THE EFFECT OF SUNG AND SPOKEN MATERIAL PRESENTATION, NUMBER OF PRESENTATIONS, AND FUNCTIONING LEVEL ON RETENTION OF A PERCEPTUAL - MOTOR TASK IN THE MENTALLY RETARDED

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ABSTRACT

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By

Barbara Jean Crowe

The purpose of this study was to assess the effect of certain variables on learning a perceptual-motor task by mentally retarded children. Variables included; use of music, functioning level of the subjects, and number of presentations of task information. Interactions among the variables were also tested for significance.

Nineteen trainable retarded students from Forest Grove School in Fenwick, Michigan, designated high functioning for this study, and seventeen severely retarded students from Marvin E. Beekman Training Center in Lansing, Michigan, designated low functioning, were used in the investigation. Subjects were randomly placed in one of four instructional groups: musical context twice, spoken context twice, musical context once, and spoken context once. Subjects were tested individually in one ten minute session. All subjects in the four instructional groups were taught the same perceptual-motor task involving placement of six colored geometric shapes in a set order on a table. Following instruction, subjects were asked to duplicate the perceptual-motor task within 60 seconds. The completed task was scored for correct

position and correct sequential placement. Position score, sequence, total score, and time of response were compared by computer statistical analysis.

The following conclusions were drawn based on the results of this investigation:

1. The musical context used to present task information did not significantly improve retention of the perceptual-motor task.
2. The number of presentations of task information did not significantly improve retention of the perceptual-motor task.
3. The functioning level of the subjects, whether they were trainable or severely mentally retarded, was the only variable that significantly influenced scores on the perceptual-motor task.

A delay before the second reiteration of the task information may have diminished the facilitation of the memory trace. Further, the melodic, highly static nature of the musical context used in this experiment did not facilitate learning in the mentally retarded. However, neuro-physiological evidence indicates that a highly rhythmic setting might produce the facilitation desired. Future researchers would be advised to continue research in the area of musical facilitation of learning by comparing rhythmic, melodic, and combined melodic and rhythmic frameworks for presentation of task information. Research should also be done to investigate different ways of presenting the task information more than once to ascertain the effect on retention in the mentally retarded.

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CHAPTER I

PURPOSE OF THE STUDY

Introduction

The mentally retarded have below average intelligence and have difficulty acquiring and retaining basic information. Because such information is essential for independent or semi-independent living, special education professionals have applied a large variety of learning modalities and theories to the education of the mentally retarded. Though these techniques vary greatly, they have a common basis in experimental or applied research so that the validity of each educational modality is firmly established. Music experiences have been postulated as one possible technique for educating the mentally retarded. However, their use in the actual acquisition of knowledge or facts has not been established by research.

Music has been an activity used with the mentally retarded for a variety of reasons. In fact, the use of music in programs for the mentally retarded dates back many years. Kraft (1963) reports music classes, such as marching bands and orchestras, were included in curricula for the mentally retarded as early as 1880. In more recent times, a great deal has been written about the importance of music in the treatment and education of the mentally retarded. As early as 1955, Fraser advocated the inclusion of music in an educational program for the mentally retarded. She wrote of the motivational aspects of music in the classroom and encouraged the use of highly rhythmical activities to promote an "ordered mind" in the mentally retarded. She proposed music as the preparation for learning in this type of child. Carey (1959) surveyed the status of music curricula for the mentally retarded to determine what musical experiences were effective and profitable for this group. She found a wide variety of musical activities used in special education settings. Loven (1956), Breidenthal (1958), and Bennis (1969) among other educators advocated the use of music with the mentally retarded. The various rationales they proposed included; emotional expression and psychological rehabilitation, opportunities for recreation and play, facilitation of decision making and responsibility, increased attention span, development of leisure time activities, and opportunities for diversion and music appreciation.

Music, in programs for the mentally retarded, was most often promoted as a general support to personal and social development and was not thought of as a direct facilitator of learning. In 1963, Elmer Weber, director of special education in Evansville, Indiana, devoted an entire chapter of his book, Mentally Retarded Children and Their Education, to the use of music. He advanced his position in favor of using music by stating that music was a "miracle" and "a psychological liberation" for the mentally retarded which prepares them for learning.[1] This rationale exemplifies the prevailing, but unsubstantiated, opinion on the use of music with retarded students.

