AN ABSTRACT OF THE THESIS OF

Donald S. Weinhouse for the degree of Doctor of Philosophy

in Education (Guidance and Counseling) presented on March 2, 1976

Title: THE EFFECTS OF AUDITORY METRONOMIC RATES ON ADDITION PERFORMANCE OF SECOND-GRADERS IN LINDSAY, CALIFORNIA

Abstract approved: Redacted for Privacy

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The purpose of this study was to investigate the effects of various auditory metronomic rates on addition performance of selected second-graders in Lindsay, California, and thereby test the theory that when such rates "approach and reach personal tempo the individual enjoys an optimal circumstance for learning" (Barsch, 1974, p. 5).

Sixty second-grade students were placed in six groups (ten in each group) based on sex and performance on the mathematics section of the Primary I Metropolitan Achievement Test (High-, Medium-, and Low mathematics levels). Each subject was then individually tested on eight, one-minute, equivalent Addition Computation Tests under different auditory environments (metronome beating at 40 beats per minute (b/m), 80 b/m, 120 b/m, 160 b/m, a self-selected Individual Rate, White Noise, and Reduced Auditory

Environment). The Classroom Noise condition was produced from a cassette recorder, while all other conditions reached subjects via headsets. Each completed test was given four different scores: 1)total number of addition responses, 2) number of correct addition responses, 3) number of incorrect addition responses, and 4) adjusted correct addition response score (20 plut twice the number of correct responses minus the number of incorrect responses). For each of the four sets of data, a three-way analysis of variance and F values were computed.

An analysis of the data revealed no significant differences (other than those which were a product of the design) for any of the four sets of data, under each of the three null hypotheses:

HO_1: There are no significant mean score differences between groups.

HO_2: There are no significant mean score differences between auditory stimuli conditions.

HO_3: There is no significant interaction between group levels and auditory stimuli conditions.

The conclusion that an "optimal circumstance for learning" (Barsch, 1974, p. 5) was not provided is supported by the analysis of variance which reveals that the metronomic rates presented to subjects did not in any predictable fashion affect addition performance.

Subjects were able to screen-out their immediate auditory environments and perform the task at hand.

It is possible that this screening-out process may have been aided by increased visual and tactile stimulation (looking around the room, at the experimenter, up and down the study carrel, and using their fingers as counters--touching them to their chins, cheeks, chests, and arms). It is also possible that the exposure times (30 seconds prior to testing and 60 seconds during testing) for each auditory stimuli condition may not have been long enough to affect performance.

None of the experimental conditions proved to significantly affect group performance; however, large standard deviations in the scores obtained by groups (small standard deviations would be expected because of the high correlations between the Addition Computation Tests and the attempt which was made to place subjects into somewhat homogenous mathematics performance levels), under each of the auditory stimuli conditions, suggest that individual differences may be hidden by groupings, or that other groupings might reveal significance.

The Effects of Auditory Metronomic Rates on Addition Performance of Second-Graders in Lindsay, California

by

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A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

Completed March 1976

Commencement June 1976

APPROVED:

Redacted for Privacy

Professor of Education
in charge of major

Redacted for Privacy

Dean of School of Education

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Dean of Graduate School

Date thesis is presented March 2, 1976

Typed by Mary Jo Stratton for Donald S. Weinhouse

ACKNOWLEDGEMENTS

Sincere appreciation is expressed to Dr. Mary Jane Wall, my advisor and major professor, who not only supported me throughout my doctoral program, but also introduced me to movigenics and the metronome.

Grateful acknowledgement is made to Dr. Alan Sugawara, who spent many hours with me in the construction of this research design.

To Dr. Gerald Becker, my deepest thanks for helping me to define who I am and what I do, and for treating me as a responsible and capable human being.

To Ted Chester, my statistician, my gratitude for sharing what I believe was a learning experience for both of us.

I also wish to thank Bob Gemar and the teachers and students of the second-grade at Washington Elementary School in Lindsay, California, without whom this study could not have been conducted.

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CHAPTER I

INTRODUCTION

Group instruction has been, and still is, a common educational technique in schools. It is a technique that works for some, but not for all. For those whose needs are not met, lowered achievement or failure may result (Brimer and Pauli, 1971). The experience of failure has been shown to have deleterious effects on the self-image of individuals (Hamachek, 1972).

In an attempt to correct this situation, a significant trend towards individualization of instruction has developed (Krug, 1972; National Schools Public Relations Association, 1971). While correcting some of the problems of group instruction (i.e., individuals can work at their own levels and speeds), this approach has not led to maximum individual attention or performance (Adams and Hotchkiss, 1972; Thompson, 1971; Trivette and White, 1969).

With children working on different tasks at the same time, classrooms have become more active and noisier than in the past. It is common to walk into a primary grade room and find some children reading silently while others are reading aloud in groups, playing games, or listening to tapes or records. This diversification, while allowing children much more freedom and individuality, also creates a confusing jumble of auditory stimuli.

Individuals react differently to different auditory stimuli. Some individuals work best under silent, or near-silent conditions, while others require varying degrees of external auditory stimuli in order to perform at an optimal level (Joiner and Kottmeyer, 1971; Klisz and Schwartz, 1972; O'Malley and Poplawsky, 1971). Research has demonstrated that different auditory stimuli yield varying levels of arousal in individuals, and that varying levels of arousal lead to differences in performance (Ottman, 1964; Weinstein and Mackenzie, 1966).

Barsch (1974) notes that individuals require different arousal levels for optimal performance, and suggests the use of "external synchronizers" (devices through which individuals can mask external auditory stimuli and bring external and internal worlds into rhythmic harmony) to achieve these arousal levels:

> When external synchronizers (programmed or accidental) approach and reach personal tempo the individual enjoys an optimal circumstance for learning. Receptiveness is at peak level, proprioceptive rhythm is smoothest, alignment is most stable, perception is most acute, attention is clearly centered and organization is most evident--a condition of 'best possible comfort' prevails. Anytime such a temporal circumstance can be assured a long step has been taken toward the guarantee of learning (p. 5).

The metronome has been used in many different settings as an "external synchronizer" (Barsch, 1974). Metronomes have been used to relax stutterers, lower blood pressure, pace speech and motoric performance, help psychiatric patients organize their thoughts during therapy, and help college students memorize lengthy lists of words or anatomical parts for examinations (Adams and Hotchkiss, 1973; Berman and Brady, 1973; Brady, 1973, 1974; Cott, 1969; Silvermann and Trotter, 1973; Silvermann, 1973).

Because individuals vary in their reactions to auditory stimuli, a means of providing each child with his own optimal auditory stimuli conditions may be found. Broadcasting one particular auditory stimuli throughout an entire classroom may benefit some children (those for whom that rate acts as an "external synchronizer"), but it may disturb others. In order to correct this, and allow all children to experience their own best rate, headsets (earphones) may be used. Headsets allow an individual to listen to a particular auditory stimuli without having that stimuli interfere with others.

For many years elementary school teachers have been using headsets as aids in reading, language development, and memorization. When attached to tape recorders or record players they act as masking devices, allowing children to screen-out other auditory stimuli and concentrate on the materials at hand. In a study of the effects of headsets on attention to tasks it was found that,

". . . increases in classroom attention and task attention and the changes in certain task performance. . .were due to a lessening of distracting sounds" (Fassler and Bryant, 1971, p. 203).

When the various rhythms of the metronome are transmitted through headsets, extraneous, erratic auditory stimuli are masked, and each child is allowed to function under his or her best auditory condition (Barsch, 1974). Under these conditions children appear to reach an optimal level of arousal for performance, and are assisted in focusing their attention on the task at hand.

If the goal that each child gain the most from his educational experience is to be realized, then it is the responsibility of educators to search out new and promising techniques which may help to achieve this. The metronome and headsets have been used in various settings to improve attention, relieve anxiety, and help individuals to concentrate and learn. It is now time to take these devices into the classroom and test their effect in that situation.

Purpose of the Study

The purpose of this study is to investigate the effects of various auditory metronomic rates on addition performance of selected second-graders in Lindsay, California.

Definition of Terms

For the purpose of this study the following definitions of terms are offered. Other terms or phrases in the study were deemed to be self-evident.

Auditory Stimuli Conditions refers to those sounds which enter through an individual's auditory modality. Conditions a through e, listed below, were produced by channeling 400 microsecond, one volt metronomic beats through headsets. The volume level for each of the five metronomic conditions was 70 $\pm$ 2 decibels (d/b). b/m is an abbreviation for beats per minute.

a. 40 b/m

b. 80 b/m

c. 120 b/m

d. 160 b/m

e. Individual Rate is that metronomic rate which was selected by the subject as his or her "favorite or most comfortable sound" (the individual rate varied from subject to subject, from 40 b/m to 208 b/m; however, for statistical purposes these various rates were grouped under the general heading of Individual Rate). Subjects were asked to say "stop" when they heard the rate they thought they could "work best with." The experimenter then moved the dial on the metronome (which was hidden from the subjects' view) from 40 b/m to 208 b/m and then from 208 b/m to 40 b/m, reversing the cycle for every other subject. This procedure required 20 seconds, and was repeated until the subjects made their selections.

f. White Noise is that auditory stimuli condition which exists when all sound frequencies are played simultaneously. It is a buzzing sound. This stimuli was recorded from a Random-Noise Generator (see Instruments, Chapter III) onto a tape cassette and broadcast through headsets at 70 $\pm$ 2 d/b.

g. Classroom Noise refers to varied auditory stimuli which were recorded in a second-grade classroom, while students were reading in groups and talking. These sounds were broadcast from a cassette recorder which was placed five feet from the subjects. A level of 70 $\pm$ 2 d/b was maintained throughout this condition.

h. Reduced Auditory Environment is that condition which exists when extraneous noise is diminished by headsets (headsets are worn, but no sound is directly emitted through them). All testing was done in a secluded, quiet classroom. Through the use of a Sound-Level Reader (see Instruments, Chapter III) the extraneous sound level for this condition was constantly monitored (a check was made every 30 seconds). The extraneous noise level remained below 60 d/b throughout all testing.

Addition Computation Tests refers to eight equivalent tests of 20, single-digit, vertical addition problems which were randomly selected from a list of all such possible combinations (60 seconds allowed for each test, see Appendix A).

a. Total Addition Responses is the total number of responses generated on a given addition computation test.

b. Correct Addition Responses is the number of correct responses generated on a given addition computation test.

c. Incorrect Addition Responses is the number of incorrect responses generated on a given addition computation test.

d. Adjusted Correct Addition Responses is an adjusted score that was derived by the following formula: 20 plus twice the number of correct responses minus the number of incorrect responses.

Mathematics Level is based on grade level equivalency scores in the mathematics test of the Primary I Metropolitan Achievement Test, administered to all subjects in the Spring of 1975. The total second-grade population of Washington School, in Lindsay, California, was divided into three groups: High, Medium, and Low, based on performance on this test, with 83 students in each group (see Subjects, Chapter III). Through the use of a random-numbers table, 60 experimental subjects and 12 alternate experimental subjects were selected.

Null Hypotheses

Each of the following null hypotheses was analyzed in terms of four different scores from the Addition Computation Tests (see Appendix A): 1) total number of addition responses, 2) number of correct addition responses, 3) number of incorrect addition responses, 4) adjusted correct addition response score. A minimum significance level of .05 was used as the criterion for statistical significance.

HO_1: There are no significant mean score differences between groups.

HO_2: There are no significant mean score differences between auditory stimuli conditions.

HO_3: There is no significant interaction between group levels and auditory stimuli conditions.

Limitations of the Study

This study includes the following limitations:

1) The subjects in this study were all elementary school students, which limits any findings to that particular age group.

2) The study was conducted in a small (population 5,300), rural town (Lindsay, California) with a population of approximately

48% Mexican-American and 52% Anglo-American children. This limits any generalization of findings to other such populations.

3) The results of this study may apply only to addition computation performance.

4) All testing was done during the morning hours (8:30 a.m. to 12:00 p.m.). An individual's internal rhythm may fluctuate during a given 24 hour period. This may limit any possible applications to the time period studied in this experiment.

Summary

This chapter presented an overview of the entire study. After briefly introducing the topic of auditory environments, the purpose of the study was stated and the fundamental terms used were defined. The null hypotheses were presented and limitations of the study were outlined.

The following chapter will review related literature.

CHAPTER II

REVIEW OF THE LITERATURE

The following review of literature is divided into six sections:

1. Individualization of Instruction
2. Effects of Noise
3. Internal and External Rhythms
4. The Metronome
5. Headsets
6. Summary

The unifying purpose of these sections is to support the investigation of the use of the metronome in elementary school classrooms as an aid to learning.

