treatment Five. It was also expected that he would score somewhat better in Treatments Three and Four than in Treatments Two and Five.

Distractibility Index. A Distractibility Index (DI) was obtained for each subject by subtracting the score obtained by the subject on T_2 from the score obtained on T_1. This DI was used to investigate interrelationships between the independent variables (Intelligence Scores, Mental Age, Chronological Age, Key Math Scores) and distractibility.

Since it was the main hypothesis of this study that a distractible student works at a reduced rate in a noisy environment, there should have been a significant difference in the number of problems solved when the student was working in a quiet environment and when he was in a noisy one.

Treatment Effects. Treatment Effect #1 (TE_1) was determined by subtracting the score obtained on T_2 from T_3.

Treatment Effect #2 (TE_2) was determined by subtracting the score obtained on T_5 from T_4.

It was expected that distractible students would be able to score higher in a masked noisy environment than in an unmasked noisy one.

The difference between TE_1 and TE_2 was that TE_1 scores were obtained in a laboratory setting and TE_2 scores were from treatments in the classroom setting. Both TE_1 and TE_2 were "difference" scores.

Analysis of the Data

A Multiple Variable Analysis based on the Gamma distribution was performed on the data. The scores are in the form of correlations between the variables.

Gamma measures the association between ordered variables. It may be applied to cross-tabulations of any size and predicts order for paired variables. It does not predict rank for each case relative to the entire set of cases. $G - \gamma$ is asymptotically normal with zero mean and variance, σ_1^2 (Goodman & Kruskal, 1963).

For a sample size of fifty, the null hypothesis is rejected 99% of the time when $\gamma \geq .60$, at least 90% of the time for $.50 \leq \gamma \leq .59$, and then at decreasing frequency as γ approaches zero (Rosenthal, 1966).

If there is a curvalinear relationship between variables, Gamma is less. Therefore, it was important to determine a linear relationship (Mueller, Schuessler, & Costner, 1970).

The Kruskal-Wallis H test (Winer, 1971) was used to test the difference between treatment levels. It utilizes the medians of each treatment level and then Grand medians of each pair-wise comparison. The chi-square distribution was then used to evaluate the differences. Yates correction term was used rather than the conventional formula. The corrected formula is a more conservative test and decreases the likelihood of rejecting the null hypothesis. All comparisons were made based on 1 df.

The association between distractibility, as measured in the study, and the various independent variables was first measured by Gamma. Also, the association of Treatment Effect #1 and #2 and the independent variables were measured in the same way. It was expected that if the resulting correlations were significant, they would then be utilized in a multiple regression formula for predicting Treatment Effectiveness from the independent variables of Intelligence Quotient, Mental Age, Chronological Age, and Key Math Scores.

Although the design was essentially a repeated measures design, the treatment levels were not additive. The usual repeated measurement design was not applicable because treatments by their design were relative contrasts. Hence, the most meaningful analysis was between specific treatment effects and distractibility. Treatment effects (TE_1, TE_2) were defined as difference scores obtained in either the laboratory setting or the classroom setting. The only meaning could come from the relative efficiency of the Treatment Effects for children identified by the study as being distractible. The degree of relationship between the Distractibility Index (DI) and Treatment Effect #1 (TE_1), and also between the Distractibility Index (DI) and Treatment Effect #2 (TE_2) was determined by the Pearson product-moment correlation coefficient.

The t test for related measures was used to test the differences between Treatment means and between DI and TE_1 and TE_2.

Chapter II

Research Related to the Study

Attention Disorders

Although several authors have written as though short attention span, distractibility and hyperactivity refer to different phenomena, differences among the behavioral aspects of these phenomena are often difficult to specify (Powers, 1967). For example, concerning the brain injured child Strauss and Kephart (1955) write:

> He finds it impossible to engage in any activity in a concentrated fashion, but is always being led aside from the task at hand by stimuli which should remain extraneous but do not...Under these conditions it would be expected that the individual would tend to respond to a variety of extraneous stimuli and lose track of the task at hand. We would describe such behavior as "distractibility" (p. 135).

Definitions. Attention span has been thought of in two ways. The first to be investigated was, "The number of distinct objects that can be perceived in a single momentary presentation"; and the second and more recent is, "The length of time a person can attend to one thing" (English & English, 1958).

In some cases, a very short attention span is simply stated as an unchanging characteristic of mental retardation with no elaboration given (Weber, 1963).

<u>Identification by observation.</u> One investigator (LaHaderne, 1968) attempted to identify "attentiveness in class" and to associate it with various attitudinal measures. Data collected from four sixth-grade classrooms were examined to determine whether children's attentiveness in class was related to their attitudes toward school or to achievement and ability. Each pupil's attention to the main class activity was recorded over a 2-month period, and questionnaires assessing the attitudes were administered. There was practically no relation between student's attitudes and measures of attention; however, a positive relationship was found between measures of attention and scores on achievement and intelligence tests.

The investigator also found a positive relationship between attentiveness and intelligence scores. She hypothesized a curvilinear relation may exist between attention and level of instruction. As the level of instruction increases in difficulty from zero, attention may also increase to an optimal point and then decrease beyond that point. That optimal point may vary with ability (LaHaderne, 1968).

<u>Identification by correlation.</u> There have been many investigations attempting to identify by specific tests those subjects characterized by behavioral aspects of an attentional deficit.

Nalven (1967) investigated the relationship between Digit Span on the WISC and distractibility as measured by the Devereux Child Behavior (DCB) Rating Scale. Subjects were 33 boys and 15 girls in residential treatment for emotional disturbance. The majority were nonpsychotic. The children were rated using the DCB by counselors and group mothers. Their WISC Digit Span and Rating were negatively significantly correlated as predicted.

Interrelationships between distractibility, attention span, field dependence, adaptive flexibility, and flexibility of closure have been studied extensively by Karp (1963), Witkin, Faterson, Goodenough and Birnbaum (1966), and Perez (1961).

The evidence from the above studies suggests considerable interrelation and overlap between measures of field dependence, flexibility of closure, and adaptive flexibility. Witkin et al. (1966) have suggested, as a basis for this overlap, that ability to overcome the effects of embedding contexts is a common requirement of tests defining each of these factors. In contrast, interpretations of flexibility of closure by Thurstone (1944) and Botzum (1951) suggest that the tests loading this factor require the subject to overcome the effects of distracting, rather than specifically embedding, contexts. The latter interpretation might imply that embedding context is but a special case of a distracting context.

Jackson (1955) administered a battery of tests to small groups of male and female subjects. The battery included the Embedded Figures Test (EBT) and a Words in Noise Test. In the latter situation, subjects were asked to identify words hidden by background "white noise." This background of noise can be viewed as providing a distracting context. Jackson obtained a significant relationship between the tests for men ($r = .46$, p $.05$) but not for women ($r = .21$). Although a different perceptual modality was used in this study, these findings offer some support for viewing embedding and distracting contexts as related.

Houston (1969) used noise to facilitate performance on the Stroop Color Word and Color Naming Tests. They hypothesized that if the subject was to inhibit the noise that he would at the same time, inhibit the interference of the peripheral extraneous stimuli of the Stroop tests. The results of the experiment were interpreted in terms of interaction and the hypothesis was supported.

A field dependent person has been identified or described as reacting more to the field than to internal direction (Witkin, 1965). If the concept of field articulation is to be applicable across modalities, then the field dependent individual should take longer to detect and report the presence or absence of the auditory signal contained in background than field independent subjects. However, Moroney and DeFazio (1966) found no differences between the two groups. They concluded that the "field-analytic approach" was erroneously generalized to include all sense modalities.

Houston (1969) reasoned that field-independent persons were able to overcome distractions by ignoring stressful stimuli and focusing attention on relevant cues. He tested his hypothesis with two groups, field-independent (FI) and field-dependent (FD). They performed first in Quiet (Q) and later in a distraction condition (D). His subjects were college students who were equated on intelligence and achievement. The tasks were three subtests, chosen because it was expected that they would be sensitive to the effects of stress. Noise was introduced as the stressful distracting condition. The results did not support his hypothesis. His subjects' performances in distracting conditions were not significantly different from their performance in quiet conditions. He concluded that field-independence is not related in a linear fashion to the capacity to ignore distracting stimuli regardless of the modality in which they occur.

Attention Deficit and Mental Disorders

A frequent complaint of psychiatric patients is that they are unable to attend to and concentrate on things (Easterbrook & Costello, 1970). Even when this is not reported by patients, it is often found to underlie his more obvious symptoms. Attention and its deficits have been the subject of much research in connection with mental disorders (Costello, 1970).

Orienting Responses (OR) are produced by stimuli that are unfamiliar. Stimuli that elicit ORs evidently reduce the breadth of attentive behavior (Treisman, 1965).

According to Soviet writers (Luria et al., 1963), ORs can be too weak or too strong. Chronic schizophrenics are reported to show weak ORs, hence weak concentration. A strong OR may extend to disorders of perceptual relativity or depersonalization.

McGhie, Chapman and Lawson (1965) found that, when either visual or auditory distractors were presented, the visual reaction time of schizophrenics was more impaired than that of normals. Similar effects of distracting extraneous stimulation were found with depressives and paranoid psychotics.

Fassler and Bryant (1972) investigated attention and performance on simple tasks as well as classroom attention of seriously disturbed communication-impaired, autistic-type children under conditions of reduced auditory input (using ear protectors) and under conditions of normal auditory input (using a placebo device). Under ear protector conditions, there was a significant increase in the amount of attention given to most of the tasks and there was significant improvement in performance on two of five tasks. In addition, teacher ratings indicated a significant improvement in classroom attention under ear protector conditions. It was concluded that a significant number of autistic-type children do improve in classroom attention and show some gains in attention and performance on certain conditions of reduced auditory input.

Payne and Caird (1967) have suggested that over-inclusive thinking, a disorder of attention, could be associated with a slow and variable reaction time because irrelevent stimulation would be attended to and processed along with relevant stimuli.

Forty-five patients (15 deluded, and 15 nondeluded schizophrenics and 15 nonschizophrenic psychiatric) were tested for simple and choice reaction times to tones with and without distracting sounds. Measures of overinclusiveness and retardation were also taken for the patients. In the absence of distracting noise, reaction time was related to retardation scores. In the presence of distracting noise, however, reaction time was closely related to overinclusive thinking scores.

Payne (1966) suggested that the distractibility of schizophrenics, particularly overinclusive schizophrenics, is because of weakness of filter, a term that was used by Broadbent (1965) in relation to selective listening.

Attention Deficit and Mental Retardation

Sen and Clarke (1969) conducted a series of studies aimed to investigate the interaction of tasks and different kinds of potentially extraneous stimuli in five inter-linked experiments each designed to clarify an issue developing out of the previous one, with the purpose of discovering particular conditions under which a retardate exhibits distraction.

The first study was designed to study the effects of meaningful relevant and meaningful irrelevant auditory distraction on a difficult picture naming task. Both types of distraction proved to cause a significant difference in picture naming. However, in correlating to intelligence, only low MAs were distracted by both conditions. High MAs were only distracted by relevant conditions.