Several educators of the mentally retarded, notably Weber (1966) and Berndt (1949), did, however, postulate a connection between

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[1]Elmer W. Weber, Mentally Retarded Children and Their Education (Springfield, Ill.: Charles C. Thomas, 1963), p. 147.

participation in music and acquisition of subject knowledge such as geography and mathematics. Weigl (1969) stated that "it is essential to use music as a means of aiding their [the mentally retarded] memory in preparing them for everyday life situations . . . Many of these youngsters will act out such songs most meticulously and remember the learned procedure to be repeated in actual life-situations later on."[2] However, the use of repetition of musical activities as valid educational tools was established by case-study information rather than by experimental research.

One reason special education professionals supported music programs for the mentally retarded was the recognition that the retarded as a group function well in music and were able to learn songs and retain those songs for a substantial length of time. Kwalwasser first recognized this general music ability of the retarded in the 1930s.[3] Lathom, in a 1970 study, found that mentally retarded children retained songs better than stories or poems. Doepke (1967) also found that mentally retarded children could remember songs almost perfectly that had been learned several months before. This ability to remember the pitch and words of songs does not necessarily mean that the retarded can learn word meanings and concepts of the song material. Verification of such a connection would help to substantiate the use of music as an educational modality for the mentally retarded.

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[2]Vally Weigl, "Functional Music--A Therapeutic Tool in Working with the Mentally Retarded," American Journal of Mental Deficiency, 63 (1959), 677.

[3]Jacob Kwalwasser, Exploring the Musical Mind, (New York: Coleman-Ross, Co., 1955).

Certain factors in human learning support the theory that music could be an effective means of educating the mentally retarded. The human ability to learn and retain information from the environment is a complex process that has been studied and speculated on by psychologists, biochemists, and neuroantomists for almost a century. A two-stage theory of learning and memory is currently the hypothesis that is most widely accepted.[4] The first stage of this process involves a brief initial period of neural activity which produces the trace of an experience on the brain. When this neural activity is sustained through reinforcement, biochemical or structural changes occur to alter the neurons of the brain or change the synaptic transmission itself. These brain alterations constitute the permanent memory trace or long-term memory function. This trace theory, or theory of reverberating circuits originally proposed by Hebb, Kornorski, and Eccles, is the electrochemical activity produced by sensory input that sustains the representation of an experience until the permanent structural or chemical storage has been accomplished.[5]

According to this theory, memory and learning are dependent on the type and amount of the initial cognitive reverberation. Much research has been done to determine the nature of reverberation. Blum, et al. (1968) found strong evidence of the occurrence of cognitive reverberation and determined that the "reverberating signal appears to

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[4]George H. Sage, Introduction to Motor Behavior (Reading, Mass.: Addison-Wesley Publishing Co., 1971), p. 260-262.

[5]E. Roy John, Mechanisms of Memory (New York: Academic Press, 1967), p. 27.

be strongest at the time of network activation and decreases until it dissipates."[6] Similarly, Adams and Dijkstra (1966) found that short-term memory or initial cognitive reverberation is a decreasing function of time and a positive function of the number of reinforcements given.[7] These findings are consistent with the hypothesis that initial memory trace decays quickly and is not capable of producing the necessary neural changes for permanent learning to occur. Facilitation of this learning must happen through the reinforcement process of adding neural input to the brain which stabilizes the reverberation circuit so that the physiological changes can occur.

Neural activity necessary for learning is produced primarily by input from the senses. Input to the brain not only produces specific memory traces for events but also produces increase in brain arousal. This general arousal is a necessary condition for learning. Welford (1968) states that at low levels of arousal neural circuits of the brain are inert so that input is lost in the complex information processing system.[8] Robert M. Smith postulates that learning ". . . consists of the extraction of information from the environment by sense organs and the translation of these perceptions into a message system appropriate for the cortex. A certain level of arousal is necessary for the

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[6]Gerald Blum, Louis Hauenstein, and Jed Graef, "Studies in Cognitive Reverberation: Replications and Extensions," Behavioral Science, 13 (March, 1968), 1976.

[7]Jack Adams and Sanne Dijkstra, "Short-term Memory for Motor Responses," Journal of Experimental Psychology, 71 (1966), 314-318.

