EFFECTS OF SEDATIVE BACKGROUND MUSIC ON
MATHEMATICS PERFORMANCE AND ON-TASK BEHAVIOR OF
LEARNING-DISABLED ELEMENTARY SCHOOL CHILDREN

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"If I am not for myself, who will be for me?
If I am only for myself, who am I for?
And if not now, when?"

Rabbi Hillel
CHAPTER I

INTRODUCTION

It is a fascinating time to be a student in the area of Learning Disabilities. The whole area is relatively new; it is only 20 years since learning disabilities began to gain prominence, and only 8 years since the passage of P.L. 94-142 gave even more impetus to the field. It is a fascinating time because new techniques are being constantly developed. Some to be discarded, others to be incorporated into this new behavioral science. How many educators could foresee 20, or even 10 years ago, the avalanche of computer software which would so suddenly crash into our classrooms? Who can imagine what new techniques and strategies will evolve in the next decade?

Helen Sutherland, an instructor at The Ohio State University, suggested that one of the beauties of behavior modification techniques is that it makes teaching a science (1982), and thus, this author concludes, takes teaching out of the realm of an art—no longer a mystic power available only to those lucky few born under the right star. Of course, teachers will always need to be intuitive, compassionate, enthusiastic and energetic, but scientifically gathered data will give educators the information needed to optimize their students’ achievement.

While behavioral modification techniques aimed directly at academics through changing methods and materials are evolving, techniques to change social behaviors are also being studied. Changing behavior to more socially desirable forms, is a major goal of public education.
Hyperactivity and distractability are problems common to many learning and behavior disabled children. Based on the premise that decreasing these inappropriate behaviors while increasing task-relevant behavior might lead to higher achievement levels, various behavior modification techniques have been studied, methods evolved, and principles established. Extensive research has shown many behavior modification procedures to be effective in increasing task-relevant behaviors and decreasing inappropriate behaviors; whether indirect strategies such as removing distracting stimuli and the use of study carrels, or direct intervention through the use of contingent reinforcement techniques.

The use of music as an instructional tool, through its effects on behavior, is one area of research. Although the use of contingent music in the classroom is not yet widespread, music has been shown to be an effective contingent reinforcer in studies conducted by Davis (1977), Jorgensen (1974), Madsen and Forsythe (1973), and Steele (1977). Music may also affect behavior through less direct means. Behavior may be modified through the use of background music, i.e., music to which we are not attentive as opposed to conventional music which is intended for entertainment and promotes thoughtful awareness by the listener (Mahler, 1978).

The possibilities of background music as an instructional tool in the classroom have not been widely explored. Those studies that have been undertaken have generally been conducted with college students or normal children. It is possible that the effects of background music on the behavior of learning disabled children may differ markedly from the effects on normal children or on older populations. The purpose of this study was
to analyze the effects of background music on the rate of mathematics achievement and on-task performance of learning disabled elementary school children.

Statement of the Problem

The purpose of this study was to determine the effect of manipulating the classroom environment through the introduction of sedative background music. Specific behaviors measured as a function of music and no-music conditions were: (1) mathematics achievement during a 15-minute mathematics seatwork assignment; (2) on-task behavior during a 15-minute mathematics seatwork assignment; and (3) the students' subjective feelings of "restfulness" and "pleasantness" following the 15-minute mathematics seatwork assignment.

Literature Review: Music and Behavior

In a letter to The Music Research Foundation written by Dr. George S. Stevenson, Director of The National Association for Mental Health, Dr. Stevensos described music as a "great psychological force" (Capurso, 1952, p. 97) with "a deep effect upon human feeling" (p. 97). However, Dr. Stevenson questioned if that force can be brought under our control and be called for a joint effort of music and science to answer that challenge (Capurso, 1952). This Literature Review will present an overview of some of the efforts made to control that force, and to utilize it systematically, to bring about more desirable human behaviors. Specifically, the review will cover music as a therapeutic agent and music as an instructional tool.

Music Therapy

Music is found in virtually every culture through the ages (Capurso, 1952; Schullian and Schoen, 1948; Gaston, 1968). Aristotle suggested that
music has an influence over the character and the soul, and that different musical modes affect people differently (Schoen, 1948). The dual function of the Greek God Apollo, God of Medicine and Music, is indicative of the Greek recognition of the value of music as a therapeutic agent (Altshuler, 1948). The Romans also had a spokesman for the effects of music in Cicero, who wrote that rhythm and musical sounds stimulate, inflame, soothe, or bring us to a state of cheerfulness or sorrow (Meinecke, 1948). Both Greeks and Romans used music in psychiatric treatments. Harmonia and Asclepiades used music as treatment for insanity and the Roman, Celsius, used cymbals and music to cure melancholy (Meinecke, 1948).

A curious use of the curative powers of music occurred in the 17th Century in the Apulia region of Italy. Tarantism, a strange malady caused by the bite of the spider, Tarantula, could be cured only by music and frenzied dancing. Once bitten, a cure was never complete, and every summer, the disease was reactivated. Bands of musicians roamed the countryside to play for the tarantati, as the patients were called, and it was common for groups of tarantati to dance wildly for 4 to 6 days before being temporarily cured (Sigerist, 1948). Carapetyan (1948) describes the 17th and 18th centuries as having widespread interest in the effects of music on man and attempts to use those effects for medical purposes. Luigi Desbout, surgeon of the Royal regiment of Tuscany late in the 18th Century, urged the use of music in hysterical, convulsive, and hypochondriac diseases. Louis Roger, a physician of Montpellier, published a comprehensive book on the influence of music on the mind, on the body, and on the union of both. He saw music as having direct mechanical effects on various substances of the body. For example, he asserted the vibrations
of nerves, which he thought especially susceptible to music, resulted in throwing off foreign humors that had attached themselves to the nerves.

For centuries, observations have been made of the effects of music, but it was not until relatively recent years that research into the subject was conducted in a scientific manner. Around the turn of the century, observations were made on the physiological effects of music. The effects of rhythm and different types of music on respiration and pulse rate were studied. In one series of fascinating studies, a young boy with a healed skull wound through which pulsations could be observed, was studied under various musical conditions. It was noted that singing of "Marseillaise" increased both cerebral and peripheral circulation (Solbelman, 1948). By 1926 Dr. Solbelman was able to write that it was evident that music has profound effects on physiological reactions, but that the "premise influence of different modes and types of music has not yet been determined" (p. 154).

It wasn't until the impetus of World War II that music therapy began its real thrust towards recognition as a behavioral science with a more systematic approach towards research and evaluation (Guthrie, 1952). In 1944, the Music Research Foundation was organized, and, at the behest of the Assistant Surgeon General, began a 3½ year study at Walter Reed General Hospital on the use and effects of specific music in relation to mental patients (Guthrie, 1952). During that study, 50 patients received music therapy in 536 sessions, and 37 (74%) had a "favorable response" as noted by their evaluating psychiatrists.

The National Association for Music Therapy defined music therapy as "the scientific application of the art of music to accomplish therapeutic aims. It is the use of music and of the therapist's self to influence
changes in behavior." (Madsen, Cotter, and Madsen, 1968, p. 69). Gaston wrote in 1968, that the behavioral sciences were relatively new and lacked data. "Because", he wrote, "little is known of what happens inside man when he is engaged musically, the only recourse is to observe and study his overt behavior. The best method for such study is the one utilized by the behavioral sciences." (Gaston, 1968, p. 7). Gaston also stressed though, the need for music therapy to be buttressed by knowledge from other sciences and other approaches (Gaston, 1968). It is appropriate at this point, to mention a problem faced by music therapists. Music therapy, when used as a treatment for mental disorders, is usually an adjunct to other psychiatric treatment, and as such, the effects may be confounded by the effects of those other treatments. Although results of music therapy have been judged on an intuitive level (Radov and Boyle, 1979), Madsen, Cotter, and Madsen (1968) stressed the importance of scientifically controlled experimentation that can separate the effects of music therapy from other variables.

The effects of music on any individual are subjective and are largely dependent on the individual's unique experiences (Fischelli and Papert, 1952). Capurso (1952) conducted a study to determine a consensus of the effects of known musical stimuli. One hundred and thirty-four music instructors supplied names of selections which they associated with each of six "mood" categories including happy, agitated, sentimental, reverent, melancholy, and weird. The 105 selections most frequently mentioned were chosen to be tested with 1075 non-music students. From 100 to 700 students listened to each selection and indicated into which of the six categories they felt the selection best fit. Data was analyzed for "Listener
Agreement" and "Emotional Strength", which was the average intensity of
the listeners' reaction. Subjects numerically rated the intensity of their
reaction on a point scale and this was translated into a percentage. Stars
and Stripes Forever, for example, was rated 94% on "Emotional Strength"
and 93% Listener Agreement for "mood" category (Happy). Only 61 of the
selections had listener agreement of 50% or more. The end product was a
list of musical selections that would likely produce the desired emotional
effect on the listener, as well as possible uses as background music for
radio and television (Capurso, 1952).

The ability to produce various moods is only one of the effects of
music listed by Lundin (1967), who classified music according to the
following properties: (a) attracting and prolonging attention; (b)
producing various moods; (c) stimulating associations; (d) relieving
internal tension; (e) aiding self-expression; (f) increasing communal
cooperation; and (g) increasing "self-respect" and "personal happiness".
Some therapists feel that one of the most valuable roles of music therapy
is its function of nonverbal communication (Gaston, 1968). Music allows
the acting out of the emotions through the guilt-free medium of nonverbal
sound (Priestly, 1975). Music can serve as the opening wedge between the
patient and his therapist.

Music in medicine is one branch of functional music which is defined
as music meant to accomplish specific predetermined ends other than
entertainment or pleasure (Cardinell, 1948). No survey of functional music
would be complete without a brief look at music in industry. While music
may not be serving its most noble purpose in this role, its very ubiquity
demonstrates the widespread belief in its effectiveness.
According to Cardinell (1948), the rise of music in industry began spontaneously. In factories manufacturing radios, workers testing radio parts found it pleasant to leave the radios on, while in other plants employees brought portable radios to work. The British Government Agency reported in 1938 that music could successfully reduce output dips at times of day when fatigue was greatest. Professor Burris-Meyer of the Stevens Institute of Technology reported in 1942, production increase, absenteeism decline, a decline in early departures, and production dips lessened—all due to the playing of music to the workers. With World War II making high production mandatory, 90% of British factories provided music by 1943, and by 1945, 6000 factories in the United States played music for their employees.

Cardinell (1948) suggests that industry and medicine could be of mutual assistance in research into the effects of music and, indeed, it does seem that industry has utilized some of the physiological and psychological findings on the effects of music. It would seem that this same mutual assistance could be useful in the last functional use of music to be discussed, the role of music as an instructional tool.

Summary. Casual observations through the centuries have noted and made use of the calming, inspirational and/or stimulating effects of music. But science has only recently made organized efforts to systematically study those effects. Many authors suggest the time period from approximately 1943 to 1950 as marking the beginnings of music therapy as a science (Soloman and Heller, 1982; Guthiel, 1952; Priestly, 1975). But, even prior to that, numerous case studies documented the positive effects of music as a therapeutic tool in efforts to change man's behavior.
Music in industry, another functional use of music, claims to be doing an effective job of changing man's behavior in a controlled environment (Stevenson, 1958; Mahler, 1978). The economic success of Muzak has to give some credence to their claims. If productivity in the factory, attentiveness in the office, and spending patterns in the supermarkets can be affected by music, then perhaps behavior in the classroom can also be affected. The uses of music as an instructional tool will be looked at in the next section of this literature review.

Music as an Instructional Tool

Almost 30 years ago, Jeffrey (1955) conducted his pioneering work in the area of motivating and reinforcing children with music. In searching for a less intrusive reinforcer than tokens, candy, or toys, Jeffrey developed a procedure involving taped children's records. Contingent listening to the tapes through earphones was controlled by a foot switch. Jeffrey used this procedure with retarded children to reinforce correct responses to a matching task with good results. This section of the Literature Review will explore pertinent research in the use of music as an instructional tool, first as a contingent reinforcer, and second, the effects of background music on behavior.