No direct research investigating the effects of the metronome on elementary school children's learning is cited. This researcher was unable to find any such study. Despite this fact, evidence will be provided to justify the introduction of metronomes into elementary school classrooms.

Individualization of Instruction

Individualized instruction is an educational technique which stresses developing programs and tasks around the particular strengths and weaknesses of each student, rather than grouping students and having them all participate in the same activities (Krug, 1972). The underlying philosophy of this technique is that children differ in their abilities, disabilities, and rates of learning, and therefore should be allowed to learn and grow in a way which is best suited to them. While this idea appears to be logical, research has not consistently supported it.

In one study of the effects of individualized instruction on the reading performance of 24 subjects it was not only found that individualized instruction had no significant positive effects, but it was also noted that the performance of 15 subjects actually dropped (Thompson, 1971).

Other studies have demonstrated significant positive gains in reading comprehension and speed, through individualized instruction, when compared to group instruction (National Schools Public Relations Association, 1972; Trivette and White, 1969); while it has also been suggested that individualized instruction may benefit some students, but not all (Adams, 1972).

The question of how children learn best, in groups or individually, has been asked for years, but has not yet received a definite, clear-cut answer (Brimer and Pauli, 1971). The issue is compounded by other factors which exist in the classroom.

One factor which has interfered with the success of individualized instruction is inappropriate learning environments

(Zifferblatt, 1972). In order for a particular instructional technique to succeed, the proper environment must be maintained (Cruickshank and Quay, 1970). When educational programs and learning environments are disharmonious, objectives may be blocked. An excellent example of this is the present trend towards individualized reading instruction, under conventional classroom conditions:

> Children may be required to concentrate on their individualized reading programs while sitting face-to-face in clusters of four or in standard row and column arrangements. The architectural message is to talk, look at your neighbor and interact, whereas the teacher's message is to concentrate on individualized reading (Zifferblatt, 1972, p. 55).

Many different environmental factors can impede learning (Brimer and Pauli, 1971). One of the most common impediments in elementary school classrooms is noise.

Effects of Noise

It has been well documented that noise affects individuals differently (Davies and Hockey, 1966; Hockey, 1972; Marsh, 1973). In a study of the effects of auditory distractions (50 decibel, 5 second, white noise interruptions) on the motoric performance of low-manifest anxiety (MA), middle-MA, and high-MA children, measured on the Klove Motor Steadiness Test (Klove, 1963), Klisz and Schwartz (1972) concluded:

> It seems, therefore, that auditory distractions may have served to increase drive in high- and medium-MA groups,

> and since the test was a rather simple one, probably had a different effect on the low-MA group. Unlike the high- and medium-MA groups, who had at least average level of drive, the low-MA group had a lower than average drive. Under an auditory distraction condition, the distraction may have disrupted attention more than it increased drive for the low-MA group (p. 206).

Klisz and Schwartz (1972) suggest that individuals function differently under different auditory conditions, and that if auditory distractors are very strong an individual's attention may shift from a given task to the distractor (p. 208).

Although individuals do differ in their responses to various auditory environments, some generalizations can be made. Various studies have demonstrated the deleterious effects of high levels of noise on working efficiency, learning rates, attention to task and auditory discrimination (Glass and Cohen, 1973; Joiner and Kottmeyer, 1971; Ottman and Poplawsky, 1971).

In a study of the effects of city noise on apartment dwellers Glass and Cohen (1973) concluded that " 'real life' noise reduces our frustration tolerance and interferes with our ability to work efficiently" (p. 96). There is also evidence that attention to extraneous cues is lowered under higher noise levels (O'Malley and Poplawsky, 1971).

O'Malley and Poplawsky (1971) tested 44 males in a college psychology class on a test of peripheral visual memory. Large four-letter words were displayed on a screen, surrounded by smaller three-letter words. The 44 subjects were randomly placed in one of four groups, and each group was exposed to a different auditory condition: 1) no noise, 2) 75 decibels, 3) 85 decibels, 4) 100 decibels. Conditions 2, 3, and 4 were intermittent noise (noise blurbs every four seconds). After 15 trials subjects were asked to write down as many of the peripheral words as they could remember. Subjects recalled significantly (.05 level) more peripheral words under condition one than conditions 2, 3, and 4. O'Malley and Poplawsky's (1971) conclusion was that "the results indicate a general reduction in the utilization of spatially peripheral, or irrelevant, information due to increases in noise induced arousal" (p. 889).

The preceding study demonstrates the negative effects of noise on peripheral learning. This same negative effect exists in learning or performing primary tasks (Joiner and Kottmeyer, 1971).

Joiner and Kottmeyer (1971) tested 80 Educable Mentally Retarded subjects, ages 11-19 years old, under four auditory conditions: 1) no noise, 2) ordinary class noise, 3) ordinary class noise with sporadic noise episodes, and 4) sporadic noise episodes. Subjects were asked to articulate a three-digit number shown on a screen for either 1/10 or 1/100 second. Analysis of data revealed significant effects (.05 level) of the various noise conditions, with the condition of no noise producing greatest success in number identification and noise episodes least. These findings indicate a distracting effect of noise on performance.

There is also evidence to suggest that the noises emitted in speech have a greater distracting effect than nonhuman noises. Canon (1967) tested 40 fourth-graders on a simple concept utilization task, under two auditory conditions: 1) social distractor (a female voice reading a story), and 2) a nonhuman distractor (nonhuman sound effects). Subjects performed significantly lower (.05 level) under the social distractor condition, leading the experimenter to conclude that the subjects' performances were more negatively effected by the human distractor than by the nonhuman distractor.

In opposition to the studies previously cited is a study by Meyer and Wurster (1972). Meyer and Wurster (1972) studied the effects of three different noise levels, quiet (45-55 decibels), average (55-70 decibels), and noisy (75-90 decibels), on mathematics and reading performance (the Mathematics Computation and Reading Sections of the Metropolitan Achievement Test, Form G, were used). The quiet treatment was attained by testing subjects in a soundproof room, while the average and noisy conditions were broadcast from a tape recording of actual classroom noise. Three experimental groups of fifth- and sixth-graders were matched on the basis of pretests in mathematics and reading. Meyer and Wurster's (1972) results showed no significant differences. Performance was not affected by the various auditory environments.

Despite such conflicting evidence, Cruickshank and Quay (1970) believe that minimization of extraneous environmental stimuli are related to a reduction in task inattention and activity level, unrelated to the task, and suggest the use of study carrels to help block-out interfering auditory and visual stimuli.

While many individuals may perform better under the conditions suggested by Cruickshank and Quay (1970), others may require more arousing or stressful environments. In an article entitled "Stress and Behavior," Seymour Levine (1971) summarizes the effects of various environmental influences:

> . . . the information we now have on the operations of the pituitary-adrenal system indicates that in many situations effective behavior in adult life may depend on exposure to some optimum level of stress (p. 31).

Working from the theory that increased auditory stimulation heightens arousal level and that individuals function differently under different arousal levels, various researchers have attempted to determine the effects of various auditory conditions on arousal levels and performance (Kaltsounis, 1973; Ottman, 1964). Ottman (1964) states: ". . . individual differences in field dependence may be due in part to differences in level of physiological arousal, which in turn affects breadth of attention" (p. 441).

Kaltsounis (1973) found that the arousal level achieved by playing music allowed his subjects to perform best in simple creative activities. Fifteen fifth-grade boys were asked to complete four sets of incomplete figures (scored for fluency, flexibility, originality, and elaboration), under four different auditory conditions: 1) music, 2) quiet (subjects wearing headsets in a sound-treated room), 3) speech (a recorded evening newscast played at 87 decibels), 4) noise (woodwork shop sounds played at 105 decibels). Subjects' mean performance was higher under music in all creative categories except elaboration. Industrial sound accounted for the lowest performance on all creative scores except fluency. Subjects also demonstrated significantly higher scores in fluency, originality, and elaborativeness under the quiet condition than under the speech condition.

All people are subject to environmental influences. Somehow, in some way, what occurs around them affects what occurs within them, and what occurs within them affects their perception of what is occurring around them (Lavie, 1974; Luce, 1971; Ward, 1971).

Internal and External Rhythms

While the noise-silence dimension is an important component in determining and controlling arousal levels, rate or rhythm must also be considered. Barsch (1974) states:

> When children encounter demands, stimulations and movements which are perceived to be too slow they lose sequence, continuity and content. Their immediate world seems to be creeping--they perceive events one frame at a time--seeing snapshots instead of movies, hearing single notes instead of melody, feeling points instead of action groups. Under such stress children often become rebellious, impatient, impulsive and contemptuous to signal their discomfort. At the opposing extreme, if a child perceives his immediate world to be moving too fast he also loses sequence, continuity, and content. He struggles amid blurring--instead of articulated configuration he sees indistinct blobs and streaks, instead of variable sound his auditory contends with white noise, instead of contrasts and textures his contacts yield only a flat, confusing field, instead of discrete, defined movements he experiences a proprioceptive muddle (p. 5).

The classroom teacher who speaks slowly and methodically may be able to retain the attention of some children (her rate of presentation may be rapid enough to keep them aroused), but she/he will no doubt force others to find their arousal elsewhere (i.e., daydreaming, foot-tapping, swaying . . .). Ralph G. Nichols, in his book Are You Listening? (1957), suggests that if an environment is not arousing enough to maintain an individual's interest, problems may arise as his attention drifts off. Nichols states, "But on one excursion you're bound to run into an especially enticing thought of your own" (p. 80).

External conditions can affect changes in internal equilibrium states. Alain Reinberg and Jean Ghata have worked extensively in the field of biological rhythms and conclude, "In man, as among animals and plants, internal timings of circadian rhythms are subject to the influence of rhythmic variations of environmental factors" (Reinberg and Ghata, 1957, p. 95).

Gary Gaer Luce (1971) believes that this environmental influence can be of utmost importance in the performance of children. Rhythmicity follows developmental patterns which are often unstable in childhood. Children with irregular rhythms are often "difficult children" who may be withdrawn, cautious, and inflexible (Luce, 1971).

Many studies have demonstrated significant results in lowering heart rate, blood pressure, and the incidence of migraine headaches by providing individuals with auditory and/or visual feedback from their own internal rhythms (Budzynski and Stoyva, 1969; Glass, 1968; Shapiro and Tursky, 1971). When patients with extreme hypertension were provided with external feedback from the rhythms of their internal cardio-vascular systems, Shapiro and Tursky (1971) found a significant (.02 level) decrease in systolic blood pressure in five of seven cases.

These observations lead to the conclusion that through the manipulation of an individual's external environment, it may be possible to alter the internal condition or rhythm, thereby affecting behavior.

The Metronome

All of this leads to the question: How can an atmosphere which will allow each individual to achieve his optimal level of arousal be provided? Barsch (1974) believes he has an answer: "When the personal tempo of a learner has been numerically defined the learning of new actions can be optimized if the learner approaches the task and practices at his tempo" (p. 36). With this goal in mind, Barsch, and others, employ the use of a metronome to help pace students. The metronome serves both as an auditory mask and as a device to arouse the learner to his optimal level--by providing a constancy between his external and internal environmental rhythms.

The metronome has been used for this purpose by many different disciplines, its most extensive use being in the areas of stuttering and stammering. The first recorded use of an external rhythm to assist stutterers in their speech was by Serre d'Alais, in 1837 (Beech, 1967). Serre d'Alais introduced a machine called an Isochrome, which emitted a regular beat which the stutterer was to follow as he spoke.

In 1963 Meyer and Mair constructed a tiny ear metronome, the basic model of which is still in use today. Meyer and Mair (1963), as well as others (Adams and Hotchkiss, 1973; Berman and Brady, 1968, 1973; Donovan, 1971; Sheehan, 1970; Silvermann, 1974), found that:

> . . . when a stutterer speaks in time with the beats of a metronome, pronouncing one word or one syllable of a word for each beat, his stuttering disappears completely or is very much reduced. The results of using a metronome to modify and control stuttering are extremely compelling (Beech, 1967, p. 50).

After studying the effects of auditory metronomic rates on reading speed and accuracy in adult stutterers, Jones and Arzin (1969) concluded:

> . . . when a stutterer speaks in time with an auditory metronomic beat, the stuttering is eliminated or greatly reduced . . . the metronome effect on stuttering results because rhythmicity of speech is restored by the rhythmic metronomic beat (p. 223).