Following experiments used only the lower MAs and attempted to answer the questions--was their greater distractibility due to the meaningful nature of the extraneous stimuli or to the difficulty level of the task. The low MAs proved to be equally distracted by several different types of stimuli. However, when the task was made very easy, none of the extraneous stimuli proved to be distracting. The ability to discriminate between relevant and irrelevant information appears to be correlated with intelligence.

Do retarded children who have been diagnosed as "brain-injured" perform differently under conditions of auditory stimulation from retarded children who have been labeled "familial?" Schoenfeld (1967) found no difference when he conducted his study using institutionalized retarded children. He hypothesized that the so called distractibility is the attempt of the brain-injured to sustain his "normal" level of stimulation and advised using an enriched environment in teaching the brain-injured retardate.

In an attempt to ascertain whether retardates are more distractible than normals, Whitman and Sprague (1968) used boys from a State School and matched them for Mental Age with boys from a kindergarten and first-grade classroom.

All subjects had to make discriminations in variable distracting conditions. The investigators (Whitman & Sprague, 1968) found a significant difference in number of correct responses. However, they did not find a significant effect of the condition by population interaction. This condition should have been present if it is indeed true that retardates are more distractible than normals and if a sensitive test is provided. The investigators believed their test to meet that condition. Their most distracting condition affected the normals more than the retardates.

A different conclusion was drawn by Follini and Sitkowski (1969) when they investigated distractibility in normals and retardates. Their experiment differed in one very important aspect. They used metronome beats to be continued and the subject was distracted by beats of a different tempo. Perhaps having the distraction and the task so nearly alike was sufficient to differentiate between the two groups. Both normals and retardates were affected by the distractions, but the retardates were more directly affected.

Do personality differences interfere with learning in a distracting condition? Howarth (1969) investigated the differences between extroverts and introverts in a learning situation under various distraction conditions. The investigators found that extroverts did overcome distractions to a greater extent than introverts in a serial learning experiment involving short-term and long-term memory.

Distractibility and Task Difficulty

Studies varying distraction conditions have had interesting results. One study (Schimek & Wachtel, 1969) used several types of subject matter for auditory distractions in an experiment which also asked the subject to participate in two tasks at once. One task was to listen and the other was to generate random letters. The listening material varied from technical (a scientific article from Time Magazine) to emotionally loaded material (a Johnson and Masters article of sexual material). One piece of listening material was simply random and non-random letters and another was a narrative piece. Unexpectedly, there was no significant difference when subjects were asked to attend and respond to two variables. There was a decrement over each when done together rather than one at a time.

The investigators (Schimek & Wachtel, 1969) found that individual differences in attention deployment are persistent through all conditions. It seemed that the conscious intention of the subject, his view of a stimulus as something irrelevant to be ignored or something to be included in the field of his attention, may be one of the most important factors in determing the distribution of his attention.

In a series of experiments with mildly, moderately, and severely retarded adults, Sen and Clark (1968) demonstrated a consistent relationship between the level of task difficulty and susceptibility to the influence of certain distracting stimuli.

In a serial learning task the experimental group under distractions consisting of words presented through earphones required 35.66 M trials to criterion while the control group required 18.56 M trials to criterion. This proved to be a significant difference. However, upon repetition of the task with the controls receiving the distraction there was no diminution of score. This, the investigators stated proved that if a task is easy, noise is no distraction.

In an experiment designed to study the effects of noise and various difficulty levels of messages, an entire seventh-grade class of 192 students was used. Hsia (1968) conducted six sub-experiments in which the stimulus material was of various levels of difficulty.

The stimuli were presented in auditory, visual and auditory-visual channels under varying noise conditions. Questions were asked following the presentation but without the noise.

Data suggested that noise affects the auditory channel more, the visual less, and the audio-visual not at all. The investigator concluded from his experiment that noise increases uncertainty, decreases information processing and reduces communication efficiency. He suggested that a solution for a receiver who must always process information in a noisy channel is to reduce noise to a tolerable level. He further found that to combat the effects of noise one could reduce the amount of input information (Hsia, 1968).

Selective Attention

Selective attention was the subject of Treisman's study (1966) in which she attempted to reconcile several theories of "attention" and thereby explain her own experiments in that area. She maintained that in selective attention three different processes emerge. She cited Cherry's (1953) experiment in which he presented his subject with two speakers and asked him to listen to only one. To make sure the subject kept his attention fixed he was to repeat what he heard in an ongoing manner. When Cherry asked about the conversation not attended, the subject would be unable to remember much of anything. The speakers even changed from English to German without the subject's being aware of it. The subject was able to notice some general physical characteristics of the unattended speech but was not aware of any of its verbal content. Treisman (1966) states,

> ...we can assume that perception of speech occurs in at least two successive stages and that the limit to our attention capacity arises chiefly at the second stage, at which we identify what is being said. Somewhere between the two stages the brain selects between the two speech messages, rejecting one, and passing the other on for further attention (p. 601).

Treisman (1966) then repeated Cherry's experiment to test whether we are able to attend to two things at once. She had her subjects attend to only one speaker but to tap whenever either conversation contained the word "tap." If our attention is limited because we are unable to do two things at once, the response would have been less for the unattended side. The latter is what happened. The signal for selective attention was a word.

The same type of experiment has been made with variations by Lawson (1964). Her subjects were to listen for "pips" in speech. The subjects were able to do equally well from both conversations. According to Treisman, the reason for this is that the brain attended to sounds at the first level but for meaning to words the attending was done at the second level. She hypothesized that the "hold-ups" in attention are caused by the number of questions that our brain must ask about raw sensory data. "This means that breakdowns will be caused not by the sheer number of stimuli, but by the number and complexity of the ways they are classified and analyzed (Treisman, 1966, p. 602)."

To investigate the possibility that there is a limited-capacity mechanism somewhere in the nervous system which disallows paying attention to two things at one time and to locate such a mechanism, Smith (1969) conducted a highly involved experiment. If a subject is presented with two signals and his deficit was at a peripheral sensory stage, he would divide his attention between them. If, however, the limited-capacity channel were at a later stage where a more detailed analysis is made of incoming stimuli, attention would be diverted to the stimulus with the most meaning. Smith hypothesized that increasing the difficulty level of one task should result in decreasing performance on the other. It did not happen. Then she increased the information content of the signals and found that as the information load of one of the signals is increased, the capacity available for dealing with the second declines, resulting in progressively worsening performance. This indicated that the limited-capacity mechanism required to process the two messages is quite centrally located.

In persons who have selective attention ability it seems that the brain has some device for rejecting sensory traffic from unwanted sources. This view of attention was first crystallized by Broadbent (1958), inspired mainly by experiments on selective listening in humans.

Treisman's (1966) hypothesis included the two types of selective attention (selection of meaning and selection of source) into one complex whole.

> This ability to block either all inputs to or selected from an analyser would allow considerable flexibility in perception. In some tasks we cannot afford to switch out an analyser completely, since we want to use it for another source. We can then select at an earlier stage in the series which stimulus we want to send to that analyser and which we do not (Treisman, 1966, p. 606).

Moray (1959) found that the un-attending ear could also attend to some simple messages such as listening for a name. Treisman (1966) analyzed that study and one of her own along the same line to mean,

> ...that selective attention might have just this effect of reducing the sensory evidence for all unattended messages to just a trickle...we can reduce the work of analysis the brain must perform

> to manageable proportions by reducing unwanted sense data to a mere trickle, and yet considerably reduce the risk of missing anything really important through inattention by setting our criterion very low for these essential sights and sounds (p. 610).

By artificially reducing the incoming to a more manageable amount, a distractible student would be able to attend to his work. It was upon this premise that "white noise" was chosen to mask the noises which plague the students who were subjects of this study.

Chapter III

Analysis of the Data

Procedure

A randomly selected sample of 53 subjects received all treatments. Order for treatments was randomized to eliminate practice effect. Tasks for each subject were selected following the administration of the Key Math Test. Each subject did five parallel tasks. The tasks consisted of math computations selected for each subject so as to assure equality of task difficulty between subjects.

The actual experimental treatments were various environmental conditions. It was hypothesized that distractible students would be able to complete more math computations in a quiet environment than in a noisy one. It was also hypothesized that by using masking in a noisy environment, the effects of the distractions would be lessened and the lessening would be reflected in higher treatment scores.

Experimental Treatments

T_1 = visual task + quiet background

T_2 = visual task + meaningful background noise

T_3 = visual task + meaningful background noise + auditory masking

T_4 = visual task + classroom setting + auditory masking

T_5 = visual task + classroom setting

A Multiple Variable Analysis (MVA) measured the degree of association between the dependent variables (T_1, T_2, T_3, T_4, T_5), and also between the independent variables (intelligence, mental age, chronological age, Key Math Scores) and Distractibility Index, Treatment Effect #1 (T_3 - T_2), and Treatment Effect #2 (T_4 - T_5).

The MVA yields a Gamma correlation and z score for each pair-wise comparison. A significant Gamma indicates a high degree of predictability in that if the investigator knows the ranking on one variable he can predict whether the ranking on the other variable will be higher or lower. It utilizes pairs of untied observations as the unit of analysis. A significant Gamma would also indicate that subjects' scores were relatively stable in their rank order between treatments. That is, if a subject ranked high on one variable he would rank high on the correlated variable.

The overall variability of the treatment levels was shown in two ways. Quantiles (Table 1) indicate the degree of variability between all treatments and the score frequencies and cumulative percentiles (Table 2) pinpoint the variation more specifically.

Table 1

COMPARISON OF TREATMENTS BY QUANTILES

	T_1	T_2	T_3	T_4	T_5
Exclusive Range	147.	128.	135.	133.	116.
Interquartile Range	35.28	31.36	34.43	40.07	35.02
Median	44.12	42.80	45.08	48.54	40.97
Q_1	34.74	30.96	32.59	33.78	32.53
Q_3	70.02	62.32	67.01	73.85	67.55

Treatment differences were measured by the t test for related measures and by the Kruskal-Wallis H test. The t test measures the individual differences between paired scores and utilizes the means as measures of central tendency. Because the scores were skewed, resulting in large standard deviations, no inferences could be made on the results of the t tests alone.

The Kruskal-Wallis H test which uses medians, is a more conservative test. It was used in this experiment because medians are relatively insensitive to skewed distributions. The chi-square distribution with 1 df is an

TABLE 2

COMPARISON OF TREATMENTS BY RANGE AND FREQUENCIES

Raw Scores	T_1			T_2			T_3			T_4			T_5		
	f	cum. f	cum. %	f	cum. f	cum. %	f	cum. f	cum. %	f	cum. f	cum. %	f	cum. f	cum. %
170	2	53	100												
160	0	51	96												
150	0	51	96	1	53	100	2	53	100	1	53	100			
140	1	51	96	1	52	98	1	51	96	2	51	99			
130	2	50	95	1	51	96	0	50	94	2	50	97	2	53	100
120	0	48	90	0	50	94	2	50	94	0	48	93	2	51	96
110	2	48	90	2	50	94	0	48	91	0	48	91	0	49	92
100	1	46	86	1	48	90	1	48	90	1	48	91	1	49	92
90	2	45	84	4	47	88	1	47	90	5	47	89	5	48	90
80	4	43	81	2	43	82	6	46	86	3	42	80	3	43	81
70	6	39	74	5	41	77	3	40	79	4	39	74	4	40	80
60	3	33	64	3	36	71	4	37	69	7	35	67	3	36	67
50	12	30	56	8	33	62	13	33	62	11	28	53	9	33	63
40	11	18	35	15	25	47	12	20	39	13	17	36	17	24	45
30	6	7	14	8	10	21	6	8	16	3	4	16	5	7	13
20	1	1	2	2	2	3	2	2	3	1	1	2	2	2	3

approximation of the sampling distribution of the H statistic (Winer, p. 849). For dependent samples, Yates correction term for discontinuity decreases the likelihood of rejecting the null hypothesis.