Contingent Music

Two studies conducted at the Cleveland Music School Settlement used musical activities as contingent reinforcers. Jorgenson (1977) used a multiple baseline design to demonstrate the use of a contingent musical activity to decrease two behaviors which interfered with learning. The subject, a 9-year-old mildly retarded boy with high frequency stereotyped behavior and poor directive skills, was given contingent check marks,
coupled with praise, to be used toward a preferred activity—listening to records. After three baseline sessions, record listening was made contingent on following directions. With one exception, directives were followed consistently throughout the remainder of the sessions. After four sessions of the procedure, record listening was made contingent upon 3 minutes of absence of stereotypic behaviors. Stereotypic behaviors fell from an average of 24 per session during baseline to 5 by the fifth session, and further decreased to no more than 1 per session thereafter. The reinforcement schedule was thinned out in the 7th month of the procedure with continued good results.

Steele (1977) used music listening to reinforce academic behaviors in a preschool setting with disadvantaged children. The preschool teacher wished to decrease the hyperactive behavior of the children while increasing the use of educational materials. Using the Premack Principle, by which access to a preferred activity is contingent upon performance of a low-frequency behavior (Sulzer-Azaroff and Mayer, 1977), a procedure was designed to demonstrate the use of music listening periods to increase the occurrence of looking at books, a low preference activity. A four-stage ABAB design (Cooper, 1981) was used alternating music and no-music conditions. Following baseline, one ticket was given for each book "read". Tickets could be exchanged for 3 minutes of record listening during the free play period. Soul-Rock music was used at a listening station. Groups of not more than four children and one adult listened to the selections with earphones, and the children were encouraged, by the adult, to sing along or make imitative actions appropriate to the music. The results clearly demonstrated that music listening periods, shared with peers and
an adult, were effective as a contingent reinforcer with this hyperactive preschool class. Steele (1977) pointed out that the type of music selected, and the social components of the listening activity, were pleasurable to the child.

The social component of musical activities was investigated in a study by Madsen and Forsythe (1977) which compared the reinforcing effect of two types of music listening activities. Sixth grade students, who had earned music listening time, were divided into two groups. One group was escorted to another room where they were allowed to socialize, and dance, while listening to music which had been selected by group survey. The second group, using earphones, listened privately to the same tape. An analysis of the data showed that there was no significant difference in the reinforcing effect of the two types of music. This study is significant because it established that music, as a contingent reinforcer, need suffer no loss of effectiveness when practical considerations such as ease of dispensing and degree of intrusiveness are considered. Contingent music, dispensed through tape and earphones, by the classroom teacher is an easily managed instructional tool.

Steele's (1977) point that the type of music selected must be pleasurable to the child, is a well-established principle. Sulzer-Azaroff and Mayer (1977), in discussing principles of effective reinforcement, point out that because an individual's learning history plays an important role in determining the effectiveness of a reinforcer, it is vital that the reinforcer be matched to the individual. One method they suggest is to offer paired choices to the individuals. Cotter and Toombs (1966), in their classic work with residents in an institution for the mentally
retarded, devised a procedure to observe and analyze the music preferences of retardates without written or verbal responses. The subjects were 20 male and female residents of Parsons State Hospital and had a mean I.Q. of 52.2 and a range of 35-83. Six classes of auditory stimuli were selected, 3 were types of noise and 3 were music categories: (1) children's music such as Hokey-Pokey (2) adult background music characterized as popular romantic, and (3) electronic music which had no definite rhythm, harmony or melody. Using a mechanical switch devised by the experimenters, during 5-20, 25-minute sessions, each subject controlled the duration of listening time committed to each category. The results showed that all preferred music to noise and the greatest amount of time was given to children's music with adult background music the next choice. The data showed that each subject had a unique pattern over the sessions, suggesting that musical preference is individualized. In a study designed to explore the effects of differential music preferences on the reinforcing effect of music, Talkington and Hall (1970) determined that those retarded subjects reinforced with their most preferred musical activity had a higher rate of response. In a study using music as an interdependent group contingency, Davis (1977) found music selection a problem. Davis studied the effect of timeout from music on the noise level of approximately 147 first through sixth grade children in an elementary school cafeteria. Taped music, chosen by the children, was played during the lunch periods as long as the noise level was below threshold which was determined by baseline data to be 78 db. When the sound level rose above threshold the music went off for 10-20 seconds. Divided into two lunch periods of 20 minutes each, the children were observed during the manipulation of three independent
variables: (1) music contingent on acceptable noise level; (2) length of timeout; and (3) instructions to subjects. Although Davis was unable to determine the optimum length of timeout, the noise level for Group I was reduced 22.9%, and the noise level for Group II was reduced 19.8%. Although music had been determined by poll and ballot, not everyone liked the music selected. One reason suggested is that the names on the ballot may not have represented the students' true preferences, especially the younger students. Davis felt the time between 3rd and 4th grade seems to be pivotal in musical taste with the older children preferring rock 'n roll. Cotter and Toombs' (1966) study which suggested that not all subjects preferred the same music seems to be reinforced by Davis's suggestion that it is difficult to find a musical contingency effective for a large group.

Olkes (1983) also used timeout from music listening as a group contingency in her study of five behavior-disabled eighth grade resource room students. Following baseline, music listening was made contingent on adherence to four rules for verbal behavior which had been decided by class discussion. Music tapes were prepared from selections brought in by the students and were played during the entire 50-minute period. Any deviation from a rule resulted in a 30-second timeout from the music. During the second phase the same procedure was carried out except music listening was contingent upon four motor behavior rules which were again decided by class discussion. During the third phase, music listening was contingent upon adherence to both sets of rules. Each phase was carried out for two weeks. Results showed significant improvement in each phase over baseline behavior and the final phase superior to the verbal and motor behavior phases.
Madsen and Madsen (1975) raised the question of whether music may be a reinforcer both for itself and for other tasks. Their study was designed to (1) elicit the subject's preferences from among three types of rewards, and (2) determine the effect of behavioral modification techniques on intonation improvement following scalar training. Two groups of sixth-grade students from a predominately black school participated as subjects. The reinforcement group was given tokens contingent upon being attentive and adequately performing the daily singing task. The tokens could be exchanged for music listening—either soul music or traditional music—or candy. The nonreinforcement group was given noncontingent tokens daily and given the same choice of music or candy. The results showed that subjects who earned tokens purchased more candy than either soul or traditional music, while the nonreinforcement students purchased significantly more soul music than either candy or traditional music. The nonreinforcement group actually regressed in intonation improvement, while the reinforced group improved significantly. The results demonstrated that musical skills can be improved with extrinsic rewards and the conclusion was drawn that it appears music can be an intrinsically rewarding experience.

Madsen and Forsythe (1977) demonstrated that music listening can serve as a positive reinforcer for increasing a student's performance in non-music academic activities. Students earning music listening time contingent upon correct responses to mathematical problems performed significantly better than students rewarded with time at math games.

Of particular interest is a study by Madsen, Moore, Wagner, and Yarbrough (1975) designed to compare music as a reinforcer for correct
mathematical responses versus music as a reinforcement for attentiveness. Fifth grade students were randomly assigned to one of three groups: Attention, Math, or Control, and were given a pretest, 3 days of treatment, and a posttest. Contingent music listening was earned either by intervals of on-task behavior, or correct mathematics responses. Students in the experimental groups were rewarded with either 1 minute of music listening for every four 10-second intervals of on-task behavior or 1 minute of music listening for every 3 correct mathematics problems. Each day the students were given a 10 minute math period during which they worked on a 64 problem worksheet. The "Attention" group was told they would get to listen to music if they worked hard, and the "Math" group was told they would get to listen to music if they got their math problems right. The "Control" group was told they could work quietly at their desks when the math period ended. Comparison of the number of correct math responses on the posttest showed the "Math" group obtaining significantly higher results. Comparison of off-task behavior displayed by the three groups showed significantly more off-task behavior in the control group and no difference between the Math and Attention groups. Therefore, it was demonstrated that contingent music listening was effective in increasing mathematics performance and increasing attentiveness in a normal elementary school class. The data also indicated that the Attention group, while increasing on-task behavior, did not significantly increase mathematics achievement as demonstrated by the posttest. These results indicated that whatever behavior is reinforced with contingent music will improve, but that the results may not generalize to other behaviors. Thus, each behavior must be specifically reinforced in order for improvement to take place.
In a sequel to this study, Yarbrough, Charboneau, and Wapnick (1977) replicated the study and added math ability grouping as an independent variable. The same procedure and materials were used, except that the children were divided into low, middle, and high ability groups. Within each ability group, students were assigned to one of three experimental groups: Attention, Math, or Control. The results differed between ability groups. Within the low ability group, music was shown to affect a significant increase in social and academic responses. The nongeneralization shown in the original study was repeated. However, no significant improvement was evident in the middle or high ability math group regardless of reinforcement.

Background Music

The use of music to change behavior through its reinforcement value is fairly well documented. However, music may also affect behavior through less direct means. Behavior may be modified through the use of background music, i.e., music to which we are not attentive as opposed to conventional music which is intended for entertainment and promotes thoughtful awareness by the listener (Mahler, 1978). The use of background music to heighten the drama in movies is familiar to all of us. Muzak has long used programmed background music to accomplish certain goals in industrial, business, and health care environments (Mahler, 1978).

The possibilities of background music in the classroom have not been widely explored, although there is a growing body of research in the area. A comprehensive study by Wolfe (1982) examined the effect of continuous background music and contingent background music on normal and hyperactive 3rd grade students. Dependent variables included task performance and
extraneous bodily movements. Each subject was given a typed story and was requested to mark through a specific letter (a, s, t, or e) during each of four conditions. Task performance score was the total number of letters marked during each condition. Four conditions: (1) no music; (2) continuous background music; (3) interruption of background music contingent upon extraneous bodily movement; and (4) music contingent upon extraneous bodily movement were counterbalanced across all subjects. In Condition 1, the task was performed during silence and in Condition 2, the task was performed during continuous background music. During Condition 3, when a movement occurred, the music was instantly stopped. The music continued after a 2 second no-movement interval occurred. During Condition 4, music was instantly stopped upon appropriate on-task performance and resumed when the subject was off-task for 2 seconds. Results indicated no significant difference between performance in any of the four experimental conditions. These findings held true for both dependent variables and for both groups of students. The results also showed little relationship between amount of bodily movement and task performance. The experimental music consisted of four John Philip Sousa marches which might be categorized as "Happy" or "Stimulating" (Capurso, 1952). Replication of this study with other categories of music would be interesting.

Borling (1981) investigated the physiological responses to stimulative and sedative music in terms of alpha rhythm production. Borling suggested that an increase in alpha rhythm should subsequently increase the subject's performance in focusing attention. Measurement of "focused attention" was determined by production of beta rhythms which is indicative of a state of conscious activity.
The study was conducted on 40 psychology students divided into high creative and low creative groups determined by scores on Hoepfner and Hemenway's Test of Creative Potential. Subjects were first asked to complete eight math problems to insure a state of active alertness. This was followed by 5 minutes of music which was immediately followed by performing the Maze Tracing Speed Test.

Analysis of the data showed a significantly superior performance from subjects in the sedative music condition although there was no significant difference in alpha production between the sedative and stimulative treatments. Borling concludes that ability to focus attention can be influenced by aural stimuli.

Other studies have shown no significant difference in the effect of different types of music. Freebourne and Fleischer (1952) used four types of music--classical, semi-classical, popular, and jazz--to compare their effects of reading rate and reading comprehension of college students, and to determine if the effect, if any, in the presence of music is a function of the subject's intelligence. They found no significant difference in reading rates or comprehension scores nor any significant relationship between the level of intelligence and the influence of the type of music distraction upon the rate of reading or reading comprehension. Similar findings were reported by Carlson and Hergenhahn (1967) in their study of the number of trials to criterion needed by 30 college students to learn nonsense syllables. They found no significant difference between groups listening to classical music, rock 'n roll, or silence.

Windwer (1981) hypothesized that hyperactive children would be less active during music programmed in an ascending progressive cycle. Ascending
progressive music increases in tone, frequency, tempo, and percussive elements. Windwer observed 13 hyperactive boys, aged 5.6 to 8.6 years, during a 40-minute art class, under a condition of a 7-minute ascending progressive music cycle. The results were opposite of those predicted with a significant increase in activity displayed. Windwer suggested that the students may have adapted to stimulating music prior to the experiment because rock 'n roll background music was a regular feature in the class.