Jones and Arzin (1969) had four subjects, 19-25 years old, read from a book while listening to different auditory metronomic rates (one-tenth, one-half, one, and two second continuous pitches interrupted by one second silent intervals). Experimental conditions as well as a control condition (no metronome, silence) were tape recorded and scored for number of errors and rate, by a panel of independent experts. A significant increase in rate and decrease in number of errors was found when pitches of from one to three seconds, with one second intervals, were played.

The metronome appears to have a relaxing or calming effect on stutterers. It helps take their attention away from their speech and allow for easier, steadier flow (Brady, 1968). This effect has also been noted by Cott (1969), in his work with schizophrenic patients.

Cott (1969) believes:

> . . . in schizophrenia the perception of duration of time, or time flow can vary frequently each day, and that the perception of the body, mind, and world can be asynchronous (p. 150).

Cott supports the use of the metronome to assist patients in achieving a sense of temporal synchrony. One patient stated that "the metronome is slowing me down inside--it makes me feel calm" (p. 152). Another patient was keenly aware of a gap between his mind and body tempos. His feeling was that:

> . . . whenever the gap between the two speeds is narrowed he feels better. The greater the gap, the more 'stuck' he feels. When the gap is the greatest, he experiences obsessive, ruminating thinking (p. 156).

For this patient the metronome helped achieve a rhythmic harmony between mind and body which allowed him to experience a sense of calmness or harmony. Cott concludes by stating:

> . . . with some future modifications it (metronome) may become a therapeutic tool of great value in adjusting the aberrations of time perception . . . . In many cases reported in this paper, depression was influenced favorably merely by increasing the patients' tolerance for a greater speed on the metronome (p. 159).

In another study on the relaxing effects of the metronome, Brady and Luborsky (1974) found it to be a useful tool in working with patients with essential hypertension. Brady's technique, which he calls Metronome Conditioned Relaxation (M.C.R.), consists of playing a tape recording which alternates between a voice saying "relax, let-go" and a metronome beating at 60 beats per minute. Using this technique, in daily one-half hour sessions, Brady was able to significantly reduce the blood pressure in three of four subjects; however, previous blood pressure levels returned after M.C.R. was discontinued. Brady's (1974) conclusion is that M.C.R. is successful, but must be continued on a regular basis.

Another interesting use of the metronome has been found in lowering arousal levels of preschool children (Brackbill and Adams, 1966). Brackbill and Adams found that an auditory metronomic rhythm of 72 beats per minute (played at 20 decibels above regular auditory conditions) was as effective as a heart beat, recorded and played at the same volume, in shortening the amount of time taken for a sample of 41 normal subjects, with a mean age of 34 months, to fall asleep. Both conditions were significantly more effective than a condition of silence.

Besides relaxing subjects and providing the learner with an auditory mask and an external environmental rate which is consistent with his internal environmental rate, the metronome may serve another function. In experiments on auditory stimuli Fraisse (1963) has found that, "an interrupted temporal interval seems longer than an empty interval" (p. 132). By providing an auditory metronomic background rate an individual's time perspective may be altered. The magnitude of this effect will vary according to the rate provided:

> (a) a divided interval appears longer than an empty interval of the same duration; (b) this effect is lessened when the total duration of the interval increases for the same number of interpolated sounds; and (c) an interval with more divisions appears longer than one with fewer (p. 132).

Headsets

Because individuals may require different auditory metronomic rates, or a given individual may require different rates at different times or for different tasks, a means through which that rate can be transmitted, without disturbing others, is required (Barsch, 1974). Headsets (earphones, ear protectors) can accomplish this, and, at the same time, help screen-out distracting auditory stimuli.

In a study of autistic children's attention to task it was found that "while wearing ear protectors in their customary classroom settings, 11 of the 20 subjects were more attentive" (Fassler and Bryant, 1971, p. 201).

Fassler (1970) also studied the effects of reduced auditory input, through the use of headsets, on various tasks: 1) Learning Test, 2) Digit Span Test, 3) Recall of Missing Picture Test, 4) Attention Test, 5) Designs Test, and 6) Syracuse Visual Figure Background Test, as performed by a sample of 30 cerebral palsied children and 35 nonhandicapped children. Fassler found that the cerebral palsied group improved significantly, with earphones, in all areas which required intellectual and cognitive skills and depended upon concentration and memory (Tests 1, 2, 3, and 4); however, no significant results were found in his nonhandicapped sample.

Further support for the use of headsets is provided by Barsch (1974):

> The use of headsets to close in the auditory field, eliminate background conflicts, reduce distractibility and more intensely personalize the metronomic beat represents a diversification in pacing practices. . . . This procedure is particularly helpful for those learners who experience difficulty in initiating or sustaining a controlled matching of action with beat. For children who demonstrate a reasonable synchrony between beat and action the use of headsets serves as an additional novelty but for those who do not grasp the notion of conformity we have found the headsets to be essential to the development of pacing (p. 24-25).

Summary

If educators are sincere in their desires to help children maximize their learning potentials, they cannot ignore these theories and their supporting research. They must seriously consider the effects of noise and auditory distractors on classroom learning, and attempt to minimize their influences. The use of steady, metronomic beats, played over headsets, may be an effective means to both block noise and present each learner with an appropriately arousing auditory environment--one which will help him to focus his attention on the task at hand and achieve at a maximal level.

CHAPTER III

METHODOLOGY

The methods and procedures described in this chapter include a description of the locale, subjects, instruments, method of testing, and statistics for analysis of data.

Locale

The subjects who participated in this study were all second-graders at Washington School, in Lindsay, California.

Lindsay is a small (population 5, 300), rural town in the east-central San Juaquin Valley (Tulare County). This is one of the most productive farming areas in the United States. The economy of Lindsay is based on its two most important crops, olives and oranges.

Lindsay is the home of the world's largest ripe olive canning plant, the Lindsay Olive Company. Besides the Lindsay Olive Company, there are three other large corporations in the area. However, over 50% of the labor force is agriculture related (i.e., farming, irrigation, packing, canning . . .).

The Lindsay Unified School District consists of four schools: 1) Lindsay High School, 2) Lindsay Junior High School, 3) Lincoln Elementary School (grades 4-6), and 4) Washington Elementary School (grades K-3). Washington School, where this study was conducted, maintains a staff of 34 credentialed personnel (26 classroom teachers, three reading specialists, one school psychologist, one mathematics specialist, one special education teacher, one school nurse, and one principal) and 22 non-credentialed instructional aides. The school serves 680 children ranging from kindergarten through third-grade.

The ethnic makeup of Washington School approximates that of the entire Lindsay School District and the town of Lindsay: 48% Mexican-American and 52% Anglo-American.

Subjects

The total second-grade population of Washington School is 189 students. The following procedure was followed to limit this number to 60 students (30 males and 30 females):

1. Students who met the following requirements were divided into six groups (High-, Medium-, and Low-mathematics level males and females), based on their grade level equivalencies from the mathematics section of the Primary I Metropolitan Achievement Test (taken in the Spring of 1975):
   a. Had attained at least a 1.3 grade level equivalency in the mathematics section of the Primary I Metropolitan Achievement Test. The reason for this was to limit the

study to subjects who were able to perform basic addition problems.

b. Had no previous record of any type of auditory disorder or epilepsy (this information was gained from school medical files). Auditory disorders were excluded because of possible problems in establishing consistent sound levels; epileptics were excluded because of the possibility of an auditory metronomic rate leading to a seizure.

2. Through the use of a random-numbers table ten experimental subjects and two alternate experimental subjects were selected from each of the six groups.

3. Written parental permission was obtained for all subjects, including alternates (Appendix D).

This procedure yielded a total of 60 experimental subjects and 12 alternate experimental subjects. Alternate experimental subjects were used in seven cases (four cases due to a lack of parental permission, and three cases due to the subjects requesting not to participate). A summary of the experimental group is given in Table 1.

Table 1. Summary Table of Experimental Group.

Mathematics level	Sex	Number	Mean age (years/ months)	Mean grade level equivalency and range on M. A. T.
high	male	10	7/4	2.6 (2.3-3.0)
medium	male	10	7/5	1.9 (1.7-2.1)
low	male	10	7/4	1.4 (1.3-1.6)
high	female	10	7/5	2.5 (2.3-3.1)
medium	female	10	7/4	1.9 (1.7-2.0)
low	female	10	7/4	1.4 (1.3-1.6)

Instruments

Tempo Tuner

A Tempo Tuner, type W3 (built by Electronic Research Products), was used to broadcast the metronomic rates. The Tempo Tuner possesses the following qualities: 1) plays metronomic rates from 40 to 208 beats per minute, and 2) comes equipped with an outlet for speakers or headsets.

Before testing any subjects the experimenter used a stop watch to calibrate the instrument, and accurately set the Tempo Tuner, $\pm$ 2 beats per minute, on 100 of 100 trials (25 attempts at each of the following settings: 40 b/m, 80 b/m, 120 b/m, and 160 b/m).

Sound-Level Reader

A type 1565-A Sound-Level Reader (built by General Radio

Company), with a range of 44 to 140 decibels, was used to standardize volume conditions on all experimental conditions.

Allied Headsets

The headsets used to broadcast the auditory stimuli conditions were Allied Supreme Stereo Headsets, model 876 (built by Allied Corporation).

Random-Noise Generator

The White Noise condition was reproduced on a cassette tape from a General Radio Company (type 1390 B) Random-Noise Generator, with a range of 20 kilocycles, and .9 volts (x 1.0) of power.

Primary I Metropolitan Achievement Test (M. A. T.)

The mathematics section of the Primary I Metropolitan Achievement Test (M. A. T.) consists of addition and subtraction computation problems as well as addition and subtraction word (story) problems. Students record their answers by marking the appropriate multiple choice.

The M. A. T. was used to obtain a content validity coefficient for the Addition Computation Tests (see Appendix A), and to place students into High, Medium, and Low groups, for statistical analysis. The method for establishing a content validity is discussed under the

Addition Computation Test section, which follows. Placement into High, Medium, and Low groups was accomplished by using grade level equivalency scores from the mathematics section of the M.A.T. Those 63 students who had the lowest grade level equivalencies were placed in the Low group; those 63 with the highest grade level equivalencies were placed in the High group; and the remaining 63 were placed in the Medium group. Experimental samples of 10 High males, 10 Medium males, 10 Low males, 10 High females, 10 Medium females, and 10 Low females (plus two alternates in each group) were then randomly selected from all eligible students (see Subjects, Chapter III).

Addition Computation Tests

The Addition Computation Tests (Appendix A) were constructed by the author. All possible single digit, vertical addition problems were randomly assigned to eight tests, with 20 problems in each test.

Face validity is demonstrated by definition. The test contains only addition computation questions and claims to be a test of addition computation skills. Content validity is demonstrated by high positive Spearman-Rho correlations with the mathematics test of the Primary I M.A.T. (M.A.T. scores were correlated with three separate scores from the Addition Computation Tests: 1) total number of responses, 2) number of correct responses, and 3) adjusted correct response score (20 plus twice the number of correct addition responses minus the number of incorrect responses)). Validity coefficients ranging from 0.72 to 0.80, with a mean of 0.76 (M.A.T. with total number of responses), 0.83 to 0.90, with a mean of 0.87 (M.A.T. with number of correct responses), and 0.84 to 0.91, with a mean of 0.89 (M.A.T. with adjusted correct response score) were computed (Appendix B).

These validity coefficients were determined by testing 30 second-graders from Washington School, in Lindsay, California, on both the mathematics test of the Primary I M.A.T. and the eight forms of the Addition Computation Tests. The M.A.T. was administered to the group in the Spring of 1975, by the school's testing specialist (a credentialed teacher) and the eight forms of the Addition Computation Tests were administered in the Fall of 1975 by the experimenter. Fifteen males (five High-, five Medium-, and five Low-mathematics level) and 15 females (five High-, five Medium-, and five Low-mathematics level) were randomly (random-numbers table used) selected from all second-graders who had not been selected as part of any experimental groups, and had met all requirements as stated in Subjects, Chapter III. A summary of subjects used to establish reliability and validity coefficients for the Addition Computation Tests is given in Table 2.

Table 2. Summary Table of Subjects Used to Establish Reliability and Validity Coefficients for Addition Computation Tests (see Appendix A).