Conventional Formula $$X^2 = \frac{N\,(ab - bc)^2}{\sqrt{(a+b)(c+d)(a+c)(b+d)}}$$

Yates' Term $$X^2 = \frac{N\left[(ab - bc) - \frac{N}{2}\right]^2}{\sqrt{(a+b)(c+d)(a+c)(b+d)}}$$

Where,

a = number of scores of variable 1 above Grand median

b = number of scores of variable 2 above Grand median

c = number of scores of variable 1 below Grand median

d = number of scores of variable 2 below Grand median

N = Total observations

X^2 = probability that the variables are different.

To analyze the relative effectiveness of the experimental treatments for distractible students, a Pearson product-moment correlations coefficient was computed. The computations utilized the Distractibility Index, Treatment Effect #1, and Treatment Effect #2. A Distractibility Index (DI) was calculated for each student by subtracting his score on T_2 from T_1. Treatment Effect #1 was the difference between T_3 and T_2.

Treatment Effect #2 was the difference between T_4 and T_5. For example, scores for S_1 were:

$T_1 = 93$	$DI = 93 - 61 = 32$
$T_2 = 61$	$TE_1 = 69 - 61 = 8$
$T_3 = 69$	$TE_2 = 74 - 67 = 7.$
$T_4 = 74$	
$T_5 = 67$	

The DI is a negative score. It represents the number less he was able to do in noisy conditions. TE_1 is the number more he was able to do in a laboratory setting when masking was used over noise. TE_2 is the number more he was able to do in a classroom setting when masking was used.

The t test for dependent variables was used to measure the differences between DI, TE_1, and TE_2.

Comparison of Treatments

H_o 1 : There is no significant difference between raw gain scores obtained by subjects in Treatment One (visual task without auditory input) and Treatment Two (visual task with meaningful background noise).

A Gamma correlation coefficient of .737 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 2.118 for the correlation coefficient is significant at the .05 level. Order on Treatment Two can be predicted from order on Treatment One correctly, 95% of the time.

Mean raw gain score differences were measured by the t test for related measures. It uses paired differences as a unit of analysis. An observed t ($2.84, p \leq .0065$) was significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The H statistic is computed on medians rather than means and is approximated by the chi-square distribution. The Grand median for the two variables was 43.44. The medians for T_1 and T_2 were 44.12 and 42.8 respectively. For calculation of the X^2 statistic, the values were: a = 27, b = 26, c = 26, d = 27. The resulting X^2 value was not significant.

The comparisons for T_1 and T_2 have been summarized in Table 3.

TABLE 3

A COMPARISON OF TREATMENT ONE AND TREATMENT TWO

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_1	.737	2.118*	44.12	35.24	0	$P \leq 1.00$
T_2			42.8	31.36		
	Mean	**SD**	$\overline{D}$	$S_{\overline{D}}$	**t**	**p**
T_1	57.94	33.89	6.04	15.5	2.84	$p \leq .0065$**
T_2	52.00	29.94				

*significant at the .05 level.
**significant at the .01 level.

The results of the comparison on mean raw gain score differences for Treatments One and Two were statistically significant with an observed t of 2.84, $p \leq .0065$. Scores taken in the laboratory under quiet conditions were significantly higher than those in the laboratory setting with background noise.

Medians for T_1 (44.12) and T_2 (42.8) were not significantly different. However, the interquartile ranges ($T_1 = 35.24$, $T_2 = 31.36$) differed as did the exclusive ranges ($T_1 = 147$, $T_2 = 128$).

The mean raw gain scores for Treatment One and Treatment Two were significantly different at the .01 level. The null hypothesis is rejected.

> H_o 2 : There is no significant difference between raw gain scores obtained by subjects in Treatment Two (visual task with meaningful background noise) and Treatment Three (visual task with meaningful background noise and masking).

A Gamma correlation coefficient of .785 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 2.602 for the correlation coefficient is significant at the .01 level. Order on Treatment Three can be predicted from Treatment Two correctly, 99% of the time.

Mean raw gain score differences were measured by the t test for related measures. It used paired differences as the unit of analysis. An observed t (1.058, $p \leq .29$) was not significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The H statistic is computed on medians rather than means and is approximated by the chi-square distribution. The Grand median for the two variables was 44.40. The medians for T_2 and T_3 were 42.8 and 45.08 respectively. For calculation of the X^2 statistic, the values were: a = 24, b = 28, c = 29, d = 25. The resulting X^2 value was .34. The probability that the variables are different is .40.

The comparisons for T_2 and T_3 have been summarized in Table 4.

TABLE 4

A COMPARISON OF TREATMENT TWO AND TREATMENT THREE

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_2	.785	2.602**	42.8 45.08	31.36 34.34	.34	$p \leq .60$
	Mean	SD	$\overline{D}$	$S_{\overline{D}}$	t	p
T_2	51.91	29.94	-2.04	14.02	-1.058	$p \leq .29$
T_3	53.94	31.19				

**significant at the .01 level

The results of the comparison on mean differences for Treatment Two and Treatment Three were not statistically significant. The direction of difference was as expected but the observed t of -1.05819 has a $p \leq .2948$.

Medians were different ($T_2 = 42.8$, $T_3 = 45.08$) but not significantly ($p \leq .60$). It was expected that the differences would be more significant. Masking, used in the laboratory setting, did not result in a significant increase in number of computations over the distraction condition.

Mean raw gain scores for Treatment Two and Treatment Three are not significantly different. The null hypothesis is accepted.

> H_o 3: There is no significant difference between raw gain scores obtained by subjects in Treatment Two (visual task with meaningful background noise) and Treatment Four (visual task in the classroom setting and auditory masking).

A Gamma correlation coefficient of .773 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 2.461 for the correlation coefficient is significant at the .01 level. Order on Treatment Four can be predicted from order on Treatment Two correctly 99% of the time.

Mean raw gain score differences were measured by the t test for related measures. It uses paired differences as the unit of analysis. An observed t (-2.44002, $\leq .0181$) was significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The H statistic is computed on medians rather than means and is approximated by the chi-square distribution. The Grand median for the two variables was 45.36. The medians for T_2 and T_4 were 42.8 and 48.54 respectively. For calculation of the X^2 statistic, the values were: a = 22, b = 30, c = 31, d = 23. The resulting X^2 value was 1.85. The probability that the variables are different is .80.

The comparisons for T_2 and T_4 have been summarized in Table 5.

TABLE 5

A COMPARISON OF TREATMENT TWO AND TREATMENT FOUR

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_2	.773	2.461**	42.8	31.36	1.85	$p \leq .20$
T_4			48.54	40.07		
	Mean	**SD**	$\overline{D}$	$S_{\overline{D}}$	**t**	**p**
T_2	51.91	29.94	-5.47	16.33	-2.440*	$p \leq .018$
T_4	57.38	30.81				

*significant at the .05 level
**significant at the .01 level

The results of the comparison on mean differences for Treatment Two and Treatment Four were statistically significant with an observed t of -2.440, $p \leq .0181$.

Medians (T_2 = 42.8, T_4 = 48.54) were also different ($p \leq .20$). Treatment Four scores were significantly higher than Treatment Two scores as was expected by research design.

Mean raw gain scores for Treatment Two and Treatment Four were significantly different. The null hypothesis is rejected.

H_o 4 : There is no significant difference between raw gain scores obtained by subjects in Treatment One (visual task without auditory input) and Treatment Three (visual task with meaningful background noise and auditory masking).

A Gamma correlation coefficient of .76 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 2.401 for the correlation coefficient is significant at the .01 level. Order on Treatment Three can be predicted from order on Treatment One correctly 99% of the time.

Mean raw gain score differences were measured by the t test for related measures. It uses paired differences as the unit of analysis. An observed t (3.04943, $p \leq .0036$) was significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The H statistic is computed on medians rather than means and is approximated by the chi-square distribution. The Grand median for the two variables was 44.79. The medians for T_1 and T_3 were 44.12 and 45.08 respectively. For calculation of the X^2 statistic, the values were: a = 25, b = 27, c = 28, d = 26. The resulting X^2 value was .34. The probability that the two variables are different is .40.

The comparisons for T_1 and T_3 have been summarized in Table 6.

TABLE 6

A COMPARISON OF TREATMENT ONE AND TREATMENT THREE

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_1	.76	2.401**	44.12	35.24	.34	$p \leq .60$
T_2			45.08	34.43		
	Mean	SD	$\bar{D}$	$S_{\bar{D}}$	T	P
T_1	57.94	33.89	4.00	9.55	3.049	$p \leq .0036$**
T_3	53.94	31.19				

**significant at the .01 level

The results of the comparison on mean differences for Treatments One and Three were statistically significant with an observed t of 3.049, $p \leq .0036$. It was expected the difference between mean raw gain scores from quiet conditions and background noise conditions with masking would be insignificant.

The H test on medians revealed an insignificant difference ($p \leq .60$). The interquartile ranges were not different (T_1 = 35.24, T_3 = 34.43). However, they differed in location (Q_3, T_1 = 70.02; Q_3, T_3 = 67.01).

Mean raw gain scores for Treatment One and Treatment Three are statistically different at the .01 level. The null hypothesis is rejected.

> H_o 5 : There is no significant difference between raw gain scores obtained by subjects in Treatment One (visual task without auditory input) and Treatment Four (visual task in the classroom setting and auditory masking).

A Gamma correlation coefficient of .796 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 2.645 for the correlation coefficient is significant at the .01 level. Order on Treatment Four can be predicted from Treatment One correctly 99% of the time.

Mean raw gain score differences were measured by the t test for related measures. It uses paired differences as the unit of analysis. An observed t (.35849, $p \leq .7214$) was not significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The Grand Median for the two variables was 44.92. The medians for T_1 and T_4 were 44.12 and 48.54 respectively. For calculation of the X^2 statistic, the values were: a = 25, b = 31, c = 28, d = 22. The resulting X^2 value was 1.86. The probability that the two variables are different is .80.

The comparisons for T_1 and T_4 have been summarized in Table 7.

TABLE 7

A COMPARISON OF TREATMENT ONE AND TREATMENT FOUR

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_1	.796	2.645**	44.12	35.24	1.86	$p \leq .20$
T_4			48.54	40.07		
	Mean	**SD**	$\overline{D}$	$S_{\overline{D}}$	**t**	**p**
T_1	57.94	33.89	.057	11.49	.35849	$p \leq .7214$
T_4	57.37	30.81				

**significant at the .01 level

The results of the comparison on mean differences for Treatments One and Four were not statistically different (observed t of .35849 $p \leq .7214$). Scores taken under conditions of masking in the classroom were comparable to those from the laboratory setting under quiet conditions.