Most of the research done on the effects of music on academic performances have been conducted with college students (Freebourne and Fleischer, 1952; Carlson and Hergenhahn, 1967). Engel and Engel's (1962) study deals with the effects of music distraction on mathematics performance of children. Five problems in each of the four basic arithmetic processes were given for 45 minutes, once each week for 8 weeks to 25 fifth grade students under alternate conditions of classical music and no music. Analysis of the data showed no significant difference between performances under the two conditions.

Geringer (1979) suggests that performance of manual, repetitive tasks appear to be aided by background music, but the relationship of background music with complex academic tasks is not clear; performance has sometimes improved, sometimes been hindered, and sometimes seems unaffected. The results appear to vary with the ages and education of the subject, the musical characteristics of the background music, and the difficulty of the task, but there does not seem to be any correlation between these factors and the results.

Results of Fogelson's (1973) and Parente's (1976) studies seem to indicate that background music hinders achievement. Fogelson (1973) found
popular instrumental music during a reading test lowered the performance of 14 eighth grade students. Less able students were more affected than bright students which may indicate that intelligence of the subject may also be a factor in the effect of background music. Parente (1976) found music preference a factor in his study of college students' achievement on a color-word task performed while listening to their most preferred music, least preferred music, or silence. Performance was better without music and better with the most preferred music than with the least preferred music.

Etaugh and Michaels (1975) allowed college students to choose their own background music and investigated the effect on reading comprehension of listening to preferred music. Indications were found that the more frequently the students reported studying to music, the less music impaired their performance. Sixteen female students performed better in the no-music condition but 10 of these students reported they never studied to music. No difference was found in the performances of the 16 males, and only 5 reported they never studied to music. These results seem to agree with Windwer's (1981) suggestion that students may adapt to background music.

Wolf and Welner (1972) compared the performance of 15 female college students on a task of simple arithmetic problems during four "noise" conditions. Conditions were quiet, speech at 87 dB, hard-rock at 95 dB, and industrial noise which consisted mainly of a high powered saw cutting wood at 105 dB. The results showed significantly more correct responses during the music condition than during the industrial noise condition, and no significant difference between other conditions. The authors suggest
that students' familiarity with hard-rock was a factor. This is in agreement with the results of Etaugh and Michaels' (1975) study. Wolf and Weiner suggest an interesting next step study would be a comparison of performance by college students and factory workers under music and industrial noise conditions. If both groups performed best under their more familiar condition, the familiarity factor would be substantiated.

In a study designed to investigate the effect of two types of background music on behavior, Reardon and Bell (1970) studied the effects of sedative and stimulative music on the activity levels of severely retarded boys under conditions of quiet, speech, sedative music, and stimulating music. Orchestral versions of Bach chorales which involved slow tempos and broad harmonies were used for sedative music and stimulative music was rock 'n roll. Observations were made on 14 behavioral conditions, including such behaviors as crying, wetting pants, and head banging, during 32 1-hour sessions. The results showed sedative music did not calm the subjects, and lower activity levels were found during more stimulating conditions. The authors suggested that the stereotypic behavior of these subjects provided stimulation to a stimulus deprived group; therefore, auditory stimulation decreased activity level.

Lane (1977) designed a comprehensive study to determine the relative effects of three types of background music on mathematics performance and task relevant behavior. The types of music used were: (a) stimulus progressive music, which is programmed to become increasingly lively and produce an uplifting effect; (b) sedative music which is relaxing in effect; and (c) popular music, which is considered distracting. Students in regular second grade classes in an elementary school were observed daily for 9
weeks under well-controlled conditions. Lane found that average math gains were superior under all three background music conditions to the music conditions. The data also revealed that, of the three music conditions, the least improvement was made under the popular music condition while the sedative music was the most powerful condition. There was little difference in performance during the sedative music condition and the stimulus progressive condition. The average number of math problems solved was lowest under the popular music condition. It was noted that a sequence of popular music, stimulus progressive, and sedative music, resulted in a positive trend in math performance.

The highest achieving class during baseline, Class C, scored highest during each of the treatments, and performed best during the sedative music condition with a score of 90.88% compared with a baseline score of 38.81%. The sedative music condition was the last treatment phase for Class C so practice effects may have been a factor although the results for Class A and Class B were not consistent with that suggestion. The performances during the last treatment phase were superior to baseline performance for the other two classes but in neither case was it the best. Class A scored 31.36% during baseline and its best performance was during the first treatment phase which was stimulus progressive (58.58%). Class B's first treatment phase, which was sedative music, was also the best, with a score of 37.83% compared to a baseline score of 18.62%. Average combined correct math scores showed sedative music to be 3.45% superior to stimulus progressive and 12.97% superior to popular music. Although performance under all music conditions was significantly superior to baseline performance, practice effects must be taken into account. Lack of a control
group prevents valid conclusions.

The data on task-relevant behavior was significant for its very lack of significance. The baseline phase showed the highest level of task-relevant behavior, which seems to indicate that mathematics performance and task-relevant behavior are not necessarily related, a finding similar to that reported by Madsen, Moore, Wagner, and Yarbrough (1975). The sedative music treatment was the superior treatment phase although the difference between that treatment and the stimulus progressive treatment was slight. Lane concluded that the relationship between task-relative behavior and achievement is inconclusive.

Simpson (1976) and Scott (1970) studied the effects of background music on the academic performance and/or on-task behavior of hyperactive children. The object of Simpson's (1976) study was to determine the effect of background music on the behavior and learning ability of brain-injured children. It was theorized that sedative music might neutralize background auditory stimuli which might otherwise be distracting to these students. Another question was whether the music might have a calming effect, which would create a better learning climate, or would the music increase the "figure-background" problem and therefore increase the children's hyperactivity.

The project was carried out over a 2½ month period with six first grade children enrolled in the Masada School for Brain-Injured Children. The children were all newly enrolled in the school so their behavior was not yet under classroom control. Six social behaviors and two academic behaviors—task success and task failure in reading—were observed daily for thirty 25-minute sessions with alternating music and no music.
conditions.

The results showed three out of the six children displayed significantly more activity under the music condition. However, while their distracting behavior increased, a significant increase in task success also occurred in at least half of the children during the music condition. Two of the individual performance scores were so outstanding that they are worth noting. Child No. 1 increased from a score of 46 on "Task success" under the no-music condition to a score of 92 during the music condition and Child No. 2 increased from a score of 39 on "Task success" under the no-music condition to a score of 90 during the music condition. These findings are in agreement with the results of Lane's (1977) study wherein there did not appear to be a direct relationship between task-relevant behavior and mathematics achievement. Simpson (1976) suggests the need for further investigation of the effect of various controlled, activity-increasing programs on the achievement rate of these children.

Scott (1970) studied the effect of background music on hyperactive behavior and found that the children's academic achievement was much more productive in the music condition. The subjects in this study were four boys, with normal IQ's, who were in a residential facility for children with behavior problems. They were considered hyperactive with classroom behavior that was "barely manageable." Mathematics achievement was compared under each of four conditions: (a) normal classroom seating arrangement without music; (b) identical to the first condition except background music was added; (c) carrel seating without music and (d) carrel seating with music. The results demonstrated that each child achieved his
highest average number of correct mathematics problems under a music condition. Three of the four performed best in a normal seating arrangement with music while the fourth child performed best in a carrel arrangement with background music. Although the sample size in this study presents limitations, it does give an indication that the achievement of hyperactive children may be optimized by the introduction of background music.

Summary. There is little question that music as contingent reinforcement can be used effectively as an instructional strategy. Research studies have repeatedly demonstrated the effectiveness of music with varied populations and dependent variables (Jorgenson, 1977; Steele, 1977; Madsen and Forsythe, 1977; Davis, 1977; Madsen and Madsen, 1975, Madsen, Moore, Wagner, and Yarbrough, 1975; Yarbrough Charboneau, and Wapnick, 1977).

The value of music in affecting behavior through manipulation of the classroom environment is less clear. Research data has been inconsistent and contradictory. Some studies have shown superior performance in the presence of background music (Scott, 1970; Simpson, 1976; Lane, 1977; and Borling, 1981); other studies have shown background music hinders performance (Fogelson, 1973, Parente, 1976); while still other studies have shown no significant difference (Freibourne and Fleischer, 1952; Engel and Engel, 1962; and Carlson and Hergenhahn, 1967).

To bring order to this body of inconsistent literature, perhaps the task should be broken down into smaller parts. By observing more specific populations, over longer time frames, and with more specific types of music, always compared to a no-music control, research may evolve a more systematic and consistent body of knowledge.
Summary

Music can be used as a functional tool, as opposed to music purely as a source of pleasure or entertainment. As a functional tool, its benefits can be categorized under the broad headings of music as a therapeutic agent, and music as an instructional tool.

No one questions the fact that music can affect our moods, or that it can reach our inner being. One has only to watch a mother sing a lullaby to her baby, or watch the young girl's eyes light up at the playing of "their song." Music affects not only individuals, but whole groups of people, as in the blood-stirring songs that lead us into battle, or the horrendous effects evident at rock concerts.

Music has been used in therapy to bring about desired behavioral changes, but not all music has the same effect on all people. Although studies have shown some consensus of subjective feelings to different categories of music, individual learning histories are a factor in reaction responses.

A multidisciplined effort is required to answer the challenge of learning to control the effects of music, but behavioral scientists take a more pragmatic view in their investigations into the use of music in the classroom. Many studies have shown the efficacy of music as an instructional tool through its reinforcement potential for academic and social behavior in a school setting with a wide range of populations. The evidence is less clear as to the usefulness of background music to change behavior. While its wide-spread use in industry seems to give credence to those studies reporting improved performance of routine tasks, there have been confusing results from studies of background music during more
complex tasks. Is the effect different with hyperactive children than with normal children? Does the age of the child make a difference? Or is it the type of music? Or maybe a combination of factors? Or is the effect just too individualized to allow background music to be used as an instructional tool. Only controlled, scientific studies will give us the answer.

**Research Questions**

This study was conducted in order to generate empirical data in response to the following research questions:

1. Does sedative background music increase mathematics achievement of elementary school learning-disabled children as measured by the rate and percentage of correct responses on a mathematics worksheet during a 15-minute seatwork assignment?

2. Does sedative background music increase the on-task behavior of elementary school learning-disabled children during a 15-minute mathematics seatwork assignment?

3. How do elementary school learning-disabled children subjectively rate background music in terms of restfulness and pleasantness?
CHAPTER II

Method

Subjects/Setting

Subjects for this study were 8 first through sixth grade learning disabled children, 6 boys and 2 girls, ranging in age from 7 to 12 years. Each subject was classified as learning disabled as documented in the child's Individualized Education Program. All of the children came from an urban area; six from upper middle class socioeconomic families and two from lower middle class socioeconomic families. Five target subjects were selected for observation to determine the effects of sedative background music on on-task behavior. Two of the subjects were judged by the teacher as being the most hyperactive of the group, two as being the least hyperactive of the group, and the fifth was randomly selected. Specific data on each student is shown in Figure 1.

The study took place in a public elementary school in an upper-middle class, urban area of a large midwestern city. The subjects were enrolled in a special education resource room with a total enrollment of 12. The physical layout of the room is shown in Figure 2.