Mathematics level	Sex	Number	Mean age (years/ months)	Mean grade level equivalency on M.A.T.
high	male	5	7/4	2.4
medium	male	5	7/5	1.8
low	male	5	7/5	1.5
high	female	5	7/5	2.4
medium	female	5	7/5	1.9
low	female	5	7/6	1.4

Coefficients of equivalence (Spearman-Rho) between the subtests of the Addition Computation Tests were established on the same sample of 30 second-graders, and range from 0.86 to 0.96, with a mean of 0.92, for total number of addition responses; 0.86 to 0.96, with a mean of 0.90, for number of correct addition responses; and 0.81 to 0.95, with a mean of 0.87, for adjusted correct addition response scores (Appendix B).

Method of Testing

The following procedure was followed for each subject tested:

1. All testing was done individually, between 8:30 a.m. and 12:00 p.m., in a secluded, quiet classroom. Subjects were seated facing the center section of a three-sided study cubicle. The

experimenter sat next to the subjects, constantly observing their performance.

2. The equipment was utilized as follows:

   a. The Tempo Tuner, Sony cassette tape recorder, stop watch, and noise-level reader were placed on the table in front of the experimenter, hidden from the subject's view by the study cubicle. The headsets were placed on the desk in front of the subject.

   b. The tape recorder and headsets were used to broadcast all metronomic rates; the headsets were used independently for the Reduced Auditory Stimuli condition; and the tape recorder was used independently, without headsets, for the Classroom Noise Condition.

3. Individual testing packets were prepared for each subject (Appendix C). This was accomplished by randomly ordering (random-numbers table) the eight Addition Computation Tests and the eight auditory stimuli conditions:

   1 = 40 beats (400 microsecond, one volt pulses) per minute broadcast through headsets at 70 $\pm$ 2 decibels.

   2 = 80 beats (400 microsecond, one volt pulses) per minute broadcast through headsets at 70 $\pm$ 2 decibels.

   3 = 120 beats (400 microsecond, one volt pulses) per minute broadcast through headsets at 70 $\pm$ 2 decibels.

4 = 160 beats (400 microsecond, one volt pulses) per minute broadcast through headsets at 70 $\pm$ 2 decibels.

5 = metronome beating (400 microsecond, one volt pulses) through headsets at rate which subject had chosen as his "most comfortable rhythm," at 70 $\pm$ 2 decibels (Independent Rate).

6 = White Noise played through headsets at 70 $\pm$ 2 decibels.

7 = taped Classroom Noise broadcast through a cassette recorder, reaching subjects at 70 $\pm$ 2 decibels.

8 = Reduced Auditory Environment, created by blocking auditory environmental stimuli (which remained below 60 decibels) with headsets.

The results of this random ordering were analyzed using chi-square, which supported the retention of all cells.

4. Each subject was assigned a number and that number was printed on his testing booklet. The number corresponded to a number on a separate sheet which was used to record the subject's name, age, and Mathematics level.

5. A testing booklet (the eight Addition Computation Tests, in various orders, labeled with the prearranged auditory stimuli condition to be presented, Appendix A) was laid face-down in front of the subjects. Subjects were told that they would listen to one of the eight auditory stimuli conditions for 30 seconds and

they could then begin their test. They could not turn their tests over until the experimenter said "begin." They had to stop writing the instant they heard "stop." After each 60-second test there was a 30-second rest period during which time the experimenter folded the packet to the next page, laid the booklet face-down, and prepared the next auditory stimuli condition. The next condition was played for 30 seconds before subjects were told to "begin."

6. In those cases where subjects continued writing after the 60-second time period, the experimenter made a slash mark (/) indicating how far the subject had actually worked in the allotted time. In cases where numbers were incomplete or difficult to discern, the experimenter used his judgment to determine whether they were correct or incorrect. Those cases which were completely indiscernible were scored as unanswered (no credit received or deducted).

7. The Individual Rate condition was presented as follows:

> I'm going to make the beats get faster and slower and faster and slower. Tell me to stop when you hear your favorite or most comfortable sound, O.K.? Remember, tell me to stop when hour hear the one you can work best with.

The experimenter then placed the headsets on the subject and began moving the dial on the metronome, which was hidden from the subject's view, from 40 b/m to 208 b/m to 40 b/m (the order was reversed for every second child: 208 b/m to 40 b/m to 208 b/m). Each cycle took 20 seconds to complete, and the procedure was repeated until the subject's selection was made. The subject was then exposed to that rate for 30 seconds, prior to testing, and throughout the 60 second test.

8. The following statement was read:

> I have some addition problems for you. You should work as fast as you can and try to get as many right as you can. If you miss one and you want to change it just cross it out and put in the right answer. Don't skip any problems. Do the top line first, going from left to right, and finish it before going on to the next line. On each test you have to stop as soon as I say 'stop.' I'm only going to give you 60 seconds, one minute, for each test, so try to finish as many as you can. You aren't expected to finish all of them, but do as many as you can. For some of the tests you'll be wearing the headsets. Try to ignore the sounds you hear and do the problems as fast as you can. Do you have any questions? . . . Let's practice some problems before we begin (all subjects were presented with three practice problems). Let's begin.

Statistical Analysis

A three-way analysis of variance was used to test all hypotheses under study and F values were generated for tests of the main effects of sex, mathematics level, auditory stimuli conditions and their interaction effects. A minimum significance level of .05 was used as the criterion for statistical significance.

Summary

Sixty second-grade students from Washington School, in Lindsay, California, were given eight equivalent, timed (60 second) Addition Computation Tests (see Appendix A) under eight different auditory stimuli conditions. Data on the effects of those eight conditions on total number of addition responses, number of correct addition responses, number of incorrect addition responses, and adjusted correct addition response scores are presented in Chapter IV.

CHAPTER IV

FINDINGS

This study was conducted during the Fall of 1975, at Washington Elementary School in Lindsay, California, to determine the effects of auditory metronomic rates on addition performance of selected second-graders. Sixty second-graders were divided into six groups (10 subjects in each group), based on sex and performance on the mathematics section of the Primary I Metropolitan Achievement Test. Subjects were individually administered eight equivalent Addition Computation Tests (see Appendix A), with each test being administered under different auditory conditions.

Analysis Procedure

The differences between sexes, mathematics levels, experimental conditions, and their interactions were analyzed by using a three-way analysis of variance technique. Each of the three null hypotheses are discussed in terms of four sets of scores:

1. Total Addition Responses: the total number of responses generated by subjects.
2. Correct Addition Responses: the number of correct addition responses generated by subjects.

3. Incorrect Addition Responses: the number of incorrect addition responses generated by subjects.

4. Adjusted Correct Addition Responses: twenty plus twice the number of correct responses minus the number of incorrect responses.

The probability level of at least .05 was used as the criterion for statistical significance.

Null Hypothesis One

HO_1: There are no significant mean score differences between groups.

Results: The null hypothesis was retained, for all four sets of data.

Null Hypothesis Two

HO_2: There are no significant mean score differences between auditory stimuli conditions.

Results: The null hypothesis was retained, for all four sets of data.

Null Hypothesis Three

HO_3: There is no significant interaction between group levels and auditory stimuli conditions.

Results: The null hypothesis was retained, for all four sets of data.

Discussion of Tables Three, Four, Five, and Six

Tables 3, 4, 5, and 6 present mean scores, for each experimental group, under all eight auditory stimuli conditions. The first six lines of each table represent the mean scores for the indicated experimental groups, under the eight different auditory stimuli conditions; lines seven and eight compare the performance of all males with that of all females, under each condition; and line nine compares the entire experimental sample (n = 60) with itself, under each condition.

Moving across each line allows for a comparison within the group indicated at the left side; while moving up and down columns reveals comparisons between groups, on the condition indicated at the top of the column.

A significant mean score difference between auditory stimuli conditions might be expected if a score in any given line diverged greatly from the mean of that line, however no such condition exists. It appears from these tables that groups performed quite consistently, regardless of their auditory environments.

Table 3. A Comparison of Mean Total Addition Response Scores of Experimental Groups under Each of the Eight Auditory Stimuli Conditions.

	I	II	III	IV	V	VI	VII	VIII	Mean I-VIII	
1. High males (n=10)	8.90	9.80	9.70	9.40	9.20	9.00	8.80	9.60	9.30	8.78
2. High females (n=10)	8.50	8.90	8.10	7.80	8.70	7.60	7.90	8.50	8.25	
3. Medium males (n=10)	7.70	8.10	7.00	7.50	7.50	7.00	6.70	7.90	7.43	7.44
4. Medium females (n=10)	7.60	8.40	7.40	6.90	7.40	7.60	6.60	7.60	7.44	
5. Low males (n=10)	5.10	5.70	5.30	6.40	5.90	5.30	5.40	5.30	5.55	5.75
6. Low females (n=10)	6.10	5.30	6.90	5.90	5.70	5.10	6.30	6.20	5.94	
7. All males (n=30)	7.23	7.87	7.33	7.76	7.53	7.10	6.96	7.60	7.43	
8. All females (n=30)	7.40	7.53	7.47	6.87	7.27	6.77	6.93	7.43	7.21	
9. All subjects (n=60)	7.32	7.70	7.40	7.32	7.40	6.94	6.95	7.52	7.32	

I.	40 b/m	V.	Individual Rate
II.	80 b/m	VI.	White Noise
III.	120 b/m	VII.	Reduced Auditory Environment
IV.	160 b/m	VIII.	Classroom Noise

Table 4. A Comparison of Mean Number of Correct Addition Responses of Experimental Groups under Each of the Eight Auditory Stimuli Conditions.

	I	II	III	IV	V	VI	VII	VIII	Mean I-VIII	
1. High males (n=10)	8.70	9.70	9.20	9.30	9.20	8.70	8.80	9.40	9.13	8.42
2. High females (n=10)	8.00	8.10	7.30	7.50	8.00	7.30	7.50	8.00	7.71	
3. Medium males (n=10)	7.00	7.10	5.70	6.20	6.40	6.20	5.80	6.80	6.40	6.23
4. Medium females (n=10)	5.90	6.70	6.10	5.50	6.10	6.70	5.20	6.30	6.06	
5. Low males (n=10)	3.00	3.80	3.40	4.30	4.30	3.50	3.50	4.30	3.76	4.05
6. Low females (n=10)	4.50	3.90	5.10	4.40	4.20	3.60	4.90	4.10	4.34	
7. All males (n=30)	6.23	6.87	6.10	6.60	6.63	6.13	6.03	6.83	6.43	
8. All females (n=30)	6.13	6.23	6.17	5.83	6.10	5.90	5.87	6.13	6.04	
9. All subjects (n=60)	6.18	6.55	6.14	6.22	6.37	6.02	5.95	6.48	6.24	

I.	40 b/m	V.	Individual Rate
II.	80 b/m	VI.	White Noise
III.	120 b/m	VII.	Reduced Auditory Environment
IV.	160 b/m	VIII.	Classroom Noise

Table 5. A Comparison of Mean Number of Incorrect Addition Responses of Experimental Groups under Each of the Eight Auditory Stimuli Conditions.

	I	II	III	IV	V	VI	VII	VIII	Mean I-VIII	
1. High males (n=10)	0.20	0.10	0.50	0.10	0	0.30	0	0.20	0.17	0.36
2. High females (n=10)	0.50	0.80	0.80	0.30	0.70	0.30	0.40	0.50	0.54	
3. Medium males (n=10)	0.70	1.00	1.30	1.30	1.10	0.80	0.90	1.10	1.03	1.19
4. Medium females (n=10)	1.70	1.40	1.30	1.40	1.30	0.90	1.40	1.30	1.34	
5. Low males (n=10)	2.10	1.70	1.90	2.10	1.60	1.80	1.90	1.00	1.76	1.68
6. Low females (n=10)	1.60	1.40	1.80	1.50	1.50	1.50	1.40	2.10	1.60	
7. All males (n=30)	1.00	0.93	1.23	1.17	0.90	0.97	0.93	0.77	0.99	
8. All females (n=30)	1.27	1.20	1.30	1.07	1.17	0.90	1.07	1.30	1.16	
9. All subjects (n=60)	1.14	1.07	1.27	1.12	1.04	0.94	1.00	1.04	1.08	

I.	40 b/m	V.	Individual Rate
II.	80 b/m	VI.	White Noise
III.	120 b/m	VII.	Reduced Auditory Environment
IV.	160 b/m	VIII.	Classroom Noise

Table 6. A Comparison of Mean Adjusted Correct Addition Response Scores of Experimental Groups under Each of the Eight Auditory Stimuli Conditions.