Analysis of ranges showed differences between T_1 and T_4. Exclusive ranges (T_1 = 147, T_4 = 133) differed as did medians (T_1 = 44.12, T_4 = 48.54) but in the opposite directions. The interquartile range for T_4 was larger (T_1 = 35.24, T_4 = 40.07), but in location the difference was less (Q_3, T_1 = 70.02, Q_3, T_4 = 73.85).

Mean raw gain scores for Treatments One and Four were not significantly different. The null hypothesis is accepted.

> H_o 6 : There is no significant difference between raw gain scores obtained by subjects in Treatment One (visual task without auditory input) and Treatment Five (visual task in the classroom setting).

A Gamma correlation coefficient of .705 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 1.885 for the correlation coefficient is significant at the .05 level. Order on Treatment Five can be predicted from order on Treatment One correctly 95% of the time.

Mean raw gain score differences were measured by the t test for related measures. It uses paired differences as the unit of analysis. An observed t (2.94, $p \leq .0045$) was significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The Grand median for the two variables was 42.90. The medians for T_1 and T_5 were 44.12 and 40.97 respectively. For calculation of the X^2 statistic, the values were: a = 28, b = 25, c = 25, d = 28. The resulting X^2 statistic was .15. The probability that the variables are different is .30.

The comparisons for T_1 and T_5 have been summarized in Table 8.

TABLE 8

A COMPARISON OF TREATMENT ONE AND TREATMENT FIVE

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_1	.705	1.888*	44.12	35.24	.15	$p \leq .70$
T_5			40.97	35.02		

	Mean	SD	$\overline{D}$	$S_{\overline{D}}$	t	p
T_1	57.94	33.89	5.94	14.70	2.942**	$p \leq .0045$
T_5	52.00	27.77				

*significant at the .05 level
**significant at the .01 level

The results of the comparison on mean differences for Treatment One and Treatment Five were statistically significant with an observed t of 2.94159 and $p \leq .0045$. Treatment One (non-distracting laboratory setting) and Treatment Five (classroom setting without masking) were expected to yield different scores.

The median for T_1 (44.12) was higher than the median of T_5 (40.97). However, the interquartile range was the same (35.24, 35.02) with the difference being location (Q_3, T_1 = 70.02; Q_3, T_5 = 67.55).

Mean raw gain scores for Treatment One and Treatment Five were significantly different at the .01 level. The null hypothesis is rejected.

H_o 7 : There is no significant difference between raw gain scores obtained by subjects in Treatment Two (visual task with meaningful background noise) and Treatment Five (visual task in the classroom setting).

A Gamma correlation coefficient of .696 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 1.804 for the correlation coefficient is significant at the .05 level. Order on Treatment Five can be predicted from Treatment Two correctly 95% of the time.

Mean raw gain score differences were measured by the t test for related measures. It uses paired differences as the unit of analysis. An observed t ($-.0424$, $p \leq .966$) was not significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The Grand median for the two variables was 41.16. The medians for T_2 and T_5 were 42.8 and 40.97 respectively. For calculation of the X^2 statistic, the values were: a = 27, b = 26, c = 26, d = 27. The resulting X^2 value was 0. The probability that the variables are different is .00.

The comparisons for T_2 and T_5 have been summarized in Table 9.

TABLE 9

A COMPARISON OF TREATMENT TWO AND TREATMENT FIVE

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_2	.696	1.804*	42.8	31.96	0	$p \leq 1.00$
T_5			40.97	35.02		

	Mean	SD	$\bar{D}$	$S_{\bar{D}}$	t	p
T_2	51.91	29.94	-.094	16.19	-.0424	$p \leq .96$
T_5	52.00	27.77				

*significant at the .05 level

Mean raw gain scores for Treatment Two and Treatment Five were not significantly different. The null hypothesis is accepted.

The results of the comparison on mean differences for Treatment Two and Treatment Five were not statistically significant. It was expected that without masking in either of the distraction conditions, the mean scores would be comparable.

In a comparison of medians (T_2 = 42.8, T_5 = 40.97) the difference was not significant. Both treatments were in unmasked environments. In the laboratory setting, the distractions were introduced, but in the classroom, the distractions were variable.

H_o 8 : There is no significant difference between raw gain scores obtained by subjects in Treatment Three (visual task with meaningful background noise) and Treatment Five (visual task in the classroom setting).

A Gamma correlation coefficient of .724 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 2.073 for the correlation coefficient is significant at the .05 level. Order on Treatment Five can be predicted from Treatment Three correctly 95% of the time.

Mean raw gain score differences were measured by the t test for related measures. It uses paired differences as the unit of analysis. An observed t (1.2088, $p \leq .265$) was not significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The Grand median for the two variables was 43.05. The medians for T_3 and T_5 were 45.08 and 40.97 respectively. For calculation of the X^2 statistic, the values were: a = 29, b = 25, c = 24, d = 28. The resulting X^2 value was .34. The probability that the variables are different is .40.

The comparisons for T_3 and T_5 have been summarized in Table 10.

TABLE 10

A COMPARISON OF TREATMENT THREE AND TREATMENT FIVE

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_3	.724	2.073*	45.08	34.43	.34	$p \leq .60$
T_5			40.97	35.02		
	Mean	**SD**	$\overline{D}$	$S_{\overline{D}}$	**t**	**p**
T_3	53.94	31.19	1.943	12.62	1.1208	$p \leq .2675$
T_5	52.00	27.78				

*significant at the .05 level

The results of the test on mean differences were as expected. There was a difference in actual scores but an observed t of 1.12 has a $p \leq .27$.

The medians (T_3 = 45.08, T_4 = 40.97) were different, but not significantly so ($p \leq .60$). Treatment scores in the laboratory setting with masking were not significantly different from scores in the classroom without masking.

The null hypothesis is accepted.

H_o 9 : There is no significant difference between raw gain scores obtained by subjects in Treatment Four (visual task in the classroom setting and auditory masking) and Treatment Five (visual task in the classroom setting).

A Gamma correlation coefficient of .833 was computed for the two variables by Multiple Variable Analysis (MVA).

A z score of 3.072 was significant at the .001 level. Order on Treatment Five can be predicted from Treatment Four correctly, more than 99% of the time.

Mean raw gain score differences were measured by the t test for related measured. It uses paired differences as the unit of analysis. An observed t (4.2297, $p \leq .0001$) was highly significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The Grand median for the two variables was 45.80. The medians for T_4 and T_5 were 48.54 and 40.97 respectively. For calculation of the X^2 statistic, the values were: a = 21, b = 31, c = 32, d = 22. The resulting X^2 statistic was 3.0577. The probability that the two variables are different is .90.

The comparisons for T_4 and T_5 have been summarized in Table 11.

Mean raw gain scores for Treatment Four and Treatment Five were significantly different at the .0001 level. The null hypothesis is rejected.

The results of the comparison on mean differences (T_4 = 57.38, T_5 = 52.00) showed that Treatments Four and Five were significantly different with an observed t of 4.229, $p \leq .0001$. Scores taken from the classroom with masking were significantly higher than those taken in the classroom without masking.

TABLE 11

A COMPARISON OF TREATMENT FOUR AND TREATMENT FIVE

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_4	.833	3.072***	48.54	40.07	3.06	$p \leq .10$
T_5			40.97	35.02		

	Mean	SD	$\overline{D}$	$S_{\overline{D}}$	t	p
T_4	57.38	30.81	5.38	9.255	4.229****	$p \leq .0001$
T_5	52.00	27.78				

***significant at the .001 level
****significant at the .0001 level

A comparison of medians for T_4 (48.54) and T_5 (40.97) revealed an even larger difference than in means.

H_o 10: There is no significant difference between raw gain scores obtained by subjects in Treatment Three (visual task with meaningful background noise) and Treatment Four (visual task in the classroom setting and auditory masking).

A Gamma correlation coefficient of .795 was computed for the two variables by Multiple Variable Analysis (MVA). A z score of 2.653 for the correlation coefficient is significant at the .01 level. Order on Treatment Four can be predicted from Treatment Three correctly, 99% of the time.

Mean raw gain score differences were measured by the t test for related measures. It uses paired differences as the unit of analysis. An observed t (-2.3467, $p \leq .0228$) was significant.

The difference between the two variables was also measured by the Kruskal-Wallis H test. The Grand median for the two variables was 46.19. The medians for T_3 and T_4 were 45.08 and 40.97 respectively. For calculation of the X^2 statistic, the values were: a = 25, b = 29, c = 28, d = 24. The resulting X^2 value was .34. The probability that the variables are different is .40.

The comparisons for T_3 and T_4 have been summarized in Table 12.

TABLE 12

A COMPARISON OF TREATMENT THREE AND TREATMENT FOUR

	Gamma	z	Median	Q_3-Q_1	X^2	p
T_3	.795	2.653**	45.08	34.43	.34	$p \leq .40$
T_4			57.36	40.07		

	Mean	SD	$\bar{D}$	$S_{\bar{D}}$	t	p
T_3	53.94	31.19	-3.43	10.65	-2.3467*	$p \leq .0228$
T_4	57.38	30.81				

*significant at the .05 level
**significant at the .01 level

Mean raw gain scores for Treatments Three and Four were significantly different ($t = -2.3467$, $p \leq .0228$). Medians were different, as were their interquartile ranges ($T_3 = 34.43$, $T_4 = 40.07$). The significant difference in scores was unexpected. Both were masking conditions; T_3 was in the laboratory setting, T_4 was in the classroom setting. Masking, in this experiment, was more successful in the classroom setting than in the laboratory.

Mean raw gain scores for Treatment Three and Four were significantly different at the .05 level. The null hypothesis is rejected.

TABLE 13

TREATMENT ORDER PROBABILITIES BASED ON GAMMA CORRELATIONS

Independent Variable	Dependent Variable	γ	z	Level of Significance
T_1	T_2	.737	2.118	.05
T_1	T_3	.76	2.401	.01
T_1	T_4	.796	2.645	.01
T_1	T_5	.705	1.888	.05
T_2	T_3	.785	2.602	.01
T_2	T_4	.773	2.461	.01
T_2	T_5	.696	1.804	.05
T_3	T_4	.795	2.653	.01
T_3	T_5	.724	2.073	.05
T_4	T_5	.833	3.072	.001

<u>Comparison of treatments--overview.</u> Students scored highest on T_1 ($\overline{X} = 57.94$) and T_4 ($\overline{X} = 57.37$). T_1 was the laboratory setting with no noise. T_4 was the classroom with masking. The lowest scores were in the classroom without masking (T_5, $\overline{X} = 52.00$) and in the laboratory setting with background noise (T_2, $\overline{X} = 51.91$).

Medians for the five treatments were very different from their means. Of the five, T_4 had the highest (48.25) and T_5 (40.97) had the lowest. The scores for all five treatments were positively skewed--as evidenced by the difference in means and medians.

Range and frequencies have been shown for each experimental treatment in Table 2. The most noticeable differences are in T_1 and T_5 (T_1 range = 147, T_5 range = 116). Scores on T_1 ranged from 16 to 163 and on T_5 from 11 to 127. However, the interquartile ranges as shown in Table 2 were not different for the two treatments ($T_1 = 35.28$, $T_5 = 35.02$). The interquartile ranges differed in location (Q_3, $T_1 = 70.02$; Q_3, $T_5 = 67.55$).