[8]A. T. Welford, "Stress and Performance," Ergonomics, 16 (1973), 567-580.

perceptions to be received."[9] Sen (1968) found that when a stimulus, assumed to be distracting, was presented to one group of mentally retarded subjects an effect occurred that was opposite of that predicted. The subjects' performance on a sorting task was actually increased. The researcher attributed this to general arousal produced by the added stimulus.[10] Baumeister and Kistler (1975) conducted retention research in which a two minute burst of white noise was presented to half the subjects used in the experiment before a test for retention. It was found that the white noise produced an arousal state in the subjects so that substantial improvement in retention occurred compared to the control group who did not receive the noise.[11]

Such research suggests that general arousal can be produced by the addition of input from other senses. The concept of sensory integration to facilitate learning and other brain activities has been postulated by Ayres. She believes that enhancing sensory integration, in her work integration of kinesthetic and vestibular senses, influences all behavior, especially perception, cognition, and motor skills. This concept of integrating input from various senses could be applied to an integration of the auditory sense to enhance cognitive functioning and learning process. A study by Davis (1971) provides evidence for the possibility of auditory integration. He found in his study of

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[9]Robert M. Smith, Clinical Teaching: Methods of Instruction for the Retarded (New York: McGraw-Hill Book Co., 1968), p. 145.

[10]Anima Sen, "The Effect of Distraction on a Perceptual-motor Task in Subnormals," Bulletin of the Council of Social and Psychological Research, 10-11 (1968), 22-25.

[11]Alfred A. Baumeister and Doris Kistler, "Facilitation of Retention by White Noise," Journal of Experimental Child Psychology 20 (August, 1975), 13-21.

educable mentally retarded subjects that audio-visual stimuli consistently produced more accurate learning than visual-visual stimuli.[12]

Music is one possible type of auditory stimulus that could be integrated with other senses to facilitate learning. This facilitation might be especially effective if the information to be learned was directly contained in a musical framework. The direct pairing of information and music has the potential for producing more general cortical arousal and, perhaps, even reinforcing the memory trace itself by augmenting the reverberation. Because music and speech are mediated in different hemispheres of the brain, it is possible that more neural activity would be produced with such paired input. This paired stimuli might provide more neural activity to a greater area of the brain.

The mentally retarded also have a need for this type of general neural arousal to facilitate learning. Because of their limited intellectual ability, this group may in fact need more neural activity than would the normal population to produce the arousal necessary for effective learning. It has been theorized that all people have an optimum level of arousal that produces maximum performance. This inverted-U hypothesis, first proposed by Yerkes and Dodson (1908) and later expanded by Birch and Veroff (1966), states that levels of arousal above or below the optimum level will produce inferior learning.[13] It is possible that the mentally retarded need more sensory input to reach

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[12]William E. Davis, "Associative Learning Ability in Mentally Retarded Children under Varied Stimulus Conditions," American Journal of Mental Deficiency 76 (Sept., 1971), 197-200.

[13]D. Birch and J. Veroff, Motivation: A Study of Action (Belmont, Cal.: Brooks and Cole, Inc., 1966).

this optimum level of arousal than do normals. This contention is supported by Baumeister and Ellis (1963) who postulate that the mentally retarded have an impairment in the neuro-physiological reverberation circuit which produces a memory trace that has less intensity and duration than normals. They found that the added sensory input of a distracting stimulus increased short-term memory in the mentally retarded.[14]

Music that is closely paired with material to be learned would seem to be an effective means of providing the added input necessary for more efficient learning by the mentally retarded. It is theorized here that the added input could create the higher levels of neural arousal needed to overcome the deficit in the short-term memory process of retardates. Since music activity is enjoyable and is also an activity in which the retarded can be relatively successful, it could easily and naturally be adapted as a support to the learning of other material or task. The retardates would be receptive and attentive to such activities thus insuring the added sensory stimulus necessary for learning to occur.

Statement of the Problem

The problem under study was to determine the effect of music on learning a short-term memory task in the mentally retarded. More specifically, the questions for this study were as follows:

1. Can the mentally impaired learn and replicate task information contained in a song medium better than they can learn

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[14]Alfred A. Baumeister and Norman Ellis, "Delayed Response Performance of Retardates," American Journal of Mental Deficiency 67 (1963), 714-722.

and replicate the same task information presented in a spoken medium?

2. Does more learning take place when there are two presentations of the task information to the mentally retarded as opposed to one presentation of the task information using the same teaching strategy?

3. Is there any interaction between the variables of musical or spoken presentation of the task information and the variables of one or two presentations of each of the two types of educational media?

Hypotheses

The following hypotheses have been established for this study:

1. There will be a difference between the retention scores of the groups receiving the task information in a musical context and those receiving the task information in a spoken context.