Experimenter

At the time of the study, the experimenter had a Bachelor of Arts degree in History, a Bachelor of Science degree in Education, and was enrolled in a graduate program leading to an Ohio teaching certificate in learning and behavior disorders and a Master's degree in the area of Mildly Handicapped Special Education. The experimenter had two courses in materials and methods for the mildly handicapped, one course in directive
<table>
<thead>
<tr>
<th>Student</th>
<th>*Approximate Age/Exact Age</th>
<th>I.Q.</th>
<th>Approximate Mathematics Level</th>
<th>*Target Subject and Subjective Judgment of Resource Teacher as to Being Among Most/Least Hyperactive/Random Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>*10</td>
<td>83-95</td>
<td>3.3</td>
<td>*Most</td>
</tr>
<tr>
<td>Student 2</td>
<td>10-7</td>
<td>95</td>
<td>4.3</td>
<td>*Least</td>
</tr>
<tr>
<td>Student 3</td>
<td>*13</td>
<td>103</td>
<td>6.6</td>
<td>*Least</td>
</tr>
<tr>
<td>Student 4</td>
<td>12</td>
<td>94</td>
<td>5.8</td>
<td>*Random Choice</td>
</tr>
<tr>
<td>Student 5</td>
<td>11-9</td>
<td>92</td>
<td>5.8</td>
<td>*Least</td>
</tr>
<tr>
<td>Student 6</td>
<td>*9</td>
<td>111</td>
<td>4.1</td>
<td>*Most</td>
</tr>
<tr>
<td>Student 7</td>
<td>7-6</td>
<td>96</td>
<td>2.3</td>
<td>*Least</td>
</tr>
<tr>
<td>Student 8</td>
<td>*10</td>
<td>85</td>
<td>4.1</td>
<td>*Most</td>
</tr>
</tbody>
</table>

**Figure 1. Data on Each Subject**
FIGURE 2: PHYSICAL LAYOUT OF CLASSROOM

A - Experimenter
B - Second Observer
C - Music Tape Player
D - Observation Tape Player
teaching of the handicapped, and a course in issues and practices related to the handicapped. The experimenter also had a course in research methodology.

**Definition and Measurement of Dependent Variable**

The dependent variables measured in this study were rate and accuracy of mathematics performance, on-task behavior, hyperactive behavior, and the students' affective responses.

**Rate and accuracy of mathematics performance.** The number of correct mathematics responses made during a daily 15 minute mathematics period was recorded. A response was considered correct if all digits were correct, and any mathematical signs, such as dollar signs or decimals, were correctly placed. The total number of problems attempted by each student was divided into the total number of correct responses for the percentage of correct responses. Each student's correct responses were divided by the unit of time (15 minutes) to determine the rate of correct responses per minute.

**On-task behavior.** Behavioral observations were conducted while the children were engaged in a seat assignment consisting of individualized mathematics worksheets. The definition of on-task behavior was actively engaged in, and attending to, completion of the assigned mathematics worksheet.

**Hyperactive behavior.** Behavioral observations were conducted for four types of hyperactive behavior. These behaviors were: (1) body movement, (2) out-of-seat, (3) talking, and (4) looking away from assigned work.

**Body movement.** Body movement was defined as any physical movement...
of the body extraneous to the performance of the assigned task. Examples would be moving the desk or seat, turning of body in seat, stretching, yawning, foot tapping, and finger play (excluding use of fingers in calculating).

**Out-of-seat.** Out-of-seat was defined as both buttocks removed from the seat of the chair.

**Talking.** Talking was defined as any vocalization, either to a neighbor, teacher, him/herself, or to no-one in particular. The vocalization may or may not have been an actual word.

**Looking away from assigned work.** Looking away from assigned work was defined as the child's eyes not being directed towards his/her mathematics worksheet.

The occurrence of on-task behavior and each hyperactive behavior was recorded for each observation on an observation form. See Appendix A for a sample Observation Form. The observer, listening through earphones, to directions on an observation tape, was instructed every nine seconds to, "Get ready. Observe. Record." At the "Get ready." instruction, the observer checked the Observation Form to see who was the next target subject to be observed, while keeping her eyes directed towards the Observation Form until the next tape signal. At the "Observe" signal, the observer would direct her eyes towards the target subject, trying to avoid eye contact with the subject, and at the "Record" signal, the observer circled the code designating the observed behavior. More than one behavior might be circled for a target subject during one observation. For example, the target subject might be foot tapping, while still giving the appearance of being on-task. If a target subject was absent for a particular session,
the observer waited through that subject's observation turn in the cycle before going on to the next target subject, making an 18 second interval at that point in the cycle. Each target subject was observed approximately 20 times per session. The total number of each behavior and the percentage of each behavior's occurrence was recorded.

**Affective responses to Music and No-Music period.** Immediately following the 15 minute mathematics session, each child was given two forms to be checked for degree of restfulness and pleasantness. The forms contained numbered/lettered illustrations depicting degrees of "restfulness" and "pleasantness". Each child circled the number/letter corresponding to the picture illustrative of his/her subjective feelings. The percentage of responses in each category for the total group was compared during music and no-music phases. See Appendix B for Restfulness and Pleasantness Forms.

**Materials.**

The following materials were used in the study:

1. Telex Slide Sync Player Tape Recorder
2. Cassettes of Sedative Music. Using recordings from the Ohio State University Music Library, approximately 30 minutes of music was taped onto each side of two 60 minute Memorex cassettes, giving a total of eight groupings of selections available. The selections were taped with only a momentary break in the continuity and the duration of each selection was noted. Although the group of selections used during each session was decided by whim, an effort was made to rotate the selection unbiased by personal preference. Sedative background music used in this study was
made up of five selections from the Prueter Study (1973) and six selections from the Caparso study (1952), played in random order. See Appendix C for the specific musical selections used in this study.

3. Portable G.E. tape recorder (Model #3-5009A), earphones and 9-second observation tape.


5. Observation Forms.

6. Mathematics Worksheets. Each child's worksheet problems were prepared prior to the first session of baseline and contained problems determined for each child during the pre-experimental phase. A sample worksheet for each of the eight subjects is found in Appendix D. The number of problems per page was determined by the type of problem and ranged from 6 two-digit multiplication problems and long division problems, to 36 one-digit addition and subtraction problems. The number of pages per child ranged from three to six. As the students increased in rate over the course of the study, it was necessary to add additional problems. Five sets of problems, labeled A through E, were prepared for each student, and were presented in random order.

7. Weather Forms. A sample Weather Form can be found in Appendix E.

8. Restfulness Rating Forms and Pleasantness Rating Forms. These forms, with minor modifications, were developed by Lane (1977); permission was requested for their use in this study.

9. Exit Interview Forms. Student and teacher exit interviews were conducted at the conclusion of this study to explore individual affective responses to the sedative background music. Samples of these forms can be found in Appendix F.
Experimental Design

The experimental design used in this study was the multi-element baseline design, more descriptively named by Barlow and Hayes (1979) as the alternating treatment design. This design was uniquely suited to the study because the critical features of the multi-element baseline design, the rapid alternation of treatments (Barlow and Hayes, 1979) independent of changes in behavior, (Ulman & Sulzer-Azaroff, 1975) and the repeated measurement of a dependent variable under the alternating condition of the independent variable (Ulman & Sulzer-Azaroff, 1975), make it especially appropriate to the study of a practiced academic response which may have occurred in this study due to the repeated presentation of the mathematics worksheets (Ulman & Sulzer-Azaroff, 1975). The alternation of treatments within a short time frame produces a high degree of internal validity. Sequential confounding may be accounted for by randomizing the order of treatment (Barlow, 1979). Ulman & Sulzer-Azaroff (1975) agree that frequent manipulation of the experimental condition and randomization of the manipulation result in a stronger experimental control.

The rapid alternation of treatments was produced in this study by the use of music and no-music conditions in 2 day blocks throughout the sessions following baseline. Within each 2 day block, the sequence was randomized by letting the toss of a coin determine which condition was presented on the first day. This procedure resulted in 14 sessions of no-music condition and 16 sessions of music condition. The second critical feature of the multi-element baseline design, the repeated measurement of a dependent variable under the alternating condition of the independent variable, resulted from the daily recording of correct mathematics responses and
behavioral observations under the alternating conditions of music and no-music.

Procedure

The study consisted of three conditions: baseline, no music and music. Prior to baseline, a pre-experimental phase was conducted to determine mathematics problem selection, and following the study, an exit interview was conducted. This section describes the procedures followed during each of these phases.

Pre-experimental Problem Selection

One week prior to the first baseline session, the subjects, in a group setting along with the other students in the class, were given the Brigance Diagnostic Inventory of Basic Skills, in accordance with the directions in the Teacher's Manual, in order to determine their general mathematics level. Consultation with the subjects' regular teacher verified the results and further narrowed the range of appropriate problems for each student. Based on this information, mathematics worksheets were made for each subject containing a few more than the estimated number of problems which the subject could respond to in 15 minutes. The subjects were told that they would have 15 minutes in which to do the problems and to do as well as they could on them. Based on the results of these worksheets, further refinements were made. For example, if a student consistently missed 3-digit multiplication problems, but usually responded correctly to 2-digit problems, 3-digit problems were eliminated from the potential test problems. Mathematics problems were chosen to reflect a practice stage for the student rather than an acquisition stage. The number of problems
completed in these tests gave a basis for the number of problems for each student's worksheet used in the study. This procedure was carried out for 2 days at which point a determination was made by the experimenter, as to the level of difficulty and number of problems to be used for each subject.

In order to accustom the subjects to the observer's presence, and to give the experimenter a practice session, the observation procedure described under Baseline was carried out once during this phase.

Baseline

Baseline data were taken for 4 days on three indices of mathematics performance: (1) rate of correct responses per minute, (2) rate of incorrect responses per minute, and (3) percent accuracy.

On the first day of baseline, the experimenter said to the class

"Every morning for the next few weeks, we are going to have a 15 minute math test. I want you to work alone on this test. That means I don't want you to come to me for help or to raise your hand for help. If you are stuck on a problem, go on to the next one. At the end of the 15 minutes, I will collect the tests. These tests will not affect your grade in math. You are helping me in something I'm doing at Ohio State and I really appreciate your help. After I have marked the tests, I will make a graph for each of you and you can keep track of how many problems you get right each day."

The five target subjects were observed during each baseline session
and the occurrence of any of the five "on/off task" behaviors was recorded.

At the end of the 15 minute test session, the tests were collected for scoring and recording. On the first day of baseline, in order to familiarize the subjects to the format of the affective response forms, the subjects were given a Weather Recording Form, similar in format to the affective response forms. The experimenter said to the class:

"Look outside. What kind of weather do you see? Would you say it is a sunny day? Is it a cloudy day? Is it raining? Is it stormy? Is there lightning? Draw a circle around the number next to the picture that shows what kind of day this is."

The experimenter then collected the forms and checked them for correctness of procedure.

No-Music

With the exception of the Weather Form and the inclusion of the affective response forms and public posting, procedures identical to those described for Baseline were conducted during the 14 sessions of No-Music.

After collecting the tests, the experimenter gave each student the Restfulness Rating Form and the Pleasantness Rating Form. The experimenter found it more efficient, beginning approximately Session 24, to attach the forms to the test packet. The first day the forms were distributed the experimenter said:

"I would like to find out how rested and how pleasant you feel. I will read each word for you. Then you will circle the number of letter next to the picture that shows how you feel."
The meaning of "pleasantness" was discussed and the synonyms "happy", "satisfied," and "feeling good" were given.

Beginning with Session 5, individual graphs depicting rate of correct responses per minute were posted on a bulletin board and charted daily. When a student bettered his previous day's score, that data point was charted in green for high visibility and the child was rewarded with an edible treat. Circles of colored paper with the student's record of correct responses per minute written on them, were attached to each graph. When a student broke his record, an additional circle with the new record was attached to the graph. The class record was posted on a larger circle, and when a new class record was achieved, the whole class was rewarded with an edible treat.

Before the tests were handed out each session, some positive aspect of the previous day's test was discussed by the experimenter. For example, the experimenter would announce new records or a no error paper.

In order to maintain interest and a high degree of cooperation from the students, several additional procedures were introduced on Session 10. A special bulletin board, named The Sam the Snoop Board, was established for graphs of students who had set new records. Once each week, those students who had a graph on the special bulletin board would gather around the board for a Polaroid picture. Then, the graphs were removed, the picture posted, and a new week begun.

**Music**

Procedures identical to those described for the No-Music Phase were conducted during the 16 sessions of Music, except, after passing out the mathematics worksheets, but prior to turning on the timer, a cassette of
sedative background music was turned on. After collecting the test, the experimenter turned off the music.

**Interobserver Agreement Procedure**

The regular resource room teacher served as a second, interobserver. The second observer, after reading the definitions of on-task and the hyperactive behaviors, was instructed in the procedure by discussion, example, and demonstration. When taking interobserver checks, the interobserver sat approximately 14 feet from the experimenter, and while both observers listened to the tape of observer instructions through earphones, simultaneous observations were taken and recorded every nine seconds. Observer agreement checks were taken Session 2 and Session 3, and once each week thereafter for a total of eight check points. The session in which the check was taken was determined by the availability of the second interobserver.
CHAPTER III

RESULTS

Data has been collected on several features of student and group performance during music and no-music phases. A detailed analysis of the data concerned with math performance is contained in this chapter, as well as an analysis of on-task behavior and a tabulation of the affective response data.