Masking was more successful in the classroom setting in this experiment than in the laboratory setting. Treatments Four and Five were significantly different. Treatments Two and Three were not significantly different.

Correlation of Independent and Dependent Variables

H_o 11: There is no significant correlation between intelligence, as measured by the WISC and Distractibility (expressed as a "difference score": $T_1 - T_2$).

A Gamma correlation coefficient (.03) was computed for WISC scores and the Distractibility Index ($T_1 - T_2$) by Multiple Variable Analysis (MVA). A Pearson product-moment correlation coefficient was .0669. The correlations were not significant. The null hypothesis is accepted.

H_o 12: There is no significant correlation between mental age as calculated by the WISC and Distractibility (expressed as a "difference score": $T_1 - T_2$).

A Gamma correlation coefficient (.023) was computed for mental ages and the Distractibility Index ($T_1 - T_2$) by Multiple Variable Analysis (MVA). A Pearson product-moment correlation coefficient was .0456. Neither correlation was significant. The null hypothesis is accepted.

H_o 13: There is no significant correlation between Key Math Scores and Distractibility (expressed as a "difference score": $T_1 - T_2$).

A Gamma correlation coefficient (.023) was computed for Key Math Scores and the Distractibility Index ($T_1 - T_2$) by Multiple Variable Analysis (MVA). A Pearson product-moment correlation was .0649. The correlations were not significant. The null hypothesis is accepted.

H_o 14: There is no significant correlation between chronological age and Distractibility (expressed as a "difference score": $T_1 - T_2$).

A Gamma correlation coefficient (.017) was computed for chronological age and The Distractibility Index ($T_1 - T_2$) by Multiple Variable Analysis (MVA). A Pearson product-moment correlation was .001. The correlations were not significant. The null hypothesis is accepted.

H_o 15: There is no significant correlation between intelligence as measured by the WISC and Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$).

A Gamma correlation coefficient (-.037) was computed for WISC scores and Treatment Effect #1 ($T_3 - T_2$) by Multiple Variable Analysis (MVA). A Pearson product-moment correlation coefficient was -.0097. The correlations were not significant. The null hypothesis is accepted.

H_o 16: There is no significant correlation between intelligence as measured by the WISC and Treatment Effect #2 (expressed as a "difference score": $T_4 - T_5$).

A Gamma correlation coefficient (-.074) was computed for WISC scores and Treatment Effect #2 ($T_4 - T_5$) by Multiple Variable Analysis (MVA). A Pearson product-moment correlation coefficient was .0781. The correlations were not significant. The null hypothesis is accepted.

H_o 17: There is no significant correlation between mental age as calculated by the WISC and Treatment Effect #1 (expressed as a "difference score": $T_3 - T_1$).

A Gamma correlation coefficient (.002) was computed for mental ages and Treatment Effect #1 ($T_3 - T_2$) by Multiple Variable Analysis (MVA). The Pearson product-moment correlation coefficient was .0038. The correlations were not significant. The null hypothesis is accepted.

H_o 18: There is no significant correlation between mental age as calculated by the WISC and Treatment Effect #2 (expressed as a "difference score": $T_4 - T_5$).

A Gamma correlation coefficient (-.082) was computed for mental age and Treatment Effect #2 ($T_4 - T_5$) by Multiple Variable Analysis (MVA). The Pearson product-moment correlation coefficient was .0185. The correlations were not significant. The null hypothesis is accepted.

H_o 19: There is no significant correlation between chronological age and Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$).

A Gamma correlation coefficient (.096) was computed for chronological age and Treatment Effect # ($T_3 - T_2$) by Multiple Variable Analysis (MVA). A Pearson product-moment correlation coefficient was .0663). The correlations were not significant. The null hypothesis is accepted.

> H_o 20: There is no significant correlation between chronological age and Treatment Effect #2 (expressed as a "difference score": $T_4 - T_5$).

A Gamma correlation coefficient (.052) was computed for chronological age and Treatment Effect #2 ($T_4 - T_5$) by Multiple Variable Analysis (MVA). The Pearson product-moment correlation coefficient was -.0268. The correlations were not significant. The null hypothesis is accepted.

> H_o 21: There is no significant correlation between Key Math Scores and Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$).

A Gamma correlation coefficient (.008) was computed for the Key Math Scores and Treatment Effect #1 ($T_3 - T_2$) by Multiple Variable Analysis (MVA). The Pearson product-moment correlation coefficient was .0146. The correlations were not significant. The null hypothesis is accepted.

> H_o 22: There is no significant correlation between Key Math Scores and Treatment Effect #2 (expressed as a "difference score": $T_4 - T_5$).

A Gamma correlation coefficient (-.035) was computed for Key Math Scores and Treatment Effect #2 ($T_4 - T_5$) by Multiple Variable Analysis (MVA). The Pearson product-moment correlation coefficient was -.0105. The correlations were not significant. The null hypothesis is accepted.

Treatment Effects and Independent Variables--Overview

The lack of association of any of the independent variables with distractibility was completely unexpected. There was a high degree of association between the Distractibility Index and treatment effects, so the small correlation coefficients for the independent variables and treatment effects was understandable.

One part of the research plan had been to use the correlations to develop a regression formula for prediction of treatment effects. The insignificant correlations (Table 14) could not be used in a prediction formula.

The statistics for intelligence, mental ages, chronological ages, and Key Math Scores have been shown in Table 15 and for the dependent variables in Table 16.

Distractibility and Treatment Effects

The Gamma distribution is useful for measuring the degree to which ranking on one ordered variable may be used to predict ranking on another ordered variable. It is relatively insensitive to skewed distributions. This measure of association can be interpreted by the normal asymptotic curve when the sample is large (n = 50) and the $\gamma \geq .10$. As Gamma approaches zero, larger sample sizes are necessary before this test has sufficient power (Rosenthal, 1966).

TABLE 14

CORRELATION COEFFICIENTS FOR INDEPENDENT VARIABLES WITH DISTRACTIBILITY AND TREATMENT EFFECTS

	C.A.	M.A.	I.Q.	MATH	DI	TE_1	TE_2
						Gamma Correlations	
C.A.	---	---	---	---	.017	.096	.052
M.A.	---	---	---	---	-.001	.002	-.082
I.Q.	---	---	---	---	.030	-.037	-.074
MATH	---	---	---	---	.023	.008	-.035
DI	.0001	.0456	.0669	.0649		.433**	.195
TE_1	.0663	.0038	-.0097	.0146	.7898**	---	---
TE_2	-.0268	.0185	.0781	-.0105	.3252*	---	---
	Pearson Product-moment Correlations						

**significant at the .01 level
*significant at the .02 level

TABLE 15

INDEPENDENT VARIABLE STATISTICS

	Mean	SD	Range
Intelligence	92.56	23.69	62 - 133
Mental Age	115.38*	10.04	93 - 137
Chronological Age	107.98*	21.95	74 - 149
Key Math Scores	19.93	6.99	6 - 37

*Ages given in months

Gamma is based on order--relative sizes of differences do not affect it, hence it is a conservative measure when applied to interval data. It can be interpreted as the degree of predictability above chance.

TABLE 16

DEPENDENT VARIABLE STATISTICS

	Mean	SD	Range
DI	5.89	15.09	-28 to 76
TE_1	2.14	13.42	-34 to 71
TE_2	5.23	9.07	-14 to 39

The Pearson product-moment correlation (r) measures the rate of change in one variable relative to another. It is primarily a predictive device to forecast an expected <u>level</u> of performance on one variable from observed performance on another.

Interpretation of the two different correlation measures took two forms in this experiment; Gamma was used simply as a prediction of order, Pearsonian correlation measured the level of change of Treatment Effects with the Distractibility Index.

A high r would mean that as DI increased, Treatment Effect would increase. A moderate r ($r \leq .50$) would mean that as DI increased, there would be a positive increase but it would not be as high as with a higher r.

> H_o 23: There is no significant correlation between Treatment Effect #1 (expressed as a "difference score": $T_3 - T_2$) and Distractibility (expressed as a "difference score": $T_1 - T_2$).

The Gamma correlation coefficient (.195) was computed by Multiple Variable Analysis (MVA). The correlation was positive, though moderate. From order on the Distractibility Index, order on Treatment Effect #2 can be predicted correctly 65% of the time.

The Pearson product-moment correlation coefficient of .3252 exceeded the critical value of .32 for the .02 level of significance. The null hypothesis is rejected.

H_o 25: There is no significant difference between the Distractibility Index (T_1 - T_2), Treatment #1 (T_3 - T_2), and Treatment #2 (T_4 - T_5).

The differences were measured by the t test for related measures. The results have been shown in Table 17.

TABLE 17

A COMPARISON OF DISTRACTIBILITY AND TREATMENT EFFECTS

	Means	SD	$\overline{D}$	$S_{\overline{D}}$	t	p
DI	6.11	15.33	3.88	9.54	2.967**	$p \leq .0045$
TE_1	2.23	13.67				
DI	6.11	15.33	.68	15.10	.327	$p \leq .744$
TE_2	5.43	9.68				

**significant at the .01 level

These derived scores had two different underlying meanings. DI was a score with a negative meaning. It reflected the number of computations less a subject was able to do in controlled distracting conditions over quiet conditions.

TE_1 reflected the number more of computations he was able to do with masking. TE_2 showed the number more of computations he was able to do with masking in a classroom as opposed to the number he was able to do in the classroom without masking.

If a subject's DI was high, his TE_1 would be high according to the r of .789. However, the scores were significantly different as measured by the t test.

One essential difference between TE_1 and TE_2 is that TE_1 was a measure taken in laboratory conditions. TE_2 was taken in the classroom. Both TE_1 and DI were in laboratory conditions. The degree of correlation was expected. However, they did not measure the same thing. The difference was significant. The null hypothesis is rejected.

Chapter IV

Summary and Interpretations

It was the purpose of this study to determine the effects on attendance to a visual task when auditory masking was used in a variable environmental setting.

Relationships between the experimental treatments and the independent variables (intelligence, mental age, chronological age and Key Math Scores) were measured in order to determine the predictibility of the experimental treatment.

It was hypothesized that distractible students would be adversely affected by noise if it were meaningful, and by masking the noise with non-meaningful noise, the distractions would be less. It was also hypothesized that the effect would be measurable and significant.

Procedure

Sample. A sample of 60 third- and fourth-grade students was randomly drawn from a larger population of students who had been described as "distractible" by use of a behavioral description (Appendix A). Due to attrition, the final sample was 53. The WISC intelligence scores ranged from 62 to 133 ($\bar{X}$ = 92.8). No students were excluded for having been retained, special class placement, or chronological age.

Mean age for the sample was 9 years, 6 months. Scores from Key Math Tests which were individually administered, ranged from 6 to 37 (X = 20).

Visual tasks. Five parallel pages of math problems (Appendix C) were prepared for each student. The difficulty level of each set was carefully chosen for subjects by the results of their Key Math Tests. It was hypothesized that if the level of difficulty were determined carefully for each individual, any fluctuation from one task to another would reflect conditions of the experiment. The tasks for each subject were, for him, in the "easy" classification.

The subjects varied in their speed of math computation. Some knew the answers and others counted fingers and made pencil marks. The individual differences were reflected in the large variance of the raw scores.