2. There will be a difference between the retention scores of those groups receiving one presentation of the task information and those receiving two presentations.

3. The group receiving the experimental treatment involving two presentations of the task information presented in the musical context will score higher than any of the other three experimental groups.

4. There will be a difference in scores of high functioning subjects and the scores of low functioning subjects.

Need for the Study

Because there is little literature on the use of music as a media for the learning of nonmusical facts, research is needed in this area to discover the role of music and the involvement of auditory musical stimulation in the facilitation of learning. Further, there is little literature on employing musical facilitation of learning with the mentally retarded who have difficulty learning. Most current research on music and the mentally retarded documents their capacity to learn songs and other musical activities. There is need for research to determine if this ability to learn songs could be used to help the mentally retarded learn material contained in the songs. More investigation is needed into the use of music as a cue in learning for the mentally retarded.

The need to find effective educational techniques for the mentally retarded has always been great. The results of this study may show that music can be used by music therapists and classroom teachers as one tool they could employ to increase the learning capability of the mentally retarded. Such knowledge would provide new teaching strategies for both the profession of special education and music therapy. It would also provide an established factual foundation for the use of music in the education of the mentally retarded.

Definition of Terms

Severely Mentally Retarded Children. Those children who have been determined to have an I.Q. score between 15 and 30 by a school psychologist using tests like the Wide Range Achievement test, the Stanford-Binet, the Wechler Intelligence Scale for Children, and the

Peabody Picture Vocabulary test. Final classification is determined by an Educational Placement and Planning Committee composed of the school principle, teachers, school psychologist, and parents. These children were considered low functioning for the purposes of this research.

Trainable Mentally Retarded Children. Those children who have been determined to have an I.Q. score between 30 and 50 by a school psychologist using tests like the Wide Range Achievement test, the Stanford-Binet, the Wechler Intelligence Scale for Children, and the Peabody Picture Vocabulary test. Final classification is determined by an Educational Placement and Planning Committee composed of the school principle, teachers, school psychologist, and parents. These children were considered high functioning for the purposes of this research.

Short-term Memory. A theory of information processing defined for this research as a memory system that rapidly loses information in the absence of sustained attention of that particular material and which usually involves a time period no more than "sixty seconds following presentation of the material."[15]

Perceptual-Motor Task. A task involving the movement of the body or parts of the body to accomplish a specified objective that is determined by processing of information received from the visual and auditory senses.

Learning. Neural change that is assumed to take place when there is a change in performance of a task which is not due to maturation or

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[15] Ronald G. Marteniuk, Information Processing in Motor Skills (New York: Holt, Rinehart, and Winston, 1976), p. 85.

fatigue.[16]

Performance. For the purpose of this research, the motor task of placing colored geometric shapes in correct position and sequence on a table, and the score assigned at the completion of this task.

Teaching or Presentation of Material. Physical demonstration of a perceptual-motor task with verbal and tonal cues to aid in the interpretation by subjects as to how the task is to be performed.

Facilitation of Learning. Increased neural activity that occurs through added sensory input. This activity helps maintain the trace of an experience in the brain so that the permanent neural changes that constitute learning can occur.[17]

Educational Media. The manner, either musical or spoken, in which the task of placing the colored geometric shapes in correct position and sequence was presented to the subjects.

Limitations of the Study

The scope of this study was limited to the investigation of the effects of song media, and the number of presentations of task information, on short-term memory. No provisions were made to study the effects of these factors on the long-term or permanent memory system. The subjects learned and replicated the perceptual-motor task of placing the articles used in the study on a table. Though it was necessary for the subjects to attend to the verbal presentation of the

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[16] George H. Sage, Introduction to Motor-Behavior: A Neuropsychological Approach (Reading, Mass.: Addison-Wesley Publishing Co., 1971), p. 245.

[17] George H. Sage, Introduction to Motor-Behavior: A Neuropsychological Approach (Reading, Mass.: Addison-Wesley Publishing Co., 1971), p. 260.

task for learning to occur, they were not required to verbalize any response themselves.

The sample was drawn from a population with a wide age range of 12-21 years and I.Q. range of 15-50. Because of this, no attempt can be made to generalize the results to other populations. The sample used in this research was drawn from a population with other factors such as personality characteristics, emotional disturbances, and cognitive deficiencies that do not characteristically occur in other populations.