	I	II	III	IV	V	VI	VII	VIII	Mean I-VIII	
1. High males (n=10)	37.20	37.30	37.50	38.50	38.40	37.10	37.60	38.60	37.78	36.39
2. High females (n=10)	35.50	35.40	34.00	34.70	35.30	34.90	34.60	35.50	34.99	
3. Medium males (n=10)	33.30	33.20	30.10	31.10	31.70	31.60	30.70	32.50	31.78	31.29
4. Medium females (n=10)	30.10	32.00	30.90	29.60	30.90	32.50	29.00	31.30	30.79	
5. Low males (n=10)	23.90	25.90	24.90	26.50	27.00	25.20	25.10	27.60	25.76	26.45
6. Low females (n=10)	27.40	26.40	28.40	27.70	26.90	25.70	28.40	26.10	27.13	
7. All males (n=30)	31.47	32.13	30.83	32.03	32.37	31.30	31.13	32.90	31.77	
8. All females (n=30)	31.00	31.27	31.10	30.67	31.03	31.03	30.67	30.97	30.97	
9. All subjects (n=60)	31.24	31.70	30.97	31.35	31.70	31.17	30.90	31.94	31.37	

I. 40 b/m
II. 80 b/m
III. 120 b/m
IV. 160 b/m
V. Individual Rate
VI. White Noise
VII. Reduced Auditory Environment
VIII. Classroom Noise

A significant group effect would be expected if a score in a particular column diverged greatly from the mean of that column. This case exists frequently in columns I through VII, however, in each case the standard deviation (see Tables 7, 8, 9, and 10) are so large that no significance was found. An apparent group effect exists in the last column of each table (mean scores of all High- vs. all Medium- vs. all Low-mathematics level subjects), however this is a result of the grouping procedures employed in the design, and has no relevance to the hypotheses under study. We would naturally expect the High-mathematics level to perform better than the Medium-, who would be expected to perform better than the Low-.

Discussion of Tables Seven, Eight, Nine, and Ten

Tables 7, 8, 9, and 10 present further analysis of group results, based on the four sets of scores. Mean scores and standard deviations of each row and column apply to the groups indicated on the left side and top (scores represent averages of specified groups, combining all eight auditory stimuli conditions). A quick overview of each table reveals extremely large standard deviations. Large standard deviations are derived from large variances, which are products of wide ranges in scores. Considering the effort that was made to group students by ability (see Subjects, Chapter III), and the high correlations

Table 7. Group Mean Total Addition Response Scores and Standard Deviations--Performance under All Eight Auditory Stimuli Conditions Averaged Together for Each Group.

	Males (n=80)		Females (n=80)		Mean (males + females, n=160)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
High (n=80, 10 High- x 8 experimental conditions)	9.30	4.43	8.25	2.85	8.78	3.64
Medium (n=80)	7.43	3.42	7.44	3.16	7.44	3.29
Low (n=80)	5.55	2.77	5.94	2.65	5.75	2.71
Mean (High + Medium + Low, n = 240)	7.43	3.54	7.21	2.89	7.32	3.21

Table 8. Group Mean Number of Correct Addition Responses and Standard Deviations--Performance under All Eight Auditory Stimuli Conditions Averaged Together for Each Group.

	Males (n=80)		Females (n=80)		Mean (males + females, n=160)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
High (n=80, 10 High- x 8 experimental conditions)	9.13	4.24	7.71	3.49	8.42	3.87
Medium (n=80)	6.40	3.71	6.06	3.91	6.23	3.81
Low (n=80)	3.76	2.72	4.34	2.61	4.05	2.67
Mean (High + Medium + Low, n=240)	6.43	3.56	6.04	3.34	6.23	3.45

Table 9. Group Mean Number of Incorrect Addition Responses and Standard Deviations--Performance under All Eight Auditory Stimuli Conditions Averaged Together for Each Group.

	Males (n=80)		Females (n=80)		Mean (males + females, n=160)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
High (n=80, 10 High- x 8 experimental conditions)	0.17	0.44	0.54	0.74	0.36	0.59
Medium (n=80)	1.03	1.26	1.34	1.98	1.19	1.62
Low (n=80)	1.76	1.77	1.60	1.65	1.68	1.71
Mean (High + Medium + Low, n=240)	0.99	1.16	1.16	1.46	1.08	1.31

Table 10. Group Mean Adjusted Correct Addition Response Scores and Standard Deviations--Performance under All Eight Auditory Stimuli Conditions Averaged Together for Each Group.

	Males (n=80)		Females (n=80)		Mean (males + females, n=160)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
High (n=80, 10 High- x 8 experimental conditions)	37.78	8.63	34.99	8.15	36.39	8.39
Medium (n=80)	31.78	7.82	30.79	7.87	31.29	7.85
Low (n=80)	25.76	7.32	27.13	5.60	26.45	6.46
Mean (High + Medium + Low, n=240)	31.77	7.92	30.97	7.21	31.38	7.57

of the eight Addition Computation Tests (see Appendix B), the eight auditory stimuli conditions no doubt played some role in varying subjects' performances. Unfortunately, the groupings employed in this study do not support this effect as being significant (see Conclusions and Recommendations, Chapter V).

The mean scores and standard deviations in the last two columns of each table would suggest possible significance, but this was not pursued, once again due to the fact that these differences were a product of the research design (High-mathematics level subjects naturally perform better than Medium-, who in turn perform better than Low- subjects) rather than of the auditory stimuli conditions.

Discussion of Tables Eleven, Twelve, Thirteen, and Fourteen

In analysis of variance tables, testing the significance of an effect is done by computing the ratio of its mean square (MS) to the error mean square, and then comparing this to tabled values of the F statistic. In order that this test be appropriate, it is necessary that the error structure be the same in both numerator and denominator.

In Tables 11, 12, 13, and 14 two error terms (Student's (E_s), and residual (E)) are presented. The reason for this is that the Student's (E_s) error terms in each table include a correlation term, which is

Table 11. Analysis of Variance Table for Total Addition Response Scores.

Source	df	SS	MS	F value	Sig.
Sex (S)	1	4.219	4.219	0.059	-
M.A.T. Group (G)	2	743.459	321.727	5.210	.01
S x G	2	41.488	20.744	0.291	-
Students (E_s)	54	3852.965	71.351	-	-
Auditory Conditions (C)	7	23.281	3.326	1.212	-
S x C	7	11.765	1.680	0.612	-
G x C	14	35.213	2.515	0.917	-
S x G x C	14	17.979	1.284	0.468	-
Residual (E)	378	1037.138	2.744	-	-
Total	479	5767.502			

Table 12. Analysis of Variance Table for Number of Correct Addition Responses.

Source	df	SS	MS	F value	Sig.
Sex (S)	1	15.408	15.408	0.199	-
M.A.T. Group (G)	2	1526.904	763.452	9.839	.001
S x G	2	75.104	37.552	0.484	-
Students (E_s)	54	4190.049	77.594	-	-
Auditory Conditions (C)	7	18.600	2.657	0.899	-
S x G	7	11.692	1.670	0.565	-
G x C	14	34.163	2.440	0.825	-
S x G x C	14	24.696	1.764	0.597	-
Residual (E)	378	1117.349	2.956	-	-
Total	479	7013.965			

Table 13. Analysis of Variance Table for Number of Incorrect Addition Responses.

Source	df	SS	MS	F value	Sig.
Sex (S)	1	3.502	3.502	0.227	-
M.A.T. Group (G)	2	143.267	71.633	4.636	.05
S x G	2	6.717	3.358	0.217	-
Students (E_s)	54	834.338	15.451	-	-
Auditory Conditions (C)	7	4.265	0.609	1.055	-
S x C	7	4.515	0.645	1.118	-
G x C	14	4.267	0.305	0.529	-
S x G x C	14	11.417	0.815	1.412	-
Residual (E)	378	218.162	0.577	-	-
Total	479	1230.450			

Table 14. Analysis of Variance Table for Adjusted Correct Addition Response Scores.

Source	df	SS	MS	F value	Sig.
Sex (S)	1	94.519	94.519	0.256	
M.A.T. Group (G)	2	8104.320	4052.160	10.975	.001
S x G	2	387.800	193.900	0.525	-
Students (E_s)	54	19937.394	369.211	-	-
Auditory Conditions (C)	7	77.831	11.119	0.795	-
S x C	7	60.165	8.595	0.615	-
G x C	14	147.350	10.525	0.753	-
S x G x C	14	146.467	10.462	0.748	-
Residual (E)	378	5284.327	13.980	-	-
Total	479	34240.163			

needed for testing Sex (S), M.A.T. Group (G), and S x G. The correlations among the different tests taken by the same students introduce this additional error structure, which must be considered when testing for group effects (S, G, and S x G).

Tables 11, 12, 13, and 14 present the results of the three-way analysis of variance. F values are presented for the three main effects and four interaction effects.

The Sex (S) F value, comparing the results of all males vs. all females, fell below the tabular F in each table. This leads to the conclusion that no significant sex effect exists.

The M. A. T. Group (G) F value, all High- vs. all Medium- vs. all Low-mathematics level subjects, was significant for all four sets of data (.01 level for Total Addition Responses, .001 level for Correct Addition Responses, .05 level for Incorrect Addition Responses, and .001 level for Adjusted Correct Addition Responses). This means that a significant difference exists between the performances of the High-, Medium-, and Low-mathematics level groups; however, this is a product of the experimental design and is not relevant to the null hypotheses under investigation.

The Auditory Conditions (C) F values compare the performance of all subjects under each auditory stimuli condition. These values reveal that no significant differences exist, in any of the tables, between the total experimental sample's (n = 60) performance under the different auditory stimuli conditions.

The S x G (Sex x M.A.T. Group) source investigates the possibility of a significant interaction between these variables; however, none exists, in any of the tables.

The S x C (Sex x Auditory Condition) source investigates the possibility of a significant interaction between these variables; however, none exists, in any of the tables.

The G x C (M.A.T. Group x Auditory Condition) source investigates the possibility of a significant interaction between these variables; however, none exists, in any of the tables.

The S x G x C (Sex x M.A.T. Group x Auditory Condition) source investigates the possibility of a significant interaction between these variables; however, none exists, in any of the tables.

Individual Rates

The mean metronomic rates selected by groups, as well as their standard deviations, are presented in Table 15. While a quick look at the means might suggest significant differences, large standard deviations exist. These large standard deviations flatten the distribution curves, which leads to a large amount of overlap between groups, thereby lessening the possibility of finding significance.

Table 15. Mean Number of Beats per Minute and Standard Deviations of Rates Selected by Groups for Individual Rate Condition.

	Males		Females		Mean (males + females, n=20)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
High (n=10)	109.00	50.61	126.40	35.35	117.70	42.98
Medium (n=10)	92.50	42.41	86.20	35.26	89.40	38.83
Low (n=10)	120.80	46.77	94.80	38.54	107.80	42.66
Mean (High + Medium + Low, n = 30)	107.40	46.60	102.50	36.38	105.00	41.49

A separate analysis of variance of the Individual Rates selected by groups was computed in order to determine if there was a significant difference between those rates. Table 16 presents the results of this analysis. The F values computed for male vs. female (Sex, S), for High- vs. Medium- vs. Low-mathematics level group (Group, G), and their interaction (S x G) were all smaller than the tabular F values, leading to the conclusion that no significant difference exists.

Table 16. Analysis of Variance Table for Individual Rates Selected by Subjects.

Source	df	SS	MS	F value	Sig.
Total	59	118630.850			-
Sex (S)	1	370.017	370.017	0.190	-
M.A.T. Group (G)	2	8380.900	4140.450	2.124	-
S x G	2	4722.233	2361.117	1.211	-
Between cells	5	13373.150	2674.630	1.372	-
Residual	54	105257.700	1949.217	-	-

Summary

The data collected for this study were reported and analyzed in this chapter. A three-way analysis of variance technique was used to analyze all null hypotheses, in terms of four sets of data: Total Addition Response Scores, Number of Correct Addition Responses, Number of Incorrect Addition Responses, and Adjusted Correct Addition Response Scores.

HO_1: There are no significant mean score differences between groups.

Results: The null hypothesis was retained for all four sets of data.

HO_2: There are no significant mean score differences between auditory stimuli conditions.

Results: The null hypothesis was retained for all four sets of data.

HO_3: There is no significant interaction between group levels and auditory stimuli conditions.

Results: The null hypothesis was retained for all four sets of data.