Math Performance

Figure 3 through Figure 18 illustrate the math performance of each of the 8 students in terms of percentage of math problems solved correctly and rate of correct responses per minute in each of the conditions. Figures 16 and 17 present mean group results. Results for individual students are as follows:

Student 1.

Figure 3 shows the percentage of correct responses during music and no-music conditions. The range during Sessions 1 through 9 was from 49% to 76% during the no-music condition, and from 62% to 76% during the music condition. During Sessions 10 through 34, the percentage of correct responses ranged from 56% to 94% during the no-music condition, and from 62% to 88% during the music condition. During Sessions 1 through 9, the mean percentage for music sessions was 66%, and the mean percentage for no-music sessions was 60%. During Sessions 10 through 34, the mean percentage for music sessions was 75%, and the mean percentage for no-music sessions was also 75%. Both music and no-music data points
Figure 3. Percentage of math problems solved correctly per minute during music and no music conditions - student 1.
illustrated a gradually ascending trend with the no-music trend punctuated by occasional extreme highs and lows. The highest data point in both conditions was achieved during the final performances with music at 88% and no-music at 94%.

Figure 4 shows the rate of math problems solved correctly during music and no-music conditions. During Sessions 1 through 9, the data points ranged from 1.2 to 2.6 during the no-music condition, and from 2.1 to 2.5 during the music condition. The data points illustrate a wide range of scores during Sessions 10 through 35; scores ranged from 2.9 to 6.5. During Sessions 1 through 9, the mean correct rate per minute was 2.1 during no-music and 2.6 during the music condition. During Sessions 10 through 35, the mean correct rate per minute was 5.06 during the no-music condition and 5.4 during the music condition. Beginning with Session 10, a sharp increase in rate is apparent in both conditions until Session 16, which is followed by a more gradual ascending trend in both conditions. The final performance in each condition was also the highest rate achieved for each -- 6.4 for no-music and 6.5 for the music condition. Student 2.

Figure 5 shows the percentage of correct responses during music and no-music conditions. The range during Sessions 1 through 9 was from 71% to 89% during the no-music condition and from 69% to 89% during the music condition. During Session 10 through 34, the percentage of correct responses ranged from 85% to 96% during the no-music condition and from 83% to 99% during the music condition showing a slightly wider range for this condition. During Sessions 1 through 9, the mean percentage for both the no-music and music conditions was identical at 82%. During Sessions
FIGURE 4. NUMBER OF MATH PROBLEMS SOLVED CORRECTLY PER MINUTE DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT 1.
FIGURE 5. PERCENTAGE OF MATH PROBLEMS SOLVED CORRECTLY DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT 2.
10 through 34, the mean percentage for no-music was 90% and the mean percentage for music sessions was 89%.

Figure 6 shows the rate of math problems solved correctly during music and no-music conditions. During Sessions 1 through 9, the correct rate per minute ranged from 1.3 to 2.0 during the no-music condition, and from 1.9 to 2.1 during the music condition. A wide range of scores is shown for Session 10 through 34 with a range of 1.13 to 4.8 during the no-music condition and a range of 1.9 to 5.2 during the music condition. The mean rate, during Sessions 1 through 9 was 1.7 for no-music and 2.1 for the music sessions. During Sessions 10 through 34, the mean rate was 3.7 during the no-music sessions and 3.6 during the music sessions. A definite ascending trend is obvious for both conditions beginning from Session 1 on through Session 34. The final performance of 4.8 correct per minute during the no-music condition was also the highest recorded for that condition; the final performance rate for the music condition was 3.9.

Student 3.

Figure 7 shows the percentage of correct responses during music and no-music conditions. The range during Sessions 1 through 9 was from 56% to 86% during the no-music condition. A much higher range, from 88% to 93%, is shown during the music condition. During Sessions 10 through 34, the ranges became similar, from 82% to 100% for the no-music condition and from 71% to 100% for the music condition. The mean percentage of problems solved correctly during Sessions 1 through 9 was only 70% compared to 90% for the music condition. During Sessions 10 through 34, the mean percentages became much closer, being 93% for no-music and 90% for the music condition. After a sudden peak in the no-music condition on Session
Figure 6. Number of math problems solved correctly per minute during music and no music conditions - student 2.
Figure 7. Percentage of math problems solved correctly during music and no music conditions - Student 3.
12, which held through Session 19, a lower level seems to have been stabilized, while the music condition began high, then suddenly dropped sharply on Session 10, slowly climbed again, to meet the no-music peak and followed the no-music trend on a stable lower level. This is reflected by the final performance of 90% for the no-music condition and 91% for the music condition.

Figure 8 reflects the rate of math problems solved correctly during music and no-music conditions. During Sessions 1 through 9, the correct rate per minute ranged from .5 to .9 during the no-music condition, and from .9 to 1.4 during the music condition. Scores during Sessions 10 through 34 ranged from .6 to 1.9 during the no-music condition and from .5 to 2.3 during the music condition. The mean rate, for the no-music condition during Sessions 1 through 9, was 1.1 and for the music condition, the mean rate was 1.3. During Sessions 10 through 34, the mean rate was 1.3 during the no-music sessions and 1.5 during the music sessions. Following an upward trend in both conditions that seems to have peaked around Session 22, both conditions began a downward trend. The final performance in the no-music condition was .6 and 1.3 in the music condition.

Student 4.

Figure 9 illustrates the percentage of correct responses during music and no-music conditions. The range during Sessions 1 through 9 was from 61% to 89% during the no-music condition, and from 75% to 85% during the music condition. During Sessions 10 through 45, the percentage of problems solved correctly ranged from 77% to 97% during the no-music condition and from 76% to 94% during the music condition. During Sessions 1 through 9, the mean percentage for no-music sessions was 77% and 79% for music
Figure 9. Percentage of math problems solved correctly during music and no music conditions - student 4.
sessions. During Sessions 10 through 34, the mean percentage for no-music sessions was 89% and the mean percentage for music sessions was 86%. After a sharp ascension for both conditions on Sessions 10 and 11, a stable trend is demonstrated until the final performance for each condition. The final performance for the no-music condition ended with an upward move to 97% while the music condition ended with a sharp drop to 81%.

Figure 10 illustrates the rate of math problems solved correctly during music and no-music conditions. During Sessions 1 through 9, the correct rate per minute ranged from 1.1 to 1.8 during the no-music condition, and from 1.0 to 1.5 during the music condition. Scores during Sessions 10 through 34 ranged from 0.6 to 2.3 during the no-music condition and from 1.3 to 2.0 during the music condition. The mean rate, for the no-music condition, during Sessions 1 through 9, was 1.3 and 1.2 during the music condition. During Sessions 10 through 34, the mean rate was 1.9 during the no-music sessions, and 1.6 during the music sessions. A generally stable trend was observed in both conditions. The final performance for the no-music condition was a 1.9 and 1.4 for the music condition.

Student 5

Figure 11 demonstrates the percentage of correct responses during music and no-music conditions. The range during Sessions 1 through 9 was from 60% to 90% during the no-music condition with a mean of 76%. The range during the same period for the music condition was from 71% to 95% with a mean of 87%. During Sessions 10 through 45, the percentage of problems solved correctly ranged from 80% to 100% during the no-music condition, and from 81% to 97% during the music conditions. The mean
FIGURE 10. NUMBER OF MATH PROBLEMS SOLVED CORRECTLY PER MINUTE DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT 4.
Figure 11. Percentage of math problems solved correctly during music and no music conditions - Student S.
percentage of 91% was the same for both conditions. The no-music trend shows a 3 session downward trend followed by a 3 session upward trend which then leveled off at a generally stable position. The music condition followed a stable trend from Session 13 until the final performance score of 97%. The final performance score for the no-music condition was 89%.

Figure 12 shows the rate of math problems solved correctly during music and no-music conditions. During Sessions 1 through 9, the data points ranged from .2 to 1.8 during the no-music condition, and from .3 to 1.4 during the music condition. Scores during Sessions 10 through 34 ranged from .7 to 2.8 during the no-music condition and from 1.5 to 2.6 during the music condition. The mean rate, for the no-music condition, during Sessions 1 through 34, was 1.0, and .9 during the music condition. During Sessions 10 through 34, the mean rate was 2.2 during the no-music sessions, and 1.9 during the music sessions. Despite peaks and valleys, especially in the no-music condition, a very gradual ascending trend may be discerned in both conditions. The final performance score for the no-music condition was 2.7 and the final performance score for the music condition was 2.1.

Student 6.

Figure 13 shows the percentage of problems solved correctly during no-music and music conditions. The range during Sessions 1 through 9 was from 87% to 94% during the no-music condition and from 88% to 94% during the music condition. During sessions 10 through 34, the percentage of correct responses ranged from 83% to 94% during the music condition. During sessions 10 through 34, the mean percentage for no-music sessions was 92% and the mean percentage for music sessions was 94%. With both no-music
Figure 12. Number of math problems solved correctly per minute during music and no music conditions - Student 5.
FIGURE 13. PERCENTAGE OF MATH PROBLEMS SOLVED CORRECTLY DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT 6.
and music conditions, a generally high stable trend can be seen. The final performance score for the no-music condition and the music condition, was identical at 93%.

Figure 14 shows the rate of math problems solved correctly during music and no-music conditions. During Sessions 1 through 9, the data points ranged from .9 to 2.2 during the no-music condition, and from 1.1 to 2.1 during the music condition. Scores during Sessions 10 through 34 ranged from 1.1 to 3.6 during the no-music condition and from 1.6 to 2.9 during the music condition. The mean rate, for the no-music condition, during Sessions 1 through 9 was 1.6, and 1.8 during the music condition. During Sessions 10 through 34, the mean rate was 2.2 during the no-music sessions, and 2.6 during the music sessions. A very gradual upward trend can be seen in both conditions. A sharp peak is seen in the final no-music session with a score of 3.6. The final performance for the music condition was 2.7.

Student 7.

Figure 15 shows the percentage of problems solved correctly during no-music and music conditions. The range during Sessions 1 through 9 was from 83% to 99% during the no-music condition. Only one session of the music condition, with a score of 97% was recorded. During Sessions 10 through 34, the percentage of correct responses ranged from 88% to 100% during the no-music condition, and from 91% to 98% during the music condition. During Sessions 1 through 9, the mean percentage for no-music sessions was 91%. During Sessions 10 through 34, the mean percentage of correct responses during no-music sessions was 94% and for music sessions it was 95%. A high level trend can be seen for both conditions with a
FIGURE 14. NUMBER OF MATH PROBLEMS SOLVED CORRECTLY PER MINUTE DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT 6
Figure 15. Percentage of math problems solved correctly during music and no music conditions - Student 7.
final performance of 95% for the no-music condition and a final performance of 96% for the music condition.

Figure 16 shows the rate of math problems solved correctly during final performance of 95% for the no-music condition and a final performance of 96% for the music condition.

Figure 16 shows the rate of math problems solved correctly during music and no-music conditions. During Sessions 1 through 9, the data points ranged from 3.4 to 5.3 during the no-music condition. Only one session of the music condition occurred during this period. The rate was 4.7. Scores during Sessions 10 through 34 ranged from 3.6 to 6.6 during the no-music condition and from 3.2 to 7.6 during the music condition. The mean rate, for the no-music condition, was 4.6, during Sessions 1 through 9 and 4.7 was the only data point recorded for the music condition during this period. During Sessions 10 through 34, the mean rate was 5.0 during the no-music sessions, and 5.5 during the music sessions. An upward trend can be seen in both conditions until approximately Session 28, when the music conditions developed a steeper ascending line while the no-music sessions began a descending trend. The final performance score for the no-music condition was 5.1 while the final performance score for the music condition ended on a high score of 7.6.

Student 8.