This research can only report if the independent variables effect the scores of the subjects thus inferring facilitation of learning. It cannot determine the actual neuro-physiological process that occurred to create such facilitation of learning.

CHAPTER II

REVIEW OF RELATED LITERATURE

Selected Research in Memory

The review of literature begins with literature generally pertinent to the theoretical basis of the current research. Selected examples are used to represent the research in each area of memory investigation.

There is a large body of literature on the general theory of cognitive reverberation and its function in memory. Early researchers like Hebb (1953), and Kornorski (1967) conducted experiments on animals that provided evidence to support the reverberation theory of memory. Memory research has also been conducted on humans. Research by Blum, et al. (1968) is characteristic of reverberation studies in humans. Two male undergraduates were presented a series of six consonants at the rate of one consonant per second. The presentation of the consonants was accomplanied by the beat of a metronome. Following a filler activity of perscribed length, the subjects were asked to tell what consonants came to mind at each tick of the metronome. Two types of filler activities were used. One subject engaged in an activity in a conscious state. The other subject experienced five second pauses under hypnosis or a posthypnotic state of low mental arousal during the filler period. It was assumed that the hypnotic state caused interruption of the reverberation process. The researchers found that the subjects could recall fewer consonants after hypnotic disruption than after the waking filler period. It was concluded that cognitive reverberation exists and that it is an ongoing process subject to disruption.

Another example of human memory research is that of Adams and Dijkstra (1966) who investigated short-term memory for a simple motor movement using the variables of length of retention interval and number of reinforcements of learning. It was found that error was an increasing function of length of retention interval and a decreasing function of number of reinforcements. The authors concluded that their findings were consistent with the hypothesis of a decaying memory trace that becomes more stable with reinforcement.

Another body of literature more specifically applicable to the theoretical basis of the current study deals with facilitation of learning through increased neural arousal. An example of this research is that of Baumeister and Kistler (1975). In this study, second and fifth grade subjects were given three verbal tasks: serial, free-recall, or paired-associate learning. Retention tests were administered immediately after the experiment or following a long delay. Half the subjects were exposed to a two minute period of bursts of white noise just prior to the retention test. It was found that white noise produced substantial improvement in performance when compared to the control group who did not have the bursts of noise.

Facilitation of learning was also studied by Davis (1971). In this study, educable mentally retarded children were presented with four types of stimulus material to determine their associative learning ability. The four types of material were visual-visual wordlike, visual-visual geometric, audio-visual wordlike, and audio-visual geometric. Subjects received all four treatments. A performance criterion of eight correct responses in successive trials was established. Significant differences were found for visual-visual wordlike which required the most trials to criterion and audio-visual wordlike which required fewest trials. The author concluded that a multisensory modality facilitated learning.

Short-Term Memory in Retardates

Two studies on the short-term memory characteristics of the mentally retarded are directly applicable to the theoretical basis of this research. Baumeister and Ellis (1963) presented fifteen institutionalized mentally retarded subjects with a delayed response task designed to measure the learning and memory defects of the retarded. A special chamber and experimental apparatus were designed for use in the research. Subjects were brought to the experimental chamber and placed before the response panel. Twelve trials were given at each of four delay periods. This occurred for four consecutive days. The delay periods were established at 2, 20, 45, and 120 seconds. An A x B x S analysis of variance was used on the data where B represented the delays, A was days of testing, and S was subjects. The A x B interaction and the factor of days were not significant. The factor of degree of delay between stimulus and response was found to be significant at .05 level. A second experiment was conducted on 10 of the subjects used in the first experiment. The subjects were exposed to essentially the same testing procedure as in experiment one except that subjects were presented a visual distraction treatment on some of the testing days. A second

A x B x S analysis of variance was conducted in which both delay (A) and distraction (B) were significant at .01 level. Longer reaction times were associated with longer delays, and subjects tended to react quicker in the presence of a distractor. The researchers observed that retardates were both more accurate and less hesitant when exposed to a distracting stimulus. It was concluded that retardates may have a deficit in short-term memory which prevents the brain from maintaining the stimulus trace. Presentation of the added stimulus of the visual distraction may have increased general neural alertness thus reinforcing the memory trace.