Analysis of the Individual Rates selected by groups led to the conclusion that no significant difference exists between those rates.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Restatement of the Problem

Anyone who has ever had trouble sleeping while the kitchen sink was dripping, has been unable to read while the television set was playing, couldn't relax when the background music was too fast, or just couldn't fall asleep without the steady tick of their bedroom clock, will readily testify to the effects that external auditory environments can have on internal functioning.

People can close their eyes and not see, but, try as they may to not listen, sounds still impinge upon their systems.

Most elementary school classrooms abound in sounds of varying frequencies and volumes. Books dropping, clocks ticking, children laughing, and chalk scratching, together create an auditory jungle in which children are expected to study and learn. While research has demonstrated that different sounds affect individuals differently, little direction has been provided for the teacher who desires to present his or her students with an optimal auditory environment for learning.

Recent research on the effects of the metronome has suggested the possibility that individuals may become more relaxed and perform better, in certain areas, when an external auditory metronomic rate or rhythm is synchronized with their own internal rate or rhythm.

The main objective for conducting this study was to determine if auditory metronomic rates affected addition performance of second-graders, and if so to analyze those effects. The second objective was to generate basic research in the area of the metronome as an instructional aide.

Summary of the Study

Sixty second-grade students were placed in six groups (ten in each group) based on sex and performance on the mathematics section of the Primary I Metropolitan Achievement Test (High-, Medium-, and Low-mathematics levels). Each subject was individually tested on eight, one-minute, equivalent Addition Computation Tests (see Appendix A). Each test was presented under a different auditory environment (metronome beating at 40 beats per minute (b/m), 80 b/m, 120 b/m, 160 b/m, a self-selected Individual Rate, White Noise, Classroom Noise, and Reduced Auditory Environment). The Classroom Noise condition was produced from a cassette recorder, while all other conditions reached subjects via headsets. Each completed test was given four different scores: Total Number of Addition Responses, Number of Correct Addition Responses, Number of Incorrect Addition Responses, and Adjusted Correct Addition Response Scores (see Definition of Terms, Chapter I). A three-way analysis of variance technique was used to analyze the three null hypotheses of this study.

Analysis of Data

Separate analyses of variance were computed for all four sets of data, resulting in the retention of the null hypotheses in every case.

HO_1: There are no significant mean score differences between groups.

HO_2: There are no significant mean score differences between auditory stimuli conditions.

HO_3: There is no significant interaction between group levels and auditory stimuli conditions.

It was also found that no significant difference existed between the Individual Rates selected by groups.

Conclusions

The conclusions that follow result from an analysis of the findings, the survey of literature, and the experience of conducting the study.

This study has demonstrated that auditory metronomic rates of 40, 80, 120, 160, and a self-selected number of beats per minute do not in any predictable fashion affect addition performance of second-graders. The auditory metronomic rates presented to the groups being studied in this design did not present subjects with "an optimal circumstance for learning" (Barsch, 1974, p. 5). Subjects were able to screen-out their immediate auditory environments and perform the task at hand.

The preceding conclusions were drawn from the analysis of variance and F values which this design generated. A further look at the standard deviations in the subjects' scores, the study's limitations, and the experimenter's experiences while conducting this study yield a deeper understanding of the data.

Considering the high positive correlations between the eight Addition Computation Tests, and the attempt which was made to group students by performance levels, small standard deviations, within groups, would be expected. The large standard deviations which occurred (see Tables 7, 8, 9, and 10) indicate that the auditory stimuli conditions did affect individual performance.

The standard deviations listed in these tables reveal a wide range in scores within groups. It is possible that grouping subjects in another way (i.e., by activity level and/or attention span) may have led to significant results (perhaps the "synchronizing" effects of the metronome are only of benefit to children who are out of "synchrony" and exhibit exceptional activity and/or attention behaviors). It is also possible that significant individual differences may be hidden by the groupings.

One possible explanation of the lack of significant findings in this study is that the 30-second exposure to each experimental condition, prior to testing, may not have been sufficient. The auditory environments presented were no doubt experienced to some degree by every subject tested; however, it is possible that the excitement of the testing situation may have lessened the effects of that preparation period by diverting subjects' attention to other aspects of their environments.

The experimenter noticed a distinct pattern of rapid eye movements in subjects (looking around the room, up and down the study carrel, at the experimenter . . .), during the 30-second preparation period. This increased visual input may have interfered with the effects of the auditory inputs.

It must also be considered that addition is a highly stressed skill in the second grade at Washington School. Subjects may have been so accustomed to taking tests such as the ones presented that they were able to rely on patterned behaviors and techniques, and screen-out the auditory inputs.

The majotiry of students used their fingers as counters. They touched their fingers to their chins, cheeks, chests, and arms in order to assist in adding numbers together. This increased tactile contact may have served to maintain attention on the task, reducing the effects of the auditory inputs.

In this study, under these conditions, the theory that certain auditory metronomic rates lead to improved academic performance cannot be supported. This study provides a serious challenge to those who support the use of the metronome as a device to improve student performance in the classroom.

Recommendations for Further Study

Replication of this study should be carried on with: different groupings of subjects (i.e., by activity level and/or attention span); a longer exposure, prior to testing, for each experimental condition; an emphasis on individual differences, rather than the group emphasis which this design was based upon; tasks other than addition computation (i.e., reading performance or manual dexterity); and different age groups, in an attempt to discover possible developmental trends.

BIBLIOGRAPHY

Adams, Martin R. and John Hotchkiss. 1973. Some reactions and responses of stutterers to a miniaturized metronome and metronome-conditioning therapy: Three case reports. Behavior Therapy 4(4):565. July.

Adams, Phyllis J. 1972. Individualized reading: Variables that make a difference. ERIC ED065 844.

Aschoff, Jurgen. 1965. Circadian rhythms in man. Science CSLVII(149):1427-1432. June.

Barsch, Ray H. 1974. Each to a different drummer. Canoga Park, California, Ray H. Barsch Center for Learning.

Beech, Reginald. 1967. Stuttering and stammering. Psychology Today 1(3):48-52. July.

Berman, Perry A. and John P. Brady. 1973. Miniaturized metronomes in the treatment of stuttering: A survey of clinician's experiences. Journal of Behavior Therapy and Experimental Psychology 4(2):117-119. June.

Berry, R.C. and G. Patrick Nerbonne. 1971. A comparison of the masking functions of speech modulated and white noise. The Journal of Audiology and Speech Research 11:248-250.

Brackbill, Yvonne and Gail Adams. 1966. Arousal level in neonates and preschool children under continuous auditory stimulation. Journal of Experimental Child Psychology 4:178-188.

Brady, John Paul. 1968. A behavioral approach to the treatment of stuttering. American Journal of Psychiatry 125(6):843-848. December.

Brady, John Paul. 1973. Metronome-conditioned relaxation: A new behavioral procedure. British Journal of Psychiatry 122:729-730.

Brady, John Paul and Lester Luborsky. 1974. Blood pressure reduction in patients with essential hypertension through metronome-conditioned relaxation: A preliminary report. Behavior Therapy V:203-209.

Brimer, M.A. and L. Pauli. 1971. Wastage in education: A world problem. ERIC ED061 647.

Budzynski, Thomas A. and Johann M. Stoyva. 1969. An instrument for producing deep muscle relaxation by means of analog information feedback. Journal of Applied Behavioral Analysis 2:231-237.

Canon, Lance K. 1967. Motivational state, stimulus selection and distractibility. Child Development 38:589-596. June.

Cott, Allan. 1969. The metronome as a measuring device in the study of disorders of 'time flow' in schizophrenia. Schizophrenia (third quarter) 1(3):148-160.

Cruickshank, William N. and Herbert C. Quay. 1970. Learning and physical environment: The necessity for research and research design. Exceptional Children 34(4):261-269. December.

Davies, D.R. and G.R.J. Hockey. 1966. The effects of noise and doubling the signal frequency on individual differences in visual vigilance performance. British Journal of Psychology 57(3, 4): 381-389.

Donovan, G.E. 1971. A new device for the treatment of stammering. The British Journal of Disorders of Communication 6(1):86-88. April.

Fassler, Joan and N. Dale Bryant. 1971. Disturbed children under reduced auditory input: A pilot study. Exceptional Children 38(3):197-204. November.

Fassler, Joan. 1970. Performance of cerebral palsied children under conditions of reduced auditory input. Exceptional Children 37:201-209. November.

Fraisse, Paul. 1963. The psychology of time. New York, Harper and Row.

Frazier, Thomas W. and John A. Rummel. 1968. Circadian rhythmicity in vigilance performance. Aerospace Medicine 39(4):383-395.

Glass, A. 1968. Intensity of attenuation of alpha activities by mental arithmetic in females and males. Physiology and Behavior 3(2):217-220.

Glass, David C. and Sheldon Cohen. 1973. Urban din fogs the brain. Psychology Today 6(12):94-99. May.

Goldstein, Kurt. 1948. Language and the language disturbance. New York, Stratton Publishers.

Hamachek, Don E. 1972. Effects of early school failure experiences on self-image development and implications for school counselors. ERIC ED062 669.

Hartley, L.R. 1974. Performance during continuous and intermittent noise wearing ear protection. Journal of Experimental Psychology 102(3):512-516.

Haubrich, Paul Arthur. 1971. An analysis of cubicle and consequence techniques in educating emotionally disturbed children. Doctoral dissertation, University of Wisconsin.

Hoch, P.H. and J. Zubin. 1955. Psychopathology of children. New York, Grune and Stratton.

Hockey, G.R. 1972. The effects of noise on human efficiency and some individual differences. Journal of Sound and Vibration 29(3):399-404.

Holt, John. 1970. How children fail. New York, Dell Printing.

Houston, Kent B. 1969. Noise, task difficulty, and Stroop color-word performance. Journal of Experimental Psychology 82(2): 403-404.

Joiner, Lee M. and Wayne A. Kottmeyer. 1971. Effect of classroom noise on number identification by retarded children. California Journal of Educational Research 12(4):164-169. September.

Jones, R.J. and N.H. Arzin. 1969. Behavioral engineering: Stuttering as a function of stimulus duration during speech synchronization. Journal of Applied Behavior Analysis 2(4): 223-229.

Kaltsounis, Bill. 1973. Effect of sound on creative performance. Psychological Reports 33:737-738.

Klisz, Diane and Melvin L. Schwartz. 1972. Effects of manifest anxiety and auditory distraction on a motor steadiness battery. Perceptual and Motor Skills 35:203-209.

Klove, H. 1963. Clinical neuropsychology. In: F.M. Forster (ed.), The medical clinics of North America. New York, Saunders. pp. 1647-1658.

Krug, Mark M. 1972. What will be taught--the next decade. ERIC ED063 269.

Lavie, Peretz. 1974. Rhythm in human performance. Catalog of Selected Documents in Psychology 4:39. Spring.

Lawrence, Jodi. 1972. Alpha brain waves. Chicago, Avon Publishing.

Levine, Seymour. 1971. Stress and behavior. Scientific America 224(1):26-31. January.

Luce, Gay Gaer. 1971. Body time: Physiological rhythms and social stress. New York, Random House.

Margolis, Judith Silberman. 1972. Academic correlates of sustained attention. Doctoral dissertation, University of California at Los Angeles.

Marsh, Dorothy. 1973. Auditory figure ground ability in children. American Journal of Occupational Therapy 27(5):218-225.

Meyer, JoAnn and Stanley R. Wurster. 1972. The effect of three noise levels on task attention and performance in reading and mathematics with fifth and sixth grade students. ERIC ED082 327.

Morris, Larry W. and Robert M. Liebert. 1970. Relationship of components of test anxiety to physiological arousal and academic performance. Journal of Consulting and Clinical Psychology 35(3):332-337. December.

National Schools Public Relations Association. 1971. Individualization in schools: The challenge and the options. ERIC ED056 002.

Nichols, Ralph G. 1957. Are you listening? New York, McGraw-Hill.

O'Malley, John J. and Alex Poplawsky. 1971. Noise-induced arousal and breadth of attention. Perceptual and Motor Skills 33:887-889.

Ottman, Philip K. 1964. Field dependence and arousal. Perceptual and Motor Skills 19:441.

Piaget, J. 1971. Biology and Knowledge. Chicago, University of Chicago Press.

Piaget, J. 1952. The origins of intelligence. New York, Norton Publishing.

Price, Landon Dewey. 1973. The trouble with 'poor auditory discrimination.' Academic Therapy 8(3):331-338.

Reinberg, Alain and Jean Ghata. 1957. Biological rhythms. New York, Walker and Company.

Robertshaw, Carroll Stuart. 1971. An investigation of attention to task behavior, arithmetic performance and behavior problems in first grade children. Doctoral dissertation, University of Kansas.