Figure 17 shows the percentage of problems solved correctly during no-music and music conditions. The range during Sessions 1 through 9 was from 40% to 73% during the no-music condition and from 55% to 79% during the music condition. During Sessions 10 through 34, the percentage of correct responses ranged from 64% to 95% during the no-music condition,
Figure 16. Number of math problems solved correctly per minute during music and no music conditions - Student 7.
FIGURE 17. PERCENTAGE OF MATH PROBLEMS SOLVED CORRECTLY DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT B.
and from 86% to 96% during the music condition. During Sessions 1 through 9, the mean percentage of no-music sessions was 62% and the mean percentage of music sessions was 69%. During Sessions 10 through 34, the mean percentage of correct responses during no-music sessions was 87% and for music sessions it was 88%. Both conditions showed a steep ascending trend beginning at approximately Session 5 and continuing until approximately Session 12, followed by a level trend with the exception of the final performance score for the no-music condition, which was 64%. The final performance score for the music condition was 88%.

Figure 18 shows the rate of math problems solved correctly during music and no-music conditions. During Sessions 1 through 9, the data points ranged from 1.8 to 3.5 during the no-music condition, and from 1.8 to 3.3 during the music condition. Scores during Sessions 10 through 34 ranged from 1.1 to 6.2 during the no-music condition and from 2.7 to 4.4 during the music condition. The mean rate, for the no-music condition, during Sessions 1 through 9, was 2.7 and the mean rate for the music condition during the same period was also 2.7. The mean rates for the no-music sessions and music sessions during Sessions 10 through 34 were 3.6 and 3.8 respectively. An unstable condition is shown in both no-music and music conditions with extremes at both ends. The final performance rate was 1.1 for the no-music condition, which was the lowest rate recorded, and 4.0 for the music condition.

Class Mean

Figure 19 shows the mean percentage of correct responses for the class during music and no-music conditions. The range during Sessions 1 through 9, for the no-music condition, was from 71% to 83%, and from 80% to 84%
FIGURE 18. NUMBER OF MATH PROBLEMS SOLVED CORRECTLY PER MINUTE DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT B
for the music condition. During Sessions 10 through 34, the percentage of problems solved correctly during the no-music condition, ranged from 86% to 91%, and from 80% to 96% during the music condition. During Sessions 1 through 9, the mean of the mean during the no-music condition was 76% and the mean of the mean was 81% during the music condition. During Sessions 10 through 34, the mean of the mean during the no-music condition was 89%, and the mean of the mean during the music condition was 90%. Both no-music and music conditions show an ascending trend before stabilizing at approximately Session 20. The final group performance mean with the no-music condition was 89% and with the music condition the final mean performance was 91%.

Figure 20 shows the mean rate of math problems solved correctly during no-music and music conditions. During Sessions 1 through 9, the data points for the no-music condition, ranged from 1.1 to 2.0 and from 1.6 to 2.2 during the music condition. During Sessions 10 through 34, the rate of math problems solved correctly during the no-music condition, ranged from 2.5 to 4.0, and from 2.5 to 4.1 during the music condition. During Sessions 1 through 9, the mean of the mean rate of correct problems solved during the no-music condition was 1.7, and the mean of the mean was 1.9 during the music condition. During Sessions 10 through 34, the mean rate of correct problems solved during the no-music condition was 3.1, and the mean of the mean was 3.3 during the music condition. The means of both conditions showed an ascending trend. The final no-music performance score was 4.0 and the final music performance score was 3.7.

On-Task Behavior

Figures 21 through 25 illustrate the on-task behavior of each of the
FIGURE 20. GROUP MEAN OF MATH PROBLEMS SOLVED CORRECTLY PER MINUTE DURING MUSIC AND NO MUSIC CONDITIONS.
Figure 21. Percentage of on-task behavior during music and no music conditions - Student 1.
five target students in terms of percentage of on-task behavior during no-music and music conditions. Figure 26 shows the mean group data. Results for individual students and the group are as follows:

Student 1.

Figure 21 shows the percentage of on-task behavior during music and no-music conditions. The range during Sessions 1 through 9, for the no-music condition, was from 55% to 86%, and the range during the same period for the music condition, was from 72% to 85%. During Sessions 10 through 34, the percentage of on-task behavior during the no-music condition, ranged from 73% to 100%, and during the music condition, the range was from 68% to 100%. During Sessions 1 through 9, the mean percentage of on-task behavior during the no-music condition, was 76%, and the mean during the music condition was 77%. During Sessions 10 through 34, the mean percentage of on-task behavior for no-music sessions was 86%, and the mean percentage of on-task behavior for music sessions was 89%. Both conditions show an erratic line with a gradually ascending trend. The final no-music performance score was 88% and the final music performance score was 89%.

Student 3.

Figure 22 shows the percentage of on-task behavior during music and no-music conditions. The range during Sessions 1 through 9, for the no-music condition, was 76% to 100% and the range during the same period for the music condition was from 94% to 100%. During Sessions 10 through 34, the percentage of on-task behavior during the no-music condition, ranged from 90% to 100%, and during the music condition, the range was from 80% to 100%. During Sessions 1 through 9, the mean percentage of on-task behavior during the no-music condition, was 91%, and the mean during the
FIGURE 22. PERCENTAGE OF ON-TASK BEHAVIOR DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT J.
music condition was 98%. During Sessions 10 through 34, the mean percentage of on-task behavior for no-music sessions was 97%, and the mean percentage of on-task behavior for music sessions was 98%. Following a downward trend through Session 9, the no-music sessions showed a sharp upward move followed by a leveling off at a medium level. The music sessions began with a similar downward trend with a steep move up and followed by an extremely high stable level. The final no-music performance score was 95% and the final music condition score was 100%.

Student 6.

Figure 23 shows the percentage of on-task behavior during music and no-music conditions. The range during Sessions 1 through 9, for the no-music condition, was 20% to 73%, and the range during the same period for the music condition, was from 60% to 76%. During Sessions 10 through 34, the percentage of on-task behavior during the no-music condition, ranged from 65% to 100%, and during the music condition, the range was from 75% to 100%. During Sessions 1 through 9, the mean percentage of on-task behavior during the music condition was 55%, and the mean percentage during the music condition was 67%. During Sessions 10 through 34, the mean percentage of on-task behavior for no-music sessions was 89%. The trend of the no-music condition is extremely unstable, although Sessions 10 through 33 show less instability and a much higher level. The trend of the music sessions is also somewhat unstable and also displays a higher level in Sessions 10 through 33. The final no-music performance score was 80% and the final music performance score was 100%.

Student 7.

Figure 24 shows the percentage of on-task behavior during music and
FIGURE 23. PERCENTAGE OF ON-TASK BEHAVIOR DURING MUSIC AND NO MUSIC CONDITIONS - STUDENT 6.
Figure 24. Percentage of on-task behavior during music and no music conditions - student 7.
no-music conditions. The range during Sessions 1 through 9, for the no-
music condition, was 80% to 100%. Only one data point, at 94%, was recorded
for the music condition during this period. During Sessions 10 through
34, the percentage of on-task behavior during the no-music condition,
ranged from 80% to 100%, and during the music condition, the range was
from 74% to 100%. During Sessions 1 through 9, the mean percentage of on-
task behavior during the music condition, was 88%. During Sessions 10
through 34, the mean percentage of on-task behavior for no-music sessions
was 93%, and the mean percentage of on-task behavior for music sessions
was 94%. The trend for both no-music sessions and music sessions was
generally stable at a high level. The final no-music performance score
was 90% and the final music condition score was 93%.

Student 8.

Figure 25 shows the percentage of on-task behavior during music and
no-music conditions. The range during Sessions 1 through 9, for the no-
music condition, was 68% to 80%, and the range during the same period for
the music condition, was from 61% to 87%. During Sessions 10 through 34,
the percentage of on-task behavior during the no-music condition, ranged
from 58% to 93%, and during the music condition, the range was from 45%
to 94%. During Sessions 1 through 9, the mean percentage of on-task
behavior during the music condition, was 75%, and the mean percentage
during the music condition was 74%. During Sessions 10 through 34, the
mean percentage of on-task behavior for no-music sessions was 79%, and the
mean percentage of on-task behavior for music sessions was 75%. Both
conditions display extremely erratic lines, with wide daily fluctuations
the rule. The final no-music performance score was 80%, and the final
Figure 25. Percentage of on-task behavior during music and no music conditions - Student 8.
Figure 26. Percentage of on-task behavior during music and no music conditions - group.
music condition score was 89%.

**Group Mean**

Figure 26 shows the percentage of on-task behavior during music and no-music conditions. The range during Sessions 1 through 9, for the no-music condition, was 60% to 85%, and the range during the same period, for the music condition, was 77% to 84%. During Sessions 10 through 34, the percentage of on-task behavior during the no-music condition, ranged from 85% to 96%, and during the music condition, the range was 81% to 100%. During Sessions 1 through 9, the mean of the mean percentage of on-task behavior during the no-music condition, was 77%, and 83% during the music condition. During Sessions 10 through 34, the mean of the mean percentage of on-task behavior for no-music sessions was 88%, and the mean of the mean for music sessions was 89%. After an initial downward slope, the no-music condition displayed an ascending line in three steps. With one exception, the music condition maintained a fairly even line beginning with Session 10. The final no-music mean performance score was 90%, and the final mean performance music condition score was 96%.

**Interobserver Agreement**

Interobserver agreement ranged from 86.7% to 95.8% with a mean of 91%. Figure 27 shows the percentage of Observer Agreement for each check point.

**Affective Responses**

Figures 28 and 29 show, in tabular form, the affective responses, in terms of percentage of degrees of restfulness-tiredness, and pleasantness-unpleasantness, of the individual children and of the class mean, during no-music and music conditions.
## Observer Agreement

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**Figure 27. Percentage of Observer Agreement.**
AFFECTIVE RESPONSES
Pleasantness - Unpleasantness

CODE
VP = Very Pleasant
P = Pleasant
AR = All Right
U = Unpleasant
VU = Very Unpleasant

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Figure 28: Percentage of affective responses (pleasantness-unpleasantness) during music and no-music conditions.
### AFFECTIVE RESPONSES

**Restfulness - Tiredness**

**CODE**
- **VP** - Very Pleasant
- **P** - Pleasant
- **AR** - All Right
- **U** - Unpleasant
- **VU** - Very Unpleasant

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<td>11%</td>
<td>78%</td>
<td>11%</td>
<td></td>
<td>11%</td>
</tr>
<tr>
<td>Student 6</td>
<td>14%</td>
<td>43%</td>
<td></td>
<td>14%</td>
<td>22%</td>
<td>10%</td>
<td>70%</td>
<td>20%</td>
<td></td>
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</tr>
<tr>
<td>Student 7</td>
<td>92%</td>
<td>8%</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 8</td>
<td>27%</td>
<td>27%</td>
<td>36%</td>
<td>9%</td>
<td>40%</td>
<td>30%</td>
<td>20%</td>
<td>10%</td>
<td></td>
<td></td>
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<tr>
<td>Class Mean</td>
<td>37%</td>
<td>33%</td>
<td>6%</td>
<td>14%</td>
<td>10%</td>
<td>30%</td>
<td>32%</td>
<td>5%</td>
<td>12%</td>
<td>12%</td>
</tr>
</tbody>
</table>

**FIGURE 29:** PERCENTAGE OF AFFECTIVE RESPONSES (RESTFULNESS-TIREDNESS) DURING MUSIC AND NO-MUSIC CONDITIONS
Exit Interview

Following the termination of the study, exit interviews were held with seven of the eight children and with the regular classroom teacher. The results of the Student Exit Interviews are shown in tabular form in Figure 30.