Hermelin and O'Connor (1964) conducted research comparing short-term memory in mentally retarded and normal children. Twelve normal and twelve mentally retarded children were subdivided into groups of older and younger children. Recall material, consisting of lists of digits, was presented auditorially to the subjects. The length of the message was determined for each subject based on individual memory spans and ranged from 3 to 6 digits. Three delay periods of 2, 6, and 12 seconds were used. The delay periods were either silent or filled by the experimenter reading lists of familiar or unfamiliar words. The retention test consisted of verbal reiteration of the digits by the subjects. Data were transformed to a standard message of 3 digits so an analysis of variance could be used. It was found that all main effects were significant at the .05 level or greater. Normals and all older children remembered better than retardates and young children. Memory decayed with interference and longer delay periods. Unfamiliar words were a distraction for normals but not for the mentally retarded subjects. When no additional material was used as an interference, scores of normal children remained the same up to the 12 second delay period, while scores of the mentally retarded declined. It was concluded that the stimulus trace has less duration in the mentally retarded than in normal children.

Use of Music to Facilitate Learning

There are only a few studies directly pertinent to the current research. An experiment to determine the effect of music as a mediating factor on learning and retention in a normal high school age population was conducted by Hahn (1972). German lexical items were presented to the subjects in either a dialog or song media. After presentation of the material, retention tests were administered using various types of recall cues. It was found that the retention scores of the subjects receiving song instruction as compared to those receiving dialog were significant at the .05 level using an analysis of variance. It was concluded that music was an effective factor in facilitation of learning and retention of German lexical items in a normal high school population. The researcher postulated that this effect may have been due to the added kinesthetic and sensory experience. The findings of this study support the general contention that music can be a facilitator of learning. However, this research differs from the present study in that the subjects were of normal intelligence and that the song and dialog media were reproduced and memorized by the subjects. The subjects in the current research only heard the song and spoken media. They did not reproduce these themselves.

More directly related to the present study was research conducted by Isern (1958) in which an attempt was made to determine the effect of songs, more specifically the "feeling state" engendered by them, on the facilitation of memory in the mentally retarded. Isern tested for immediate, recent, and remote recall of the content of the song as compared to the content of a story when the conceptual level and number of items in the song and the story were comparable. The t-test values reported for the difference between the means of the recall of the content of the song and the content of the story were significant beyond the .001 level for all three types of recall; immediate, recent, and remote. It was concluded by the author that the feeling state produced by the song was a factor in the facilitation of memory for the content of that song in the mentally retarded subjects. Isern's research provides support for the use of song material to enhance retention of facts contained in that song. The research relates to the present investigation because of the use of mentally retarded subjects. Further, neither the song nor the story material were reproduced by the subjects.

A study by Staples (1967) was conducted to determine the effectiveness of music as a mediator in a paired-associate learning task for mentally retarded subjects. Pairs of nonsense syllables and vocabulary words were set into two musical frameworks--melodic and iso-rhythmic. These were then presented to the subjects five times alternatively with five tests for retention. Three groups--Experimental Group 1, melodic framework; Experimental Group 2, an iso-rhythmic framework; and a Control Group, spoken framework--were used in the research. The Mann-Whitney U Test values reported for the difference between scores of Experimental Group 2 and the Control Group were found to be significant at the .05 level. However, the test values reported for the scores of the Experimental Group 1 as compared to the Control Group were not significant. The results of this study suggest that the strong rhythmic aspects of music facilitate learning in the mentally retarded, while melodic elements show no real facilitation of retention. Though the type of task presented to the subjects in Staples' research differs from the task presented to the subjects in the current research, the use of mentally retarded subjects and the fact that the subjects did not reproduce the musical frameworks makes the study pertinent to the present invetigation.

CHAPTER III

DESIGN OF THE STUDY

Methods

Thirty-six subjects from two public schools for the mentally retarded were randomly placed in one of four instructional groups. All subjects were randomized together to help eliminate the effects of the different educational approaches of the two schools involved. Randomization was accomplished by placing thirty-six slips of paper, nine for each instructional group, in a container. As subjects entered the testing room, one slip of paper was drawn from the container. They were given the instructional method that corresponded with the designation on the paper.

For each subject, the entire instructional-testing sequence occurred in one ten-minute time period. All subjects were tested individually by the experimenter. All testing was done in a two hour time block from 9:30-11:30 A.M. on the selected days of Tuesday, Wednesday, and Thursday. This was suggested by the school staff to prevent experimenter fatigue and to help insure consistency in alertness and attention of the subjects. Prior to the beginning of the experiment, the researcher spent one morning at each school participating in the regular school schedule to familiarize the subjects with the experiment. It was assumed that some contact with the individuals involved in the study would help eliminate fear and resistance to the experimenter.