Samuels, S. Jay and James E. Turnure. 1974. Attention and reading achievement in first-grade boys and girls. Journal of Educational Psychology 66(1):29-32. February.

Sanders, Derek A. 1961. The influence of noise on two discrimination tasks. Ergonomics 4:253-257.

Seiden, Henry M. 1969. The perspective and style of consciousness: An exploratory study. Doctoral dissertation, New School for Social Research.

Shane, James. 1970. Time perception: A comparative study of Mexican-American and Anglo-American subjects involving temporal sense and perception. Doctoral dissertation, Oklahoma State University.

Shapiro, David and Bernard Tursky. 1971. Decreased systolic blood pressure through operant conditioning techniques in patients with essential hypertension. Science 173:740-742. August.

Sheehan, Joseph G. 1970. Stuttering: Research and therapy. New York, Harper and Row.

Silverman, Franklin H. 1974. Effects of pacing speech with a miniature electronic metronome on the frequency and duration of selected disfluency behaviors in the spontaneous speech of adult stutterers. Behavior Therapy 5(3):410-414. May.

Silverman, Franklin H. and William Trotter. 1973. Impact of pacing speech with a miniature electronic metronome upon the manner in which a stutterer is perceived. Behavior Therapy 4(3):414. July.

Silverman, Franklin H. 1971. A rationale for the use of the hearing-aid metronome in a program of therapy for stuttering. Perceptual and Motor Skills 32:34.

Slater, Barbara R. 1968. Effects of noise on pupil performance. Journal of Educational Psychology 59:239-243. August.

Somervill, John W. and Larry S. Warnberg. 1973. Effects of cubicles versus increased stimulation: On task performance by first-grade males perceived as distractible and nondistractible. Journal of Special Education 7(2):169-185.

Thompson, Richard A. 1971. Summarizing research pertaining to individualized reading. ERIC ED065 836.

Trivette, A.C. and Kinnard White. 1969. Title III, Co-op STEP: Statistical report showing the effect of individual instruction and team teaching upon the academic growth of high school students in English. ERIC ED062 355.

Ward, Ritchie R. 1971. The living clocks. New York, Alfred A. Knopf Co.

Weinstein, Alexander and Richard S. Mackenzie. 1966. Manual performance and arousal. Perceptual and Motor Skills 22:498.

Zifferblatt, Steven M. 1972. Architecture and human behavior: Toward increased understanding of a functional relationship. Educational Technology 12(8):54-57. August.

APPENDICES

APPENDIX A

ADDITION COMPUTATION TESTS

TEST 1

$\begin{array}{r} 1 \\ +\underline{0} \end{array}$	$\begin{array}{r} 6 \\ +\underline{8} \end{array}$	$\begin{array}{r} 5 \\ +\underline{6} \end{array}$	$\begin{array}{r} 4 \\ +\underline{4} \end{array}$	$\begin{array}{r} 5 \\ +\underline{1} \end{array}$
$\begin{array}{r} 4 \\ +\underline{7} \end{array}$	$\begin{array}{r} 8 \\ +\underline{9} \end{array}$	$\begin{array}{r} 3 \\ +\underline{2} \end{array}$	$\begin{array}{r} 3 \\ +\underline{6} \end{array}$	$\begin{array}{r} 6 \\ +\underline{3} \end{array}$
$\begin{array}{r} 1 \\ +\underline{7} \end{array}$	$\begin{array}{r} 8 \\ +\underline{4} \end{array}$	$\begin{array}{r} 4 \\ +\underline{0} \end{array}$	$\begin{array}{r} 6 \\ +\underline{7} \end{array}$	$\begin{array}{r} 6 \\ +\underline{6} \end{array}$
$\begin{array}{r} 1 \\ +\underline{3} \end{array}$	$\begin{array}{r} 5 \\ +\underline{3} \end{array}$	$\begin{array}{r} 2 \\ +\underline{1} \end{array}$	$\begin{array}{r} 5 \\ +\underline{0} \end{array}$	$\begin{array}{r} 8 \\ +\underline{1} \end{array}$

total ____________

correct _________

incorrect _______

adjusted ________ sex ____________

I. D. # ___________ level __________

condition _______

TEST 2

$+\frac{8}{9}$	$+\frac{0}{6}$	$+\frac{3}{9}$	$+\frac{1}{6}$	$+\frac{0}{7}$
$+\frac{7}{5}$	$+\frac{3}{0}$	$+\frac{4}{7}$	$+\frac{4}{5}$	$+\frac{9}{2}$
$+\frac{4}{2}$	$+\frac{9}{9}$	$+\frac{2}{1}$	$+\frac{3}{2}$	$+\frac{9}{4}$
$+\frac{2}{4}$	$+\frac{4}{8}$	$+\frac{5}{1}$	$+\frac{6}{5}$	$+\frac{8}{6}$

total ____________

correct ________

incorrect _______

adjusted ________ sex ____________

I. D. # ___________ level __________

condition ________

TEST 3

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

total ___________

correct ________

incorrect ______

adjusted _______ sex ___________

I. D. # __________ level __________

condition ______

TEST 4

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

total ____________

correct _________

incorrect _______

adjusted ________

I. D. # ___________

condition _______

sex ____________

level __________

TEST 5

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

total ___________

correct _________

incorrect _______

adjusted ________ sex ____________

I. D. # _________ level __________

condition _______

TEST 6

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

total ____________

correct _________

incorrect _______

adjusted ________

I. D. # ___________

condition _______

sex ____________

level ___________

TEST 7

$\begin{array}{r}2\\+\underline{3}\end{array}$	$\begin{array}{r}5\\+\underline{5}\end{array}$	$\begin{array}{r}9\\+\underline{3}\end{array}$	$\begin{array}{r}9\\+\underline{5}\end{array}$	$\begin{array}{r}4\\+\underline{1}\end{array}$
$\begin{array}{r}0\\+\underline{5}\end{array}$	$\begin{array}{r}5\\+\underline{4}\end{array}$	$\begin{array}{r}4\\+\underline{6}\end{array}$	$\begin{array}{r}8\\+\underline{4}\end{array}$	$\begin{array}{r}3\\+\underline{6}\end{array}$
$\begin{array}{r}6\\+\underline{1}\end{array}$	$\begin{array}{r}9\\+\underline{0}\end{array}$	$\begin{array}{r}8\\+\underline{7}\end{array}$	$\begin{array}{r}4\\+\underline{3}\end{array}$	$\begin{array}{r}6\\+\underline{5}\end{array}$
$\begin{array}{r}1\\+\underline{8}\end{array}$	$\begin{array}{r}8\\+\underline{9}\end{array}$	$\begin{array}{r}3\\+\underline{0}\end{array}$	$\begin{array}{r}1\\+\underline{1}\end{array}$	$\begin{array}{r}3\\+\underline{4}\end{array}$

total ____________

correct _________

incorrect _______

adjusted ________

I. D. # ___________

condition _______

sex ____________

level __________

TEST 8

$\begin{array}{r}5\\+\underline{8}\end{array}$	$\begin{array}{r}4\\+\underline{6}\end{array}$	$\begin{array}{r}2\\+\underline{3}\end{array}$	$\begin{array}{r}5\\+\underline{5}\end{array}$	$\begin{array}{r}3\\+\underline{1}\end{array}$
$\begin{array}{r}4\\+\underline{5}\end{array}$	$\begin{array}{r}6\\+\underline{7}\end{array}$	$\begin{array}{r}0\\+\underline{4}\end{array}$	$\begin{array}{r}2\\+\underline{4}\end{array}$	$\begin{array}{r}6\\+\underline{5}\end{array}$
$\begin{array}{r}1\\+\underline{7}\end{array}$	$\begin{array}{r}0\\+\underline{9}\end{array}$	$\begin{array}{r}6\\+\underline{6}\end{array}$	$\begin{array}{r}4\\+\underline{7}\end{array}$	$\begin{array}{r}4\\+\underline{3}\end{array}$
$\begin{array}{r}0\\+\underline{7}\end{array}$	$\begin{array}{r}1\\+\underline{5}\end{array}$	$\begin{array}{r}0\\+\underline{3}\end{array}$	$\begin{array}{r}3\\+\underline{7}\end{array}$	$\begin{array}{r}6\\+\underline{8}\end{array}$

total ___________

correct ________

incorrect ______

adjusted _______ sex ___________

I. D. # _________ level _________

condition _______

APPENDIX B

SPEARMAN-RHO CORRELATION COEFFICIENTS BETWEEN THE EIGHT ADDITION COMPUTATION TESTS AND THE METROPOLITAN ACHIEVEMENT TEST

SPEARMAN-RHO CORRELATION COEFFICIENTS

(total number of addition responses)

$$P = 1 - \frac{6 \Sigma D^2}{N(N^2 - 1)} \qquad N = 30$$

	M.A.T.	Test I	Test II	Test III	Test IV	Test V	Test VI	Test VII	Test VIII
M.A.T.	1.0	.72	.80	.78	.73	.77	.72	.78	.75
Test I		1.0	.90	.92	.91	.92	.95	.92	.92
Test II			1.0	.95	.94	.95	.88	.94	.96
Test III				1.0	.91	.94	.89	.91	.92
Test IV					1.0	.92	.86	.92	.94
Test V						1.0	.90	.93	.94
Test VI							1.0	.90	.89
Test VII								1.0	.92
Test VIII									1.0

1) Spearman-Rho correlations of total number of addition responses from the Addition Computation Tests (numbers I-VIII), with the mathematics section of the Primary I M.A.T. range from .72 to .80, with a mean correlation of .76.

2) Spearman-Rho correlations between total number of addition responses, from the eight forms of the Addition Computation Tests, range from .86 to .96 with a mean of .92.

SPEARMAN-RHO CORRELATION COEFFICIENTS

(number of correct addition responses)

N = 30

	M.A.T.	Test I	Test II	Test III	Test IV	Test V	Test VI	Test VII	Test VII
M.A.T.	1.0	.88	.88	.89	.89	.90	.84	.87	.83
Test I		1.0	.91	.89	.90	.88	.88	.88	.87
Test II			1.0	.96	.94	.92	.93	.95	.92
Test III				1.0	.91	.92	.92	.92	.91
Test IV					1.0	.89	.87	.93	.92
Test V						1.0	.89	.87	.86
Test VI							1.0	.88	.87
Test VII								1.0	.88
Test VIII									1.0

1) Spearman-Rho correlations of number of correct addition responses, from the Addition Computation Tests (numbers I-VIII), with the mathematics section of the Primary I M.A.T. range from .83 to .90, with a mean of .87.

2) Spearman-Rho correlations between number of correct addition responses from the eight forms of the Addition Computation Tests, range from .86 to .96, with a mean of .90.

SPEARMAN-RHO CORRELATION COEFFICIENTS

(adjusted correct response scores)

N = 30

	M.A.T.	Test 1	Test II	Test III	Test IV	Test V	Test VI	Test VII	Test VIII
M.A.T.	1.0	.90	.89	.90	.90	.91	.86	.88	.84
Test I		1.0	.88	.85	.83	.85	.85	.84	.82
Test II			1.0	.95	.90	.90	.89	.92	.86
Test III				1.0	.87	.91	.90	.91	.87
Test IV					1.0	.88	.84	.87	.87
Test V						1.0	.86	.84	.83
Test VI							1.0	.88	.82
Test VII								1.0	.81
Test VIII									1.0

1) Spearman-Rho correlations of adjusted correct response scores, from the Addition Computation Tests (numbers I-VIII), with the mathematics section of the Primary I M.A.T. range from .84 to .91, with a mean of .89.

2) Spearman-Rho correlations between adjusted correct response scores, from the eight forms of the Addition Computation Tests, range from .81 to .95, with a mean of .87.