The regular resource room teacher, who has had 15 years experience in Special Education, indicated in her interview, that she found the music very pleasant and felt that the music enhanced the classroom environment "very much". She would like the music to continue and would like it all morning although she felt that the music had only a "moderate" positive effect and a "slight" negative effect on the children. The experimenter interprets that response as meaning the teacher observed different reactions with different children, or at different times. The teacher's written comment concerning the procedure was, "I loved the music and choice of selections. I may continue the procedure next year."
### Student Exit Interview

<table>
<thead>
<tr>
<th>Question</th>
<th>Student 1</th>
<th>Student 2</th>
<th>Student 3</th>
<th>Student 4</th>
<th>Student 5</th>
<th>Student 6</th>
<th>Student 6</th>
<th>Student 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Did you like it more with/without music?</td>
<td>with</td>
<td>with</td>
<td>without</td>
<td>with</td>
<td>without</td>
<td>without</td>
<td>without</td>
<td>without</td>
</tr>
<tr>
<td>2. Did the music disturb you?</td>
<td>no</td>
<td>a little</td>
<td>a lot</td>
<td>no</td>
<td>no</td>
<td>a little</td>
<td>a lot</td>
<td></td>
</tr>
<tr>
<td>3. Did the music help you to do a better job?</td>
<td>helpful</td>
<td>no difference</td>
<td>no</td>
<td>helpful</td>
<td>no difference</td>
<td>no</td>
<td>&quot;worse&quot; job</td>
<td></td>
</tr>
<tr>
<td>4. Would you like the music during every mathematics class?</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>5. Would you like the music to be on for a longer time?</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
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</table>

### Class Mean

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<th>Question</th>
<th>Positive Response</th>
<th>Negative Response</th>
<th>No Difference</th>
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<td>1.</td>
<td>57%</td>
<td>43%</td>
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</tr>
<tr>
<td>2.</td>
<td>57%</td>
<td>43%</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>28.5%</td>
<td>43%</td>
<td>20.5%</td>
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<td>4.</td>
<td>57%</td>
<td>43%</td>
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</tr>
<tr>
<td>5.</td>
<td>57%</td>
<td>43%</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 30:** Individual Student and Class Mean Responses to Student Exit Interview
CHAPTER IV

DISCUSSION

This chapter presents a discussion of the results and limitations of the study, the implications for classroom practices, and suggestions for future research.

Research Question #1

Does sedative background music increase mathematics achievement of elementary school learning-disabled children as measured by the rate and percentage of correct responses on a mathematics worksheet during a 15-minute seatwork assignment?

The rate and percentage of correct responses for each student and for the entire class were compared during conditions of sedative background music and no music. Performance for the class as a whole was virtually identical across the two conditions. Accuracy of responses, which was reflected by percent of correct responses, was determined by scoring all incorrect answers as errors and dividing the number of problems completed correctly by the total number of problems attempted. The class mean percent of correct responses for Sessions 10-34 showed only a 1% difference in favor of the music condition. While a measure of percent of correct responses reflects accuracy of performance, it does not reflect the student's work rate, which is a good indicator of proficiency (Van Houten, 1980). Van Houten (1980) defines correct rate as the number of problems worked correctly in a unit of time. In this study, data on the number of problems worked correctly during the 15 minute mathematics period was used to determine the correct rate per minute, which showed a mean .2 increase in rate during the music condition. Although both measurements demonstrated
a slight difference in favor of the music condition, the differences are insignificant.

problems worked correctly during the 15 minute mathematics period was used to determine the correct rate per minute, which showed a mean .2 increase in rate during the music condition. Although both measurements demonstrated a slight difference in favor of the music condition, the differences are insignificant.

The individual mean performances for percent and rate of correct responses during Sessions 10-34 were as follows:

Student 1 displayed an identical percent of correct responses, reflecting the same degree of accuracy, during both conditions and less than .4 difference in rate of correct responses in favor of the music condition.

Student 2 displayed a slightly better performance during the no music condition with a 1% difference in percentage of correct responses and .1 better in rate of correct responses during that condition.

Student 3 showed contradictory results, with a 3% better performance during the no music condition for percent of correct responses, while achieving a .2 better in rate of correct responses during the music condition.

Student 4 displayed exactly opposite results with a 3% better performance for percent of correct responses during the music condition, and .3 better performance in rate of correct responses during the no music condition.

Student 5 showed the same percentage of correct responses under both conditions and .3 better performance in rate of correct responses under
the no music condition.

Student 6's performance was superior under the music condition by 2\% in percent of correct responses and by .4 in rate of correct responses.

Student 7's performance was also slightly superior under the music condition with 1\% better in percentage of correct responses and .5 better in rate of correct responses.

Student 8 showed a 1\% better performance under the music condition for percentage of correct responses, while the rate of correct responses was identical under both conditions.

In summary, four students performed with slightly higher accuracy under the music condition, two performed better under the no music condition, and two achieved identical scores under both conditions. Four students achieved higher rates of correct responses under the music condition, and three under the no music condition, while one showed identical rates under both conditions.

The results clearly show no significant difference in mathematics performance during music and no music conditions. These results are in agreement with the data from several earlier studies with various other types of populations. Anno (1958) found no significant difference in academic performance of normal children during music and no music conditions over a 16 week time period. These results are also consistent with studies by Engel and Engel (1962) involving mathematics performance of normal children, Freebourne and Fleisher (1952) who studied reading rate and comprehension of college students during four types of music, and Carlson and Hergenhahn (1967) which involved trials to criterion in learning nonsense syllables by college students. The results are not consistent with studies by Lane (1977), Simpson (1976), or Scott (1970). It should
with studies by Lane (1977), Simpson (1976), or Scott (1970). It should be noted that Simpson's study (1976) dealt with brain-injured children and Scott's (1970) subjects were severely hyperactive. This may suggest that the level of hyperactivity present in the subjects may be a factor in the effect of background music on academic performance.

Research Question #2

Does sedative background music increase the on-task behavior of elementary school learning-disabled children during a 15 minute mathematics seatwork assignment?

The percentage of on-task behavior for the class and target students, during the performance of a 15-minute daily mathematics assignment, was compared during music and no music conditions. The mean percentage of on-task behavior during music sessions was 1% higher than that during no music sessions; the difference is too slight to be noteworthy. Therefore, the difference in on-task behavior during music and no music conditions observed in this study is insignificant.

Data for the five individual target students is summarized below:

Student 1 showed a mean percentage of on-task behavior during the music condition of 89%, which was 1% higher than that displayed during the no music condition.

Student 3 displayed the same difference of 1% in favor of the music condition, with 98% on-task behavior during the music condition, and 97% on-task behavior during the no music condition.

Student 6 showed 79% on-task behavior during no music sessions, and 75% during music sessions, for a 4% superior no music performance.
Student 7 displayed a 1% difference in on-task behavior in favor of the music condition, with mean performances of 94% and 93%.

Student 8 showed 79% on-task behavior during no music sessions, and 75% during music sessions, for a 4% superior no music performance.

A marked lack of relationship between on-task behavior and mathematics achievement was observed in two of the target students. Student Three, who had been chosen by the teacher as being among the least hyperactive in the class, and Student Six, who had been chosen at random, displayed inferior performances during several sessions when they gave the appearance of having a high level of on-task behavior. Student Six, for example, was on-task 75% of the time during Session 21, which was only 4% below his mean no music on-task behavior. His mathematics rate that session was only 1.06 correct responses per minute, more than 1.1 problems per minute below his average performance during the no music condition of 2.2 correct responses per minute. By contrast, during Session 28, his on-task behavior was again at 75% but his mathematics rate was about 2.9 or more than twice that of Session 21. Student Three displayed an extremely high rate of on-task behavior throughout the study. Although his on-task behavior was 100% during Session 20 and again during Session 24, his mathematics rate for those sessions was only .8 and .46, in contrast to his mean rate of correct mathematics responses of 1.28 during the no music condition and 1.46 during the music condition. These observations suggest that on-task behavior does not necessarily mean a higher level of task performance or valid task attentiveness although superior task performance does seem to cause a higher level of on-task behavior. This is consistent with findings of several studies that analyzed on-task behavior versus academic
performance. In a study of 29 fifth/sixth grade students, McLaughlin and Malaby (1972) used tokens to reinforce students for either assignment completion or on-task behavior. The results showed that tokens for on-task behavior increased on-task behavior but did not result in an increase in production. Tokens awarded for assignment completion resulted in an increase in production and in on-task behavior. Results of Lane's (1977) study also indicate that math performance and task-relevant behavior do not necessarily have a positive relationship. Similar indications were found by Madsen et al. (1975) in their study of music as a reinforcer for correct mathematical responses versus music as a reinforcer for attentiveness. Included in the Juniper Gardens Children's Project (Greenwood, Delquadri, and Hall, 1983), Greenwood, Terry, Wade, Dinwiddie, Stanley, Thibadeau, and Delquadri (1982) studied the effect of opportunity to respond on spelling performance in an inner-city fourth grade classroom. The results indicated that spelling achievement was related to increased academic practice, and that both discussion and student attention were negatively related to spelling achievement. Greenwood et al. (1983) suggests that good classroom behavior does not necessarily produce achievement. Therefore, the instructional implication would seem to follow that the better strategy for the classroom teacher would be to reinforce task performance rather than on-task behavior.

Although Simpson (1976) found three of the six brain-injured students he observed showed an increase in activity during the music condition, several studies showed no significant difference. Lane (1977) found no significant relationship between task-relevant behavior and the background music conditions or no music condition. In a recent study, Wolfe (1982)
found no significant difference in bodily movement during 4 music conditions and a no music condition.

Research Question #3
How do elementary school learning-disabled children subjectively rate background music in terms of restfulness and pleasantness?

The percentage of responses in each of five categories for Pleasantness-Unpleasantness and for Restfulness-Tiredness were analyzed. Pleasantness-Unpleasantness data showed 61% Very Pleasant or Pleasant responses during the no music condition compared to only 54% in those categories in the music condition for a 7% superiority of the no music condition. This finding is contrary to Lane's (1977) results which displayed a superiority of music condition over no music in feelings of pleasantness.

The Restfulness-Tiredness data revealed exactly equal percentages, 70%, of responses of Very Rested or Rested, during music and no music conditions. These results are again, in opposition to those of Lane's (1977) study which showed superior results during the music condition.

It was observed that two of the student's responses displayed unusual stability. Student 7 consistently indicated he felt Very Pleasant and Very Rested with only one exception (Session 10) during the whole study. On the other hand, Student 3 never varied his response on the Pleasantness-Unpleasantness Form from All Right, and never marked anything but Tired or Very Tired on the Restfulness-Tiredness Form. This seemed to reflect these students' general attitude. Student 7 was usually energetic and hard-working, while Student 8 was slow moving and extremely slow performing as indicated in his rate of correct responses data. Student 8 was on
medication which may have been a factor.

The other students seemed to be affected more by what might have happened just prior to the session. Since the sessions were usually held early in the morning, troubles on the bus resulting in detentions frequently affected response.

Mathematics Performance over the Course of the Study

Although not directly related to the research questions in this study, interesting developments in the mathematics performance of the students during the course of the study were observed, and merit a place in these discussions.

After only a few sessions into the study, the experimenter saw a need to develop a strategy to maintain interest. Students' comments, such as, "Do we have to do that again?" and nonverbal communications, such as facial expressions showing weariness, and body language expressing reluctance and disinterest, clearly showed a need for intervention. The "Sam the Snoop Board" procedure described in Chapter II was begun in Session 10, and the results, as displayed in the graphs, show an ascending trend in performance from that point. Because one criteria for a paper being placed on the Board was a new rate record at least once during that week, students had to show steady improvement.

Student 1 showed great progress which the experimenter felt was due to the public posting contingency. Her teacher reported that she had spent many months at virtually the same mathematics level. Student 1 became very involved in the Board, and as can be seen in Figures 3 and 4, went from a score of 40% of correct responses in Session 2 to a score of 87% of correct responses in Session 33, and a rate of 1.4 correct responses per
minute during Session 2 to a high of 6.5 during Session 33. This student would check her graph immediately upon entering the room, and if she had set a new record, she would literally dance with joy, grin happily, and hug the experimenter. Meanwhile, her everyday mathematics assignments continued at the previous low level of performance. Despite this, it was decided to have this child begin multiplication based on her performance on the daily 15 minute mathematics worksheet. She performed quite well, was enthusiastic, and told the experimenter that she loved multiplication.

The reactions to public posting observed in this study are similar to the results of a study by Van Houten, Hill and Parsons (1975) which examined the effects of public posting on the story writing rate of fourth-grade children. The results showed that not only did timing and self-scoring increase the rate of story writing, but also that public posting increased the effect of these variables. Van Houten (1980) points out that public posting results in an increase in comments students make about their performance. Although data was not collected on this aspect, the same effect was observed in this study. Students tended to gather by the Board although that type of behavior was discouraged by the teacher’s classroom management system. The graphs and the Board were continual topics of conversation amongst the students, and while the experimenter worried that the students would be unable to set new records, they showed great determination and continued to progress. On more than one occasion the students reminded the experimenter that it was time for the test, and when a scheduling conflict would arise for one or two of the students, they actually asked if they could take the test at a later time.