Scores for the tasks were determined by the number of math computations done in five-minutes time. When a subject finished before the time allowed, the scores were determined by extrapolation.

Treatments. The five experimental treatments varied in location and condition. The actual manipulated variable was the environmental condition. The laboratory setting was the same for each student (a portable trailer which was moved from school to school). Treatments One, Two, and Three (T_1,

T_2, T_3), were conducted in the laboratory setting. For T_1 the condition was quiet, but for T_2 and T_3 it was noisy. The noise, a tape of classroom noise recorded in a third-grade classroom, was played in the laboratory on a reel-to-reel tape player for both treatments. For T_3 the subject wore a special kind of talk-through earphones which did not block sound. Through the earphones, white noise was introduced. It was hypothesized that distractible students would do best in quiet conditions and worse in noisy conditions without masking. For some students this was true. For others, just the opposite happened, as was evidenced by several negative scores on the Distractibility Index.

The other setting varied from student to student. It was his own classroom. No effort was made to control for time of day except that students were not tested during their recess or lunch time. T_4 was with masking and T_5 was without it. Treatment order was randomized to eliminate "practice effect." Classroom environment varied. Some students were in special education classrooms with carpets and individual study carrels. Others were in large open area classes with as many as four or five teachers. The classroom environment was the most distracting condition in the experiment when "distraction" is defined as "any variable which deploys attention from a task."

<u>Auditory masking.</u> Students reacted in different ways to the auditory masking. When they found they could control the volume, the masking was more tolerable. However, it was evident that for some students, masking was an irritant. The degree of irritation was reflected in their negative Treatment Effect scores.

Data Analysis

<u>Score distributions.</u> The scores were positively skewed by the students who were able to compute quickly. However, all distributions were skewed, not just one or two. A transformation was not performed on the scores. Score transformations or Winsorizations (Winer, p. 51-53) were developed to equalize samples skewed because of experimental error. A prime purpose of transformations is to narrow the confidence limits and make inferences more meaningful. Since the skewness in this experiment was evident from treatment to treatment, it was determined that the skewed scores were the result of individual differences rather than experimental error.

The median, because of its relative insensitivity to skewness, was the unit of analysis in making inferences considering parameters. The means, which were larger than the medians, were all larger. Though they varied, they varied together. Therefore, because they have more statistical usefulness, the means were used as the unit of analysis in determining the difference between treatments.

Statistical tests. Data were analyzed first by a Multiple Variable Analysis computer program. The program was designed to measure cross classifications. For this study, the output was in the form of Gamma correlation coefficients and the corresponding z scores.

A significant Gamma correlation means that order on a correlated variable can be predicted by order on its own distribution. Gamma does not measure the degree of difference from one variable to another.

Treatment differences were measured by two procedures. They were first measured by the Kruskal-Wallis H test. It uses the median as a unit of analysis and is relatively insensitive to marginal distributions. It is a conservative test (underestimates) when scores cluster about the median. The comparisons based on medians were used to make inferences about parameters.

Treatment differences were also measured by mean differences (North Texas State Statistical Library, STØØ3). The t test for related means utilizes pairs of difference scores to compute a mean difference score (D), standard deviation of that difference ($S_{\overline{D}}$), a t score and its significance level.

Pearson product-moment correlation coefficients were computed (North Texas State Statistical Library, STØØ6) following the extremely insignificant correlations obtained by the Gamma tests for the independent variables and the treatment effects. The same low correlations were obtained (Table 14).

Treatment Effects and the Distractibility Index were compared first by correlations--Gamma and Pearsonian. The Gamma correlations indicated a certain amount of predictability of order on Treatment Effects from the Distractibility Index (Table 14). The Pearson product-moment correlation coefficient measured the rate of change of the Treatment Effects with a change in the Distractibility Index.

The differences in the Distractibility Index and Treatment Effects were measured by the t test for related samples.

Summary of the Findings

Treatment comparisons. The investigator hypothesized that distractible students would be adversely affected by meaningful noise. It was also hypothesized that by using auditory masking over the noise, the effects of the distraction would be lessened to a significant degree. The hypothesis was tested in two settings--laboratory and classroom.

The hypothesis was supported in the classroom setting but not in the laboratory setting.

Critical values for rejecting the null hypotheses were: $\alpha/2$, .05, 50df, $\pm$ 2.010.

The following null hypotheses were accepted:

$$H_o\ 2 : T_2 - T_3 = 0$$

The treatment score means were not significantly higher. It was expected that masking (T_3) scores would be significantly higher than scores from unmasked noise conditions (T_2). Such was not the case: $t = -1.058$, $p \leq .29$.

$$H_o\ 5 : T_1 - T_4 = 0$$

Treatment scores taken in the classroom with masking were comparable to those in the laboratory under quiet conditions. Perhaps the laboratory setting itself was a distraction: $t = .35949$, $p \leq .7214$.

$$H_o\ 7 : T_2 - T_5 = 0$$

Treatment scores taken in the laboratory in noise conditions were comparable to those taken in the classroom without masking: $t = -.0424$, $p \leq .9663$.

$$H_o\ 8 : T_3 - T_5 = 0$$

Treatment scores in the laboratory with masking (T_3) were not significantly higher than those taken in the classroom without masking (T_5): $t = 1.1208$, $p \leq .2675$.

The following null hypotheses were rejected:

$$H_o\ 1 : T_1 - T_2 = 0$$

Scores taken in the laboratory under quiet conditions (T_1) were significantly higher than those taken in the laboratory under noise conditions (T_2). This difference score was the Distractibility Index (DI): $t = 2.836$, $p \leq .0065$.

$$C\left[9.36,\ 2.7\right] = 95\%$$

$$H_o\ 3 : T_2 - T_4 = 0$$

Scores taken in the laboratory under noise conditions (T_2) were significantly lower than those taken in the classroom under masking conditions (T_4): $t = -2.437$, $p \leq .0182$.

$$C\left[-8.84,\ -1.9\right] = 95\%$$

$$H_o\ 4 : T_1 - T_3 = 0$$

Scores taken in the laboratory under quiet conditions (T_1) were significantly higher than those taken in the laboratory under conditions of masking (T_3): $t = 3.04943$, $p \leq .0036$.

$$C\left[1.95,\ 6.05\right] = 95\%$$

$$H_o\ 6 : T_1 - T_5 = 0$$

Scores taken in the laboratory under quiet conditions (T_1) were significantly higher than those taken in the classroom without masking (T_5): $t = 2.94$, $p \leq .0049$.

$$C\left[1.88,\ 9.09\right] = 95\%$$

$$H_o\ 9 : T_4 - T_5 = 0$$

Scores taken in the classroom under masking conditions (T_4) were significantly higher than those taken in the classroom without masking (T_5): $t = 4.2297$, $p \leq .0001$.

$$C\left[3.38,\ 7.37\right] = 95\%$$

H_o 10 : $T_3 - T_4 = 0$

Scores taken in the classroom under masking conditions (T_4) were significantly higher than those taken in the laboratory under masking conditions (T_3): $t = -2.347$, p _ .0229.

$$C \left[-6.03, \ .03\right] = 95\%$$

<u>Correlation of Independent and Dependent Variables</u>

There were no significant correlation coefficients between the dependent and the independent variables. The critical values for testing the null hypotheses at 50df were:

α .10, r = .231

α .05, r = .273

α .02, r = .322

α .01, r = .354

Intelligence Scores with Distractibility Index

H_o 11 : r = 0

observed r = .0669

Mental Age with Distractibility Index

H_o 12 r = 0

observed r = .0456

Key Math Scores with Distractibility Index

H_o 13 r = 0

observed r = .0649

Chronological Age with Distractibility Index

H_o 14 : r = 0

observed r = .001

Intelligence Scores with Treatment Effect #1

H_o 15 : r = 0

observed r = -.0097

Intelligence Scores with Treatment Effect #2

H_o 16 : r = 0

observed r = .0781

Mental Age with Treatment Effect #1

H_o 17 : r = 0

observed r = .0038

Mental Age with Treatment Effect #2

H_o 18 : r = 0

observed r = .0185

Chronological Age with Treatment Effect #1

H_o 19 : r = 0

observed r = .0063

Chronological Age with Treatment Effect #2

H_o 20 : r = 0

observed r = -.0268

Key Math Scores with Treatment Effect #1

H_o 21 : r = 0

observed r = .0146

Key Math Scores with Treatment Effect #2

H_o 22 r - 0

observed r = -.0105

Distractibility Index and Treatment Effects. TE_1 and TE_2 were compared to the Distractibility Index (DI) in two ways. First, Gamma correlations showed a degree of relatedness. Then Pearson product-moment correlation coefficients indicated the degree of relationship. The differences were measured by the t test for related measures.

Treatment Effect #1 and Distractibility Index

H_o 23 : r = 0

observed r = .7898 α .01

observed γ = .433 α .01

Treatment Effect #2 and Distractibility Index

H_o 24 · r = 0

observed r = .32 α .02

observed γ = .195 α .09

It was expected that there would be a high degree of association between DI and TE_1. Both measures were taken in the laboratory setting. Both null hypotheses were rejected.

$$H_0\ 25 : DI - TE_1 \quad TE_2 = 0$$

$$H_1 : DI \quad TE_1 \neq 0 \quad , \quad t = 2.967$$

$$H_2 : DI - TE_2 \neq 0 \quad , \quad t = .327$$

The null hypothesis was rejected. Alternate hypothesis H_2 was accepted. As DI increased the TE_1 scores increased but there was a significant difference in scores. As the DI scores increased, the TE_2 scores increased but not to the same degree. Masking in the laboratory setting was more effective for those subjects who were more distracted in the laboratory setting.

Interpretations

Treatment differences. The relative efficiency of auditory masking in overcoming auditory distraction was the experimental condition being tested. Auditory masking was tested in the laboratory and in the classroom. The laboratory setting was used to get a base line (quiet condition) to use in comparison of the other conditions. It was theorized that masking conditions over noise would result in scores which would not differ significantly from quiet conditions.

In order to generalize to the classroom, it was necessary to get a baseline in the classroom. The investigator hypothesized that scores from the masking condition in the classroom would be significantly higher than those without masking in the classroom.

Students included in the study had been randomly selected from a population of third- and fourth-grade students who had been described as "distractible." A comparison of two treatments (T_1 - T_2) was used as a measure of that distractibility. It was theorized that distractible students would work less efficiently in noisy conditions. The number of math computations accurately completed under controlled noisy conditions was subtracted from the number of problems computed under conditions of quiet. The higher the difference--the more distractible the student. A ratio score might have been a better measure than raw score deviations. The skewed scores would have been eliminated and the comparisons would still have been possible.

The null hypothesis of "no difference" in raw gain scores was rejected for six treatment differences: T_1 - T_2 (H_o 1), T_2 - T_4) (H_o 3), T_1 - T_3 (H_o 4), T_1 - T_5 (H_o 6), T_4 - T_5 (H_o 9), T_3 - T_4 (H_o 10). The rejections were made on the basis of the differences in their means. However, the large standard deviations made it difficult to make meaningful statements about the population from which they were drawn.

The findings of the treatment contrasts in question have been shown in Table 18 and Table 19. The most significant differences across all measures were between classroom scores with masking and without, and between laboratory scores in quiet and with masking.