Subjects

Subjects for this study were drawn from two settings. Nineteen subjects came from Forest Grove School in Fenwick, Michigan which serves Trainable Mentally Retarded children from Montcalm and Ionia counties. They ranged in age from 12-21 years and in I.Q. scores from 30-50. These children were designated high functioning for the purpose of this research. There were 13 boys and 6 girls. The subjects were taken from the summer program at this school which emphasizes recreational activities. These children are seen regularly by a registered music therapist who sees all students in the school for music and who provides guidance to classroom teachers in the use of music with mentally retarded children. Consequently, these students have a great deal of experience in music and are accustomed to receiving instructions and directions in a musical context.

Seventeen subjects were drawn from the Marvin E. Beekman Training Center in Lansing, Michigan which serves Trainable Mentally Retarded and Severely Mentally Retarded from Ingham county. Subjects were taken from the summer program for Severely Mentally Retarded which continues basic academic work with some flexibility for outdoor recreational activities. Subjects ranged in age from 12-21 years and had an I.Q. range from 15-30. These children were designated low functioning for the purpose of this research. There were 9 boys and 8 girls. The subjects from this center are not serviced by any music professional and, therefore, have little musical experience. They are accustomed to receiving instructions and directions in a spoken-lecture method.

Setting

The physical setting for experimentation was as similar as possible in both schools. All testing occurred in a small, isolated room with little decoration to distract the subjects. The door to the room was shut to prevent interruption and eliminate extraneous noise. The room contained a table and two chairs positioned side by side so that the experimenter could sit next to the subjects during the learning-testing sequence. Each subject was escorted from the classroom by the experimenter to the testing room. All subjects were addressed by name during the experiment.

Perceptual Motor Task

The task subjects performed to indicate the amount of learning that had occurred was a perceptual-motor task. The task was identical for all four instructional groups. The perceptual-motor task was for subjects to place six geometric shapes of contrasting color in correct position and sequence on the table in front of them. The task involved perception of the verbal instructions of the experimenter designating the proper sequence of the objects and the motor performance of placing them on the table. No verbal skill was required of the subjects.

The use of both shape and color cues were employed to enhance perceptual differentiation of the objects by the subjects. Six items were selected because it was found in a study by Cardozo and Leopold (1963) that six was the maximum number of digits that could be recalled with no error.[1] Because there is no specific literature on recall

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[1]B. L. Cardozo and F. F. Leopold, "Human Code Transmission: Letters and Digits Compared on the Basis of Immediate Memory Error Rates," <u>Ergonomics</u> 6 (1963), 133-141.

capacity for geometric shapes, colors, or colored geometric shapes, the digits in Cardozo and Leopold's study were used to designate one bit of information. Each shape used in this research was also considered one bit of information.

The correct sequence of the items was established as follows:

red circle

yellow square

blue star

green triangle

orange oval

black diamond

Experimental Procedure

Four instructional groups were established by random selection. In each group, subjects were tested individually. The overall design of this research can be outlined as follows:

Instructional Group A - R Xm $T_{5\ sec.}$ Xm $T_{5\ sec.}$ 0

Instructional Group B - R Xc $T_{5\ sec.}$ Xc $T_{5\ sec.}$ 0

Instructional Group C - R Xm $T_{5\ sec.}$ 0

Instructional Group D - R Xc $T_{5\ sec.}$ 0

The R indicates random placement of subjects in the group as described under Method. Xm signifies the instructional technique utilizing music to present task information, while Xc is the instructional technique of spoken presentation of task information. 0 is the retention test that was identical for all groups. Specific procedures for each instructional group were as follows:

Instructional Group A. After the subject was seated, the directions and purpose of the session were read aloud. The experimenter then gave the tonic note, G, of the song on a pitch pipe. Once started, the song was sung without interruption. The motor act of placing the colored shapes in the correct position and sequence accompanied the verbal instructions. As the colored shape was mentioned in the song, the experimenter placed that colored shape on the table in front of the subject starting at the left hand of the subject and moving to the right as subsequent shapes were mentioned.

At the completion of the song, the colored shapes remained in order on the table for approximately five seconds. Subjects were not told to study the order nor were they prevented from looking at the colored shapes on the table. The five second time interval was used to prevent interference with short-term memory processing as reported in work by Halstead and Rucker (1968).[2]

At the end of this time period, the colored shapes were removed by the experimenter, and the song with corresponding motor movements was repeated exactly as it had been presented previously. A five second time period immediately followed the second reiteration of the material.