Contrary to Van Houten’s (1980) statement that public posting does
not typically cause negative interactions among students, an episode did develop during the study. Student 4, who had been a good friend of Student 5, suddenly showed great animosity towards Student 5, threatening to beat him up and making continuous derogatory remarks. The suspicion that rivalry over papers on the Board might be the cause was confirmed by Student 4 asking permission to speak to the class. He stood up, and announced that the reason the class wasn't doing so well in the math tests, was because it was almost the end of the year. By making it possible for Student 4 to achieve recognized success in another area, the problem was quickly resolved.

Limitations of the Study

The subjects of this study displayed a high level of on-task behavior even before the study began. Baseline data showed 82% on-task behavior. It is possible that the use of sedative background music may have had different results with a more hyperactive population.

The setting of this study in a Resource Room was also a limiting factor. A Resource Room is a unique setting, its characteristic feature being that students spend only a portion of the school day in that class, while returning to their regular classrooms for some classes with their peers. This results in a constant flow of students entering and leaving the room, which is a steady source of distraction. In addition, this particular Resource Room had frequent visitors including, but not limited to, Senior Citizen Volunteers, Aides, college student observers, Student Teacher Observers, mothers of potential students, and regular teachers. Each visitor necessitated a moment of conversation, which meant another
distraction. Anno (1958) suggested that background music served to block out other distracting noises but that effect was not noted in this study. It has been noted that background music seems to increase efficiency in repetitive tasks but results are inconsistent with complex academic tasks (Geringer, 1979). The dependent variable in this study, correct mathematical responses, was a complex task. It is possible that a study involving a less complex task, such as handwriting exercises, might show different results.

The type of background music used in this study presented another limitation. Other categories of music, such as stimulating or melancholy, or selections chosen by the students, might have shown different results.

The experimental design used in this study, the Alternating Treatment Design, which features alternating experimental and baseline conditions, is another limitation of this study. It is possible that another design, which would call for an exposure to the experimental condition over a longer period of time, allowing the students to become accustomed to the background music, might show different results.

Implications for Classroom Practice

The results of this study showed background music has no significant effect on either mathematics performance or on-task behavior of this particular population. Although the teacher and experimenter enjoyed the musical interlude, the children seemed equally divided in their affective reactions. It would seem that, given the limitations of this study, sedative background music will neither help nor hinder student performance.

The observation was made that, while some students may give the
appearance of being on-task, their performance indicates a lack of attentiveness to the task at hand. The implication for the classroom teacher is that rather than reinforce on-task behavior, a better strategy might be to reinforce task performance, which in turn seems to increase on-task behavior.

Although an analysis of the effects of public posting was not the purpose of this study, and therefore the experimental design did not allow for a scientific evaluation of the effects of the "Sam the Snoop Board", the implementation of the procedure did correlate with positive results. The utilization of a similar procedure in a classroom should stimulate interest and increase performance in similar tasks. The procedure is costly in terms of teacher time unless the students are given instruction in self-scoring and self-graphing.

Suggestions for Future Research

Based on a consideration of the results, implications, and limitations of this study, suggestions for future research into the effects of background music include:

1. Experimental replication of this study in other elementary school learning disabled resource rooms displaying higher levels of hyperactivity.
2. Experimental replication of this study in other types of special classes, such as a learning disabled self-contained classroom or a behavioral disabled classroom.
3. Experimental replication of this study in other grade levels.
4. Experimental replication of this study using other academic subjects as the dependent variable.
5. Experimental replication of this study using other types of background music.

6. A study of the effects of sedative background music using a different experimental design, such as a reversal design.


Summary

This study involved a comparative analysis of mathematics performance and on-task behavior during alternating conditions of sedative background music and no music. Inherent in the experimental design used, the alternating condition design, is the use of the experimental group acting as its own control group, which eliminates confounding the results by practice effects.

Rate of correct responses and percent of correct responses on a 15-minute daily mathematics seatwork assignment by eight elementary school learning disabled students in a resource room setting was observed. During the mathematics assignment, observations were also made of the on-task behaviors of five target students using a time sampling technique. Analysis of the data showed no difference in mathematics performance, nor on-task behavior, during the music condition. The conclusions suggested by these results are that sedative background music will neither help nor hinder mathematics achievement, nor affect on-task behavior of learning disabled children in a resource room.

Limitations of this study peculiar to the setting include the high level of on-task behavior present in this population prior to the study,
and the confounding effects of constant distractions common in a resource room setting. Other limitations include the task selected for the dependent variable, the type of music selected, and the experimental design.

A public posting procedure was instituted partway into the study, and the effects, although not scientifically evaluated, suggest a correlation with a positive trend in performance. It was observed that some students displayed a lack of correlation between on-task behavior and achievement. This would suggest the preferred instructional strategy would be behavioral modification techniques aimed directly at academic performance rather than on-task behavior.

Suggestions for future research include replication with different populations, academic tasks, types of music, and experimental designs. Future research is also suggested in the use of public posting with special populations.
References


Olles, J. R. Music reinforcement in conjunction with the Premack principle to modify behaviors, unpublished manuscript. University of Missouri, St. Louis, 1963.


Sutherland, H. Personal communication, Dec., 1982.


Appendix A - Music Selections
SEDATIVE BACKGROUND MUSIC

Beethoven: Moonlight Sonata (First Movement)
Bizet: L’Arlesienne (Suite #1) Adagietto
 Brahms: Symphony #3 in F Major (3rd Movement)
Debussy: Clair de Lune
Liszt: Liebestraum #3
Rachmaninoff: Rhapsody on a theme of Paganini (Main Theme)
Ravel: Pavane pour une enfante de fune
Rimsky-Korsakoff: Scheherazade
Schubert: Symphony #8 (The Unfinished)
Sibelius: The Swan of Tuonela
Tchaikovsky: Waltz of the Flowers from the Nutcracker Suite
Appendix B - Observation Sheet
### Observation Code for Selected Behaviors of Children Performing Assigned Behaviors

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**Second Observer**

- O - On-task
- B - Body movement
- S - Out of seat
- T - Talking out
- G - Behavior occurrence
- L - Looking away from task

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- O: On-task
- B: Body movement
- S: Out of seat
- T: Talking out
- G: Behavior occurrence
- L: Looking away from task
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Student 2

\[ \frac{8136}{54} \times 53 \quad 4532 \times 7 \]

\[ 79 \times 64 \quad 852 \times 40 \quad 29 \times 44 \quad 689 \times 5 \]

\[ 624 \div 12 \quad 6578 \div 7 \quad 475 \div 4 \]

\[ 403 \div 4 \quad 64 \div 83 \times 5 \]
\[ 6 \frac{1}{4} \times 3 \frac{2}{3} = \]
\[ = \frac{173}{49} \]

\[ 32 \overline{\div} \]

\[ 39 \]
\[ \times 4 \]

\[ 6073 \]
\[ \times 29 \]
\[ \overline{17534.27} \]
Student 4

\[ \begin{align*}
99 & \quad \cdot 0.9 \quad 8.1 & \quad 12 \\
\times 5 & & \times 7 \\
\hline
4.42 & \quad 6.45 \quad 128 & \quad .459 \\
-5.81 & & \\
\hline
96.7 & \quad 56.13 & \quad 8.69 \\
\times 8 & \times 7 & +3.74 \\
\hline
30.04 & \quad 80.05 & \quad 72.9 \\
\times 4 & \times 3 & \times 4
\end{align*} \]
Student 5

\[
\begin{align*}
40384 & \quad 572.4 & \quad 787 & \quad 807 \\
\times 4 & & \times 4 & -139 \\
\hline
5.2 & \quad 8132 & \quad 7150.4 & .9 \\
-4.8 & & \times 7 & \\
\hline
.07360.2 & \quad 4.50 & \quad .76 & \quad 4.7 \\
\times 4.4 & \times 4.1 & \times 1.6 \\
\hline
909 & \quad 878 & \quad .79884 & \quad 730 \\
-339 & & \times .3 & \times .54 \\
\hline
\end{align*}
\]
508 + 802 = 1310
42 × 16 = 672
7 × 8 = 56
8 × 9 = 72

312 - 19 = 293
90 - 7 = 83
712 × 4 = 2848
49 + 46 = 95

15 - 8 = 7
40 × 8 = 320
85 × 5 = 425
83 + 99 = 182

89 + 46 = 135
48 + 37 = 85
74 - 47 = 27
900 - 79 = 821
Student 7

\[
\begin{array}{ccccccc}
15 & +5 & 11 & -2 & 22 & +1 & 8 & +3 & 8 & -4 & 12 & +4 \\
    &    &    &    &    &    &    &    &    &    &    &    \\
13 & +4 & 13 & -2 & 6 & +9 & 3 & +2 & 12 & +4 & 11 & -9 \\
    &    &    &    &    &    &    &    &    &    &    &    \\
    &    &    &    &    &    &    &    &    &    &    &    \\
    &    &    &    &    &    &    &    &    &    &    &    \\
9 & -4 & 12 & -3 & 10 & -4 & 14 & -2 & 3 & +4 & +9 & \\
    &    &    &    &    &    &    &    &    &    &    &    \\
    &    &    &    &    &    &    &    &    &    &    &    \\
    &    &    &    &    &    &    &    &    &    &    &    \\
8 & -3 & 11 & +2 & 3 & +5 & 5 & +5 & 6 & +6 & +7 & \\
    &    &    &    &    &    &    &    &    &    &    &    \\
    &    &    &    &    &    &    &    &    &    &    &    \\
    &    &    &    &    &    &    &    &    &    &    &    \\
9 & -4 & 5 & -4 & 13 & +3 & 12 & +6 & 8 & -9 & 11 & -5 \\
    &    &    &    &    &    &    &    &    &    &    &    \\
    &    &    &    &    &    &    &    &    &    &    &    \\
    &    &    &    &    &    &    &    &    &    &    &    \\
+3 & +2 & 9 & -9 & 15 & -0 & 23 & +1 & 12 & +4 &    & \\
\end{array}
\]
Student B

\[ \frac{9127}{+37} + 99 \times 5 = 275 \times 8 \]

\[ \frac{609}{-88} \times 9 = 315 \times 7 = 584 \times 3 \]

\[ \frac{5348}{\times 4} \times 6 = 73 \times 9 = 27 \times 9 = 56 \]

\[ \frac{306}{\times 8} \times 3 = 87 \times 7 = 45 \times 17 = 809 \times 19 \]
Appendix D - Pleasantness-Unpleasantness Form
Restfulness-Tiredness Form
Pleasantness - Unpleasantness

1. Very Pleasant
2. Pleasant
3. All Right
4. Unpleasant
5. Very Unpleasant
Restfulness-Tiredness

A. Very Rested
B. Rested
C. Average
D. Tired
E. Very Tired
Appendix E - Student Exit Interview Form
Teacher Exit Interview Form
Student Exit Interview

Student ___________________________ Date __________
Interviewer ________________________

1. Did you like it more with or without music when you did your mathematics worksheet?
   with ______ without ______

2. Do you think the music disturbed you?
   a lot ______ a little ______ no ______ don't know ______

3. Do you think the music helped you to do a better job on your mathematics worksheet?
   helpful ______ no difference ______ don't know ______

4. Would you like the music during every mathematics class?
   yes ______ no ______

5. Would you like the music to be on for a longer time?
   yes ______ no ______
Teacher Exit Interview

1. Did you find the music pleasant?
   very ______ moderately ______ slightly ______ no ______

2. Do you think the music enhanced the classroom environment?
   very much ______ moderately ______ slightly ______ no ______

3. Would you like the music to continue for a period of time each day?
   yes ______ no ______

   * If yes, for how long?

5. Do you feel the music had a positive effect on the children?
   strong ______ moderate ______ slight ______ no difference ______

6. Do you feel the music had a negative effect on the children?
   strong ______ moderate ______ slight ______ no difference ______

7. Do you have any comments concerning the procedure? Please use the remaining space for your comments.
Appendix F - Weather Form
Weather Form

1. Sunny

2. Cloudy

3. Rainy

4. Stormy

Bang! Crash!