TABLE 18

TREATMENT DIFFERENCES BASED ON MEDIANS

Contrasts	Grand Median	First Median	Second Median	X^2	Prob-abilities
$T_1 - T_2$	43.44	44.12	42.80	N.S.	
$T_1 - T_3$	44.79	44.12	45.08	.34	.25
$T_1 - T_4$	44.92	44.12	48.54	1.855	.80
$T_1 - T_5$	42.90	44.12	40.97	.15	.30
$T_2 - T_3$	44.40	42.8	45.08	.34	.25
$T_2 - T_4$	45.36	42.8	48.54	1.85	.80
$T_2 - T_5$	41.16	42.8	40.97	N.S.	
$T_3 - T_4$	46.19	45.08	48.54	.34	.25
$T_3 - T_5$	43.05	45.08	40.97	.34	.25
$T_4 - T_5$	45.80	48.54	40.97	3.06	.90

TABLE 19

TREATMENT CONTRASTS

Contrasts	$\bar{D}$	$\sigma_{\bar{D}}$	t	α	95% C		Median D	X^2 p
$T_1 - T_5$	5.94	1.61	2.94	.0049	1.88	10.69	3.14	$p \leq .70$
$T_2 - T_4$	-5.37	1.77	-2.437	.0182	-8.84	-1.90	-5.74	$p \leq .20$
$T_1 - T_2$	6.04	1.70	2.836	.0065	2.70	9.36	1.32	p N.S.
$T_3 - T_4$	-3.43	1.17	-2.347	.0228	-6.03	0.03	3.46	$p \leq .60$
$T_4 - T_5$	5.38	1.04	4.229	.0001	0.38	7.37	7.57	$p \leq .10$
$T_1 - T_3$	4.00	1.05	3.049	.0036	1.95	6.05	0.96	$p \leq .60$

Masking in the laboratory setting was not successful in overcoming distractions. If it had been, then there would not have been a significant difference between T_1 and T_3.

Masking in the classroom was successful in overcoming distractions. T_4 scores were significantly higher than T_5 scores: $\sigma_{\overline{D}} = 1.04$; 95% confidence limits, 6.05 - 1.95; and the medians were significantly different.

Masking was successful in overcoming classroom distractions for third- and fourth-grade children who had been described as "distractible" in classroom situations.

<u>Independent variables and distractibility.</u> There were no significant correlations between distractibility, as measured in this study, and the independent variables of intelligence, mental age, chronological age, and Key Math Scores (Table 14).

The original population from which the sample was selected may have been biased on more than distractibility. No restrictions were put on level of intelligence, but the mean I.Q. for the sample was 92.8. While it is still in the normal range, confidence limits around that mean (89.42-96.16) place it in the low part of the normal range. The Distractibility Index may not have measured the same thing as the criterion for selection.

Some investigators have found attentiveness to be related to mental age (LaHaderne, 1968; Weber, 1963). Others in more sensitive experiments have found important differences (Karp, 1963; Witkin, 1966; and Perez, 1961).

Sen and Clark (1968) found a consistent relationship between level of task difficulty and susceptability to distraction. The same conclusions were drawn by Whitman and Sprague (1968).

One interesting investigation (Schimek & Wachtel, 1969) found no significant relationship between types of taped listening material on attention deployment. They concluded that the conscious view of the subject, as to the relevance of the stimuli to be ignored or something to be included in the field of his attention was more important in determining the distribution of his attention.

The findings of the present study were not entirely in conflict with previous studies on attention. Subjects were all selected on the basis of their inability to focus their attention for school tasks. The mental age range was from 6 years 1 month to 11 years 5 months. Task difficulty level was for <u>all</u> subjects in the "easy" range. The artificial distraction condition in the laboratory proved less distracting to more students than did the classroom. The relevance of the stimuli of their own peers was evidently more distracting than taped noise.

The study also supported the work of Treisman (1960) and others (Cherry, 1953; Broadbent, 1958). From her work in dichotomous listening experiments, Treisman concluded that our brain has a central analyzer which allows us to selectively listen to important sources. She also hypothesized that the selection was of two types; one of meaning and one of source. It was upon this premise that the present study was designed. The investigator hypothesized that distractible students were not able to make the selection between relevance and source. By introducing noise of low frequency and no relevance at a source closer than the extraneous stimuli, the subject would be able to focus his attention to the more relevant task.

Directions for Further Research

The results of the present study revealed the following questions for later research:

1. Could the results have been more predictive if students had been pre-conditioned to the laboratory setting?
2. Would a research design which allows for analysis of order as a dimension, reduce experimental error?
3. Would ratio scores from quiet to noise conditions be a better measure of "distractibility" than difference scores?

There is need also for more research into the distractibility of children who are in the average range of intelligence, have not been diagnosed as brain-damaged, and are not psychotic.

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APPENDIX A

To the Classroom Teacher:

An experimental study has been planned utilizing earphones and cassettes in a unique way which will, if successful, provide a means of increasing the attention span of distractible students.

For the purposes of this study, a distractible student is defined as "one who, in the classroom setting, has difficulty in attending to a task which is within his capabilities."

Fifty third- and fourth-grade students are needed to participate in the study. The fifty will be randomly selected from a much larger list of about 150 to 200 students.

Your cooperation is requested in the compilation of a list of students who fit the behavioral description of the "distractible student" as given above. Please list the names of the students on this paper in the spaces indicated. Add other spaces if needed. Place the completed list in the envelope, seal it, and I will come by to pick it up.

Children whose names have been selected to participate in the study will receive letters informing their parents of the exact nature of the study and asking permission to include their child in the study.

Thank you for your cooperation,

Elizabeth Walters
Doctoral Assistant
Texas Woman's University

____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

To the Parents of ,

In providing appropriate instructional methods and materials for students, it sometimes becomes necessary to test such new methods, materials, and equipment before using them on a larger scale.

Your child's name was one of fifty which were randomly selected to participate in such a study. If you allow your child to help in this evaluation, he/she will miss about thirty minutes of class time on three separate occasions.

Please sign the lower part of this letter and return it to school to indicate that your permission has been granted for your child to participate in the study.

Thank you for your cooperation,

Elizabeth Walters
Texas Woman's University

____
(Student's Name)

has my permission to participate in the study.

____
(Parent or Guardian)

APPENDIX B

KEY MATH TESTS

SUBTEST	ITEM NUMBER	BEHAVIORAL OBJECTIVE
Part II--Operations:		
ADDITION	D-1	Given two sets, one of which has a single element, finds the sum of their elements.
	D-2	Given two sets, finds the sum of their elements.
	D-3	Given two sets, finds the sum of their elements.
	D-4	Given two one-digit numbers, one of which is the numeral one, computes their sum.
	D-5	Given two one-digit numbers, computes their sum.
	D-6	Given a one-digit and a two-digit number, computes their sum.
	D-7	Given two one-digit numbers, computes their two-digit sum.
	D-8	Given a one-digit and a two-digit number, computes their sum requiring regrouping.
	D-9	Given two two-digit numbers, computes their three-digit sum requiring regrouping.
	D-10	Given three numbers with up to four digits, computes their sum.
	D-11	Given two amounts of money with decimals and up to five digits, computes their sum.
	D-12	Given two numbers with decimal values to hundredths, computes their sum.
	D-13	Given two fractions with common denominators, computes their sum.

SUBTEST	ITEM NUMBER	BEHAVIORAL OBJECTIVE
	D-14	Given two mixed fractions without common denominators, computes their sum.
	D-15	Given two mixed fractions without common denominators, computes their sum requiring regrouping.
SUBTRACTION	E-1	Given a set of three, subtracts one element and computes result.
	E-2	Given a set of five, subtracts two elements and computes result.
	E-3	Given a set of eight, subtracts four elements and computes resu t.
	E-4	Given one-digit numbers, subtracts to compute result.
	E-5	Given one-digit numbers, subtracts to compute result.
	E-6	Given two-digit numbers, subtracts to compute result.
	E-7	Given a two-digit number and a one-digit number, subtracts with regrouping required.
	E-8	Given two-digit numbers, subtracts with regrouping required.
	E-9	Given a three-digit number and a two-digit number, subtracts with regrouping required.
	E-10	Given a three-digit number possessing two zeros, and a two-digit number, subtracts with regrouping required.
	E-11	Given numbers with decimal values to hundredths, subtracts with regrouping required.
	E-12	Given amounts of money with decimals and up to five digits, subtracts with regrouping required.

SUBTEST	ITEM NUMBER	BEHAVIORAL OBJECTIVE
	E-13	Given mixed fractions without common denominators, subtracts to compute result.
	E-14	Given mixed fractions without common denominators, subtracts with regrouping required.
MULTIPLICATION	F-1	Given two equal sets, multiplies to compute product.
	F-2	Given three equal sets, multiplies to compute product.
	F-3	Given a one-digit number, multiplies by the number two to compute product.
	F-4	Given a one-digit number, multiplies by itself to compute product.
	F-5	Given two one-digit numbers, multiplies, resulting in a two-digit product.
	F-6	Given a one-digit multiplier and a two-digit number, multiplies requiring regrouping, resulting in a two-digit product
	F-7	Given a one-digit number and a two-digit number, multiplies requiring regrouping, resulting in a three-digit product.
	F-8	Given a one-digit number and an amount of money with decimal and up to four digits, multiplies requiring regrouping.
	F-9	Given two two-digit numbers, multiplies requiring regrouping.
	F-10	Given two larger two-digit numbers, multiplies requiring regrouping.
	F-11	Given a mixed fraction and a one-digit number, multiplies to compute product.

SUBTEST	ITEM NUMBER	BEHAVIORAL OBJECTIVE
DIVISION	G-1	Given an even-numbered set, partitions into two equal subsets.
	G-2	Given an even-numbered set, partitions into four equal subsets.
	G-3	Given a one-digit number, divides by a one-digit divisor.
	G-4	Given a two-digit number, divides by a one-digit divisor.
	G-5	Given a two-digit number, divides by a one-digit divisor obtaining a two-digit quotient.
	G-6	Given a three-digit number, divides by a one-digit divisor with regrouping required.
	G-7	Given a three-digit number, divides by a two-digit divisor, obtaining a one-digit quotient.
	G-8	Given a fraction, divides by a fraction, reducing quotient to lowest terms.
	G-9	Given an amount of money with decimal and up to four digits, divides by a one-digit divisor.
	G-10	Given a four-digit number, divides by a two-digit quotient.