APPENDIX C

FORMAT FOR TEST BATTERY CONSTRUCTION

FORMAT FOR TEST BATTERY CONSTRUCTION

Equivalent forms of Addition Computation Test = numbers 1-8

Auditory Stimuli Conditions = numbers I-VIII

I = 40 b/m
II = 80 b/m
III = 120 b/m
IV = 160 b/m
V = Individual rate
VI = White Noise
VII = Classroom noise
VIII = Reduced Auditory Environment

Battery Number	Form Number / Auditory Stimuli Condition number							
1	5	2	4	6	1	8	7	3
	II	V	VII	VI	IV	III	VIII	I
2	6	1	3	7	8	5	4	2
	III	VII	V	II	VIII	I	VI	IV
3	3	6	4	2	5	7	8	1
	VIII	I	IV	II	VI	VII	V	III
4	6	1	5	4	2	7	3	8
	VIII	VI	VII	I	II	III	IV	V
5	3	4	6	1	7	8	5	2
	V	VIII	VI	II	III	IV	VII	I
6	6	7	3	1	5	4	2	8
	V	II	IV	III	VI	VII	I	VIII
7	1	6	3	2	4	7	8	5
	VII	III	V	VI	I	II	VIII	IV
8	8	2	6	3	1	5	4	7
	VI	IV	II	VII	V	III	VIII	I
9	3	8	1	5	6	7	4	2
	II	IV	V	VIII	I	III	VII	VI
10	5	3	7	8	2	6	4	1
	VI	II	III	VII	VIII	V	I	IV

Battery Number	Form Number Auditory Stimuli Condition number							
11	6 VI	2 II	7 IV	5 V	8 VII	3 I	1 VIII	4 III
12	2 I	6 VIII	8 VI	7 II	1 III	4 V	5 IV	3 VII
13	8 VI	1 III	7 V	3 II	4 VIII	5 IV	6 VII	2 I
14	2 V	6 VII	5 II	1 I	7 VIII	8 III	3 VI	4 IV
15	7 VII	3 V	5 II	8 I	2 VI	6 VIII	4 III	1 IV
16	1 II	3 III	5 IV	7 V	8 VIII	2 VII	4 VI	6 I
17	6 I	2 VI	7 VII	4 V	3 II	1 III	5 VIII	8 IV
18	8 IV	6 VI	5 V	7 II	3 I	1 VIII	4 III	2 VII
19	7 VI	1 VII	6 II	8 VIII	3 III	5 V	2 IV	4 I
20	6 V	4 I	1 VI	8 II	5 VIII	7 III	2 VII	3 IV
21	8 VI	5 VIII	7 VII	2 III	1 V	3 IV	6 I	4 II
22	8 VI	3 I	1 VIII	7 V	5 IV	4 II	2 VII	6 III
23	7 V	4 VI	1 VIII	5 IV	3 I	8 II	2 III	4 VII
24	2 II	6 V	3 I	8 IV	4 VIII	1 III	7 VII	5 VI

Battery Number	Form Number Auditory Stimuli Condition number							
25	3	6	2	1	4	5	7	8
	II	V	I	IV	VIII	III	VII	VI
26	4	7	5	8	6	3	1	2
	V	II	VI	VIII	I	IV	VII	III
27	1	7	3	5	2	4	6	8
	VII	VI	I	VIII	IV	III	V	II
28	7	4	1	3	6	2	5	8
	III	VII	IV	I	II	V	VI	VIII
29	1	5	4	2	8	7	3	6
	VII	IV	V	VIII	II	III	I	VI
30	3	6	1	5	8	4	7	2
	VIII	V	IV	II	VI	I	III	VII
31	1	6	7	2	4	3	8	5
	II	V	VII	IV	III	VIII	I	VI
32	5	1	2	7	8	3	4	6
	II	I	VII	III	VI	IV	V	VIII
33	7	4	3	1	5	8	2	6
	IV	VIII	V	I	VII	VI	II	III
34	8	5	7	2	1	3	6	4
	IV	III	VI	VIII	VII	II	I	V
35	3	1	6	4	2	8	5	7
	VI	VIII	IV	I	V	VII	III	II
36	6	1	7	3	4	2	5	8
	VI	II	I	VIII	V	VII	III	IV
37	5	2	1	4	7	8	3	6
	I	II	VI	VIII	IV	V	II	VII
38	2	5	6	7	3	8	4	1
	V	VI	IV	VIII	VII	II	I	III

Battery Number	Form Number / Auditory Stimuli Condition number							
39	1	7	2	8	3	4	5	6
	II	I	IV	III	VIII	VI	VII	V
40	2	6	1	8	7	4	3	5
	I	VIII	IV	VII	III	V	II	VI
41	4	1	3	6	7	2	5	8
	III	I	VIII	II	VI	IV	V	VII
42	5	7	2	6	4	1	8	3
	IV	VIII	VI	I	II	V	VII	III
43	3	7	1	5	2	6	8	4
	II	III	V	IV	I	VI	VIII	VII
44	1	6	2	5	3	4	7	8
	V	III	VIII	I	IV	VI	II	VII
45	4	8	5	1	2	6	3	7
	VIII	VI	IV	V	VII	I	III	II
46	2	6	7	1	5	4	3	8
	VII	II	III	VI	IV	VIII	V	I
47	8	5	6	3	4	2	7	1
	III	VII	I	II	VIII	VI	V	IV
48	2	5	1	4	8	3	7	6
	I	III	VIII	IV	VII	VI	V	II
49	1	3	5	7	8	6	2	4
	VII	III	V	I	II	VI	VIII	IV
50	8	4	1	3	5	7	2	6
	III	VIII	VI	IV	VII	I	II	V
51	6	8	4	1	2	5	3	7
	IV	VIII	V	III	II	VI	VII	I
52	1	5	3	2	4	6	7	8
	VIII	VI	VII	IV	I	III	II	V

Battery Number	Form Number / Auditory Stimuli Condition number							
53	7 IV	6 III	5 II	2 I	8 V	1 VII	4 VI	3 VIII
54	6 I	3 V	5 III	2 VI	4 VIII	8 VII	1 IV	7 II
55	8 V	1 IV	7 II	6 I	3 VIII	4 III	5 VI	2 VII
56	6 II	4 VI	2 III	7 IV	8 VIII	5 I	1 VII	3 V
57	4 IV	8 VIII	3 V	1 III	5 VII	7 VI	6 I	2 II
58	7 V	6 VI	1 IV	8 VIII	4 VII	3 II	2 I	5 III
59	4 V	6 VII	8 VI	5 VIII	1 I	3 III	2 IV	7 II
60	8 I	1 VII	3 III	4 II	5 V	6 VI	7 IV	2 VIII

APPENDIX D

PARENTAL PERMISSION FORM

PARENTAL PERMISSION FORM

Dear Parents,

I'm conducting a study, at Washington School, on the effects of different noises on addition performance. I would like your child to participate in this study. The total test time is about 20 minutes.

Your child will listen to different sounds, through headsets, while answering addition problems. The test is simple and easy and your child should enjoy it.

In order to test your child I must have your written permission. Please fill-out and return the form below, as soon as possible.

Thank you,

Don Weinhouse

Queridos Padres,

Voy a derigir un programa en la escuela Washington, de estudio de los efectos de diferentes sonidos. Deseo de que su niño puede participaren en este estudio. El tiempo total del examen son 20 minutos.

Su niño va oi'r diferentes sonidos por tele'fonos de oi'dos al mismo tiempo va estar sumando problemas vocales. El examen es muy faci'l y simple, su niño se va a divertir' mucho.

En orden de que su niño pueda participar, necessito su permiso. Por favor de firmar esta nota y regresarla lo mas pronto que pueda.

Muchas Gracias,

Don Weinhouse

Don Weinhouse has my permission to test my child.

El senor Weinhouse tiene mi permiso de examinar mi niño.

child's name	signature	date
nombre del niño	firma	fecha

APPENDIX E

RAW DATA

RAW DATA

40 b/m		80 b/m		120 b/m		160 b/m		Independent Rate		White Noise		Reduced Noise		Class Noise	
tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor
								High Males							
8	8	12	12	10	8	8	8	2	2	8	8	5	5	6	6
8	7	5	4	9	8	6	5	8	8	6	5	8	8	9	9
8	8	7	7	10	10	10	10	9	9	10	9	12	12	8	8
15	15	16	16	14	13	15	15	19	19	15	15	13	13	16	16
5	5	7	7	8	8	7	7	4	4	7	7	7	7	8	8
10	9	19	19	11	11	16	16	17	17	13	12	13	13	19	19
6	6	2	2	6	5	5	5	7	7	8	8	5	5	7	7
14	14	18	18	13	13	13	13	14	14	14	14	10	10	13	13
9	9	8	8	8	8	8	8	6	6	8	8	8	8	7	5
6	6	4	4	6	6	6	6	6	6	1	1	7	7	3	3
								Medium Males							
5	5	5	4	1	1	4	4	5	4	6	5	4	3	7	7
8	8	7	7	8	7	6	5	6	5	6	6	6	6	8	7
4	3	6	4	5	3	4	3	4	4	4	3	4	2	5	3
5	5	8	8	4	4	7	6	5	5	6	6	6	5	6	6
10	10	10	10	12	12	12	12	12	12	11	11	10	10	10	10
9	8	10	10	12	12	10	10	10	10	10	10	8	8	12	12
4	4	5	4	2	1	3	2	5	5	1	1	3	3	5	4
11	6	12	7	9	3	13	5	11	4	9	4	9	5	11	5
5	5	5	4	4	1	4	3	5	4	6	5	5	5	2	1
16	16	13	13	13	13	12	12	12	11	11	11	12	11	13	13

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RAW DATA

40 b/m		80 b/m		120 b/m		160 b/m		Independent Rate		White Noise		Reduced Noise		Class Noise	
tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor
								Low Males							
7	0	6	2	8	3	7	2	6	1	7	2	8	1	4	2
5	3	3	1	4	4	4	4	1	1	5	3	4	3	4	4
1	1	3	3	0	0	1	1	3	3	7	7	0	0	1	1
4	1	7	4	5	3	8	4	7	5	4	1	6	1	6	4
7	3	7	5	8	5	10	5	9	6	10	7	9	5	7	5
9	9	11	11	10	8	8	8	11	11	6	6	10	10	12	12
4	3	4	4	3	2	7	5	7	5	1	0	3	3	3	3
2	2	1	1	5	3	4	3	5	3	3	2	1	1	4	3
5	4	5	2	2	0	5	3	3	3	3	1	4	2	5	3
7	4	8	5	8	6	10	8	7	5	7	6	9	9	7	6
								High Females							
9	9	10	10	11	8	8	7	7	7	8	8	9	9	8	8
5	5	7	6	8	8	5	5	8	7	6	6	7	6	7	6
7	5	3	1	4	3	6	6	8	7	4	3	6	6	5	4
4	2	5	4	5	4	6	5	6	3	5	3	5	3	5	3
9	8	7	6	6	6	8	7	7	6	7	7	8	8	8	7
13	13	15	14	13	13	10	10	12	12	13	13	11	10	11	11
10	10	10	9	12	12	8	8	9	9	11	11	7	7	11	11
11	11	13	12	14	12	10	10	12	11	11	11	13	13	14	14
8	8	8	8	2	2	8	8	6	6	5	5	3	3	6	6
9	9	11	11	7	6	9	9	12	12	9	9	10	10	10	10

(Continued on next page)

RAW DATA

40 b/m		80 b/m		120 b/m		160 b/m		Independent Rate		White Noise		Reduced Noise		Class Noise	
tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor	tot	cor
Medium Females															
9	5	8	5	9	6	8	5	6	5	9	8	6	2	8	7
2	2	1	1	4	4	0	0	1	1	0	0	1	1	4	3
12	11	8	6	9	9	11	11	10	9	9	8	9	7	10	9
5	3	7	5	7	4	5	3	5	4	5	4	5	4	5	3
6	5	7	7	7	7	7	7	8	8	7	7	5	5	9	9
9	2	8	1	8	1	7	0	8	1	6	0	7	2	6	1
5	5	10	10	4	4	10	10	10	10	11	11	6	6	8	8
9	7	13	13	10	10	9	9	11	11	9	9	12	12	10	9
14	14	11	11	11	11	9	7	10	7	14	14	12	11	11	10
5	5	8	8	5	5	3	3	5	5	6	6	3	2	5	4
Low Females															
5	4	5	5	6	5	5	3	0	0	3	2	7	6	5	5
4	2	1	0	3	3	2	1	2	2	3	2	4	2	2	1
2	2	1	1	5	4	4	4	4	4	4	4	3	3	3	3
6	5	3	2	7	6	5	5	3	3	7	6	5	3	5	4
6	4	5	3	6	4	9	5	5	3	2	1	3	2	7	4
10	10	9	8	8	6	9	8	6	5	8	7	10	10	10	10
5	3	4	1	8	6	5	3	6	5	5	3	6	5	7	5
5	5	7	6	7	6	5	3	10	8	5	3	5	3	6	2
8	1	7	3	10	3	6	2	9	3	7	2	8	3	9	2
10	9	11	10	9	8	11	10	12	9	7	6	12	12	8	5