APPENDIX C

3	1	2	2	4	0	2	1
+4	+5	+3	+0	+3	+6	+5	+3
2	2	3	0	3	0	1	3
+3	+2	+4	+4	+3	+0	+6	+4
1	7	4	2	3	2	5	0
+2	+0	+2	+2	+0	+3	+2	+4

3	0	4	4	2	5	4	1
+3	+7	+1	+3	+1	+0	+2	+3
0	2	1	5	6	4	3	1
+5	+2	+4	+2	+1	+0	+2	+2
3	0	4	3	2	1	2	1
+1	+1	+3	+2	+3	+1	+0	+6
2	0	6	4	5	1	5	7
+4	+2	+0	+2	+2	+0	+1	+0

0	4	2	3	4	4	8	6
+10	+5	+8	+6	+4	+6	+1	+3
6	6	7	7	8	7	5	1
+4	+2	+3	+1	+2	+2	+4	+9
1	2	4	1	2	3	2	4
+7	+8	+5	+8	+6	+7	+7	+6

7	10	6	8	1	0	4	8
+1	+0	+3	+2	+7	+9	+5	+0
7	8	5	0	5	6	1	7
+3	+1	+3	+8	+4	+2	+9	+2
6	7	9	2	9	5	6	1
+4	+2	+1	+6	+0	+5	+4	+8
1	3	6	0	2	3	7	4
+7	+7	+4	+8	+7	+5	+2	+4

Add

31 + 3	74 2	11 8	84 4	42 0	50 7	26 0	61 2
51 4	70 3	96 1	85 3	70 2	43 3	29 0	92 4
41 5	53 2	35 1	52 7	18 0	64 1	50 6	67 0
42 3	84 0	26 2	90 1	13 5	60 8	32 1	44 3
71 0	98 1	42 5	24 5	30 0	62 6	75 0	81 7
50 9	96 3	12 2	83 1	33 4	53 6	71 6	27 1
20 4	15 2	13 0	67 2	81 1	35 4	72 4	98 1

Add

92	74	43	91	76	63	52	80	10	78
+10	74	81	94	83	43	64	27	12	51
80	80	72	61	35	74	90	82	30	63
38	74	93	87	74	60	21	96	90	56
17	54	47	45	80	21	60	71	46	82
91	85	30	63	89	72	95	30	92	61
51	93	22	61	96	8	45	51	93	95
56	34	92	75	41	60	70	98	80	72
72	31	64	83	39	94	50	87	96	25
45	83	62	45	20	51	73	52	60	81

Add

13	39	59	78	29	82	47	64
+ 8	9	1	8	7	8	8	7
37	79	49	26	74	58	17	98
5	4	6	8	9	5	3	9
28	99	86	68	59	96	18	41
7	2	7	6	3	5	3	9
88	27	95	48	19	69	46	52
4	4	7	2	8	5	6	9
63	45	97	15	84	67	75	56
9	6	7	5	6	9	8	4
55	38	89	43	93	24	76	87
9	8	9	8	7	8	9	6

3	4	5	3	2	5	6	7
−1	−4	−0	−3	−2	−2	−0	−2
7	7	6	7	7	6	5	6
−4	−0	−2	−6	−5	−4	−1	−6
5	7	6	7	5	7	6	7
−3	−1	−5	−7	−2	−3	−1	−2

3	2	7	1	4	7	5	6
−0	−1	−3	−1	−2	−7	−1	−2
4	7	1	4	5	3	6	7
−0	−1	−0	−2	−3	−2	−3	−5
4	7	5	6	6	2	7	3
−3	−6	−4	−0	−6	−0	−4	−3
5	6	1	6	6	7	4	6
−5	−1	−1	−3	−4	−0	−1	−5

13 −4	14 −6	9 −9	5 −4	14 −8	2 −2	14 −9	10 −3	5 −5	4 −2
11 −9	8 −7	10 −6	7 −2	13 −9	8 −4	11 −6	9 −1	7 −6	15 −9
13 −5	7 −5	6 −6	17 −8	6 −1	2 −0	15 −8	3 −0	9 −4	16 −8
10 −4	12 −3	5 −0	11 −8	15 −6	16 −9	4 −0	8 −3	9 −8	12 −7
9 −5	12 −6	8 −1	14 −5	7 −4	12 −9	10 −8	17 −9	6 −5	3 −3

5 −1	7 −7	8 −5	3 −2	13 −7	6 −2	9 −3	8 −0	9 −7	10 −5
11 −5	4 −3	7 −0	12 −4	1 −1	8 −2	14 −7	12 −8	6 −0	10 −7
3 −1	11 −7	8 −8	10 −9	6 −3	7 −3	13 −8	9 −6	15 −7	5 −2
16 −7	0 −0	18 −9	8 −6	7 −1	12 −5	10 −1	5 −3	11 −2	2 −1
1 −0	13 −6	4 −4	9 −0	11 −3	10 −2	11 −4	4 −1	6 −4	9 −2

90	83	84	41	52	33	81	75
−3	−6	−7	−6	−6	−5	−3	−7
21	40	92	72	10	87	64	51
−2	−8	−8	−4	−5	−9	−8	−7
12	82	63	70	36	45	60	80
−9	−4	−8	−2	−9	−8	−4	−9
93	34	50	26	46	71	94	62
−7	−5	−5	−7	−8	−4	−9	−3
30	22	61	32	31	43	53	28
−6	−7	−5	−7	−9	−4	−9	−9
47	91	76	54	74	65	20	55
−8	−4	−8	−9	−6	−6	−1	−9

54 −14	129 −62	100 −80	157 −85	148 −60	105 −95	103 −11	137 −57
69 −35	103 −43	116 −31	119 −86	122 −52	109 −77	116 −52	131 −61
97 −11	155 −93	109 −59	143 −80	126 −86	128 −42	116 −24	167 −74
103 −22	115 −64	132 −40	128 −73	18 − 8	104 −62	145 −70	168 −87
184 −93	159 −70	137 −90	108 −31	87 −66	139 −73	142 −51	157 −62
126 −90	129 −34	134 −81	175 −82	116 −45	177 −93	114 −90	149 −98
107 −95	120 −60	148 −60	109 −82	168 −94	118 −75	145 −141	155 −85

1080	1625	1094	1040	1534	1234
−412	−784	−937	−125	−906	−615
1752	1045	1333	1260	1539	1371
−882	−202	−619	−524	−676	−875
1771	1239	1165	1202	1482	1623
−932	−931	−847	−471	−723	−808
1472	1119	1300	1360	1014	1152
−505	−762	−780	−411	−673	−207
1007	1318	1119	1112	1425	1875
−334	−998	−639	−906	−695	−916
1208	1016	1191	1542	1163	1005
−394	−843	−448	−714	−304	−563
1036	1275	1419	1234	1184	1438
−766	−859	−910	−754	−508	−805
1678	1787	9676	1684	1589	1365
−796	−278	−5968	−939	−898	−557

2 ×5	4 ×3	6 ×3	7 ×4	8 ×1	7 ×5	5 ×3	4 ×4
8 ×2	3 ×4	8 ×5	4 ×1	7 ×3	1 ×2	9 ×1	4 ×2
6 ×4	2 ×0	7 ×2	0 ×1	2 ×4	5 ×5	1 ×4	9 ×5
1 ×4	5 ×5	7 ×2	9 ×5	0 ×1	2 ×4	6 ×1	9 ×4
3 ×1	8 ×4	9 ×3	4 ×5	3 ×2	5 ×1	1 ×3	6 ×5
3 ×3	1 ×1	2 ×3	0 ×4	3 ×5	6 ×2	8 ×3	7 ×1
0 ×3	1 ×5	2 ×1	5 ×2	9 ×2	0 ×5	2 ×2	5 ×4

1 ×1	6 ×6	4 ×1	7 ×8	0 ×1	5 ×3	1 ×9	2 ×4	4 ×0	5 ×5
4 ×9	3 ×1	2 ×9	4 ×4	9 ×6	1 ×2	8 ×0	7 ×9	3 ×7	6 ×4
0 ×6	8 ×9	6 ×8	3 ×4	7 ×2	9 ×2	1 ×7	5 ×0	8 ×4	2 ×7
3 ×5	0 ×2	5 ×8	9 ×4	6 ×1	0 ×0	8 ×7	2 ×6	3 ×9	1 ×8
5 ×6	4 ×3	8 ×1	6 ×9	4 ×5	7 ×6	1 ×3	5 ×4	6 ×7	0 ×7
3 ×0	2 ×2	6 ×3	3 ×8	7 ×0	4 ×6	8 ×3	0 ×4	9 ×5	3 ×6
2 ×8	7 ×5	1 ×5	4 ×8	9 ×9	0 ×9	3 ×3	6 ×5	2 ×0	9 ×3
5 ×9	8 ×8	1 ×0	9 ×8	5 ×7	8 ×2	0 ×5	9 ×1	2 ×5	7 ×7
5 ×1	0 ×8	7 ×1	4 ×7	8 ×6	1 ×6	9 ×7	4 ×2	8 ×5	6 ×0
1 ×4	7 ×3	2 ×1	9 ×0	3 ×2	6 ×2	0 ×3	7 ×4	2 ×3	5 ×2

92 ×5	61 ×5	70 ×5	54 ×5	73 ×5	50 ×5
38 ×5	47 ×2	10 ×3	36 ×2	29 ×3	30 ×4
20 ×3	16 ×4	33 ×5	45 ×4	40 ×5	27 ×2
62 ×2	90 ×2	53 ×2	71 ×2	82 ×2	14 ×2
63 ×3	74 ×3	51 ×3	93 ×3	80 ×3	52 ×3
94 ×4	55 ×4	72 ×4	60 ×4	64 ×4	83 ×4

1) 5	8) 32	4) 16	5) 10	3) 18	7) 28
9) 45	6) 24	7) 49	6) 18	1) 1	4) 36
1) 3	8) 8	7) 42	2) 14	3) 24	5) 30
5) 15	2) 12	5) 25	4) 20	8) 48	9) 72
7) 21	6) 30	3) 9	6) 6	3) 27	1) 6
5) 5	2) 4	5) 40	5) 20	8) 24	4) 4
6) 12	7) 7	3) 6	7) 14	1) 9	8) 64
8) 72	4) 32	1) 2	2) 16	7) 63	3) 15
3) 12	8) 16	6) 48	9) 9	2) 2	6) 42
2) 18	9) 54	1) 8	5) 35	7) 56	4) 8
1) 4	7) 35	4) 28	8) 56	9) 18	3) 21
8) 40	1) 7	9) 63	6) 36	9) 36	2) 6
5) 45	2) 8	2) 10	9) 81	4) 24	9) 27
5) 10	3) 18	7) 28	3) 3	6) 54	4) 12

4) 8	3) 6	4) 16	5) 30	2) 2	5) 15
4) 36	2) 10	2) 14	2) 18	4) 12	5) 10
3) 3	5) 25	2) 24	5) 5	3) 18	4) 20
5) 40	3) 27	5) 25	2) 8	3) 15	4) 4
3) 12	4) 28	2) 16	3) 21	2) 6	5) 20
3) 9	4) 32	2) 12	4) 24	5) 45	2) 4

4) 3684	3) 2499	7) 567	4) 480
4) 2448	7) 420	9) 810	8) 728
3) 126	5) 400	3) 126	4) 848
5) 255	8) 4088	6) 4266	8) 648
5) 405	9) 639	3) 369	3) 969
6) 1206	6) 546	7) 567	2) 846
7) 6307	6) 486	3) 6903	8) 5608
9) 819	7) 357	3) 1209	9) 7200

2) 28	2) 468	2) 65	5) 65	5) 355	5) 233
3) 93	3) 369	3) 65	5) 100	4) 380	3) 318
4) 44	4) 848	4) 189	3) 816	2) 217	5) 640
5) 50	5) 550	5) 657	2) 94	2) 152	2) 178
2) 106	3) 417	2) 119	3) 84	3) 243	3) 286
4) 846	5) 518	4) 932	4) 76	4) 248	4) 347