Following this, the subject was asked to perform the perceptual-motor task by replicating the order of the colored shapes just observed. The experimenter picked up the six colored shapes and randomly scattered them on the table to the left of the subject. The instructions for

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[2] W. Halstead and W. Rucker, "Memory: A Molecular Maze," Psychology Today 2 (June, 1968), 38-41.

completion of the task were given to the subject by the experimenter as the colored shapes were placed on the table. The subject had one minute to perform the task. A stop watch was used to determine the amount of time necessary for the subject to complete the task. The time, in seconds, was recorded on the score sheet.

Instructional Group B. After the subject was seated, the directions and purpose of the session were read aloud. The experimenter then presented the material in a spoken manner with no artificial speech rhythms or emphasis. The motor act of placing the colored shapes in the correct sequence accompanied the verbal instructions. As each colored shape was mentioned in the spoken material, the experimenter placed the correct colored shape on the table in front of the subject starting at the left hand of the subject and moving to the right as subsequent colored shapes were mentioned. At the completion of the spoken instructions, the colored shapes remained in order on the table for approximately five seconds. Subjects were not told to study the order nor were they prevented from looking at the colored shapes on the table.

At the end of this time period, the colored shapes were removed by the experimenter, and the spoken presentation of the task information with corresponding motor movements was repeated exactly as it had been presented previously. A five second time period immediately followed the second reiteration of the material.

Following this, the subject was asked to perform the perceptual-motor task by replicating the order and sequence of the colored shapes just observed. The experimenter picked up the six colored shapes and randomly scattered them on the table to the left of the subject. The instructions for completion of the task were given by the experimenter as the shapes were placed on the table. The subject had one minute to perform the task. A stop watch was used to determine the amount of time necessary for the subjects to complete the task. The time, in seconds, was recorded on the score sheet.

Instructional Group C. After the subject was seated, the directions and purpose of the session were read aloud. The experimenter then gave the tonic note, G, of the song on a pitch pipe. Once started, the song was sung without interruption. The motor act of placing the colored shapes in correct position and sequence accompanied the verbal instructions. As the colored shape was mentioned in the song, the experimenter placed that colored shape on the table in front of the subject starting at the left hand of the subject and moving to the right as subsequent colored shapes were mentioned.

At the completion of the song, the colored shapes remained on the table for approximately five seconds. Subjects were not told to study the order nor were they prevented from looking at the colored shapes on the table. At the end of the five second time period, the subject was asked to perform the perceptual-motor task by replicating the order and sequence of the colored shapes just observed. There was no second reiteration of the learning. Again the experimenter picked up the colored shapes and randomly scattered them on the table to the left of the subject. The instructions for completion of the task were given by the experimenter as the colored shapes were placed on the table. The subjects had one minute to complete the task. A stop watch was used to determine the amount of time necessary for the subjects to complete the task. The time, in seconds, was recorded on the score sheet.

Instructional Group D. After the subject was seated, the directions and purpose of the session were read aloud. The experimenter then presented the task information in a spoken manner with no artificial speech rhythms or emphasis. The motor act of placing the colored shapes in the correct position and sequence accompanied the verbal instructions. As each colored shape was mentioned in the spoken material, the experimenter placed the correct colored shape on the table in front of the subject starting at the left hand of the subject and moving to the right as subsequent colored shapes were mentioned. At the completion of the spoken instructions, the colored shapes remained in order on the table for approximately five seconds. Subjects were not told to study the order nor were they prevented from looking at the colored shapes on the table.

At the end of this five second time period, the subject was asked to perform the perceptual-motor task by replicating the order of the colored shapes. There was no second reiteration of the learning. The experimenter picked up the colored shapes and randomly scattered them on the table to the left of the subject. Instructions for completion of the task were given to the subject while the scattering occurred. The subject had one minute to complete the task. A stop watch was used to determine the amount of time necessary for the subject to complete the task. The time, in seconds, was recorded on the score sheet.

In all four instructional groups, subjects were informed at the beginning of the experimental sequence that they would be asked to replicate the order of the colored shapes. The instructional material for all four groups was identical whether presented in a musical or spoken context. Further, all directions and instructions were standardized and read by the experimenter (see Appendix A). Directions were spoken for all groups. Finally, if a subject did not initially respond when asked to replicate the perceptual-motor task, two encouraging admonishments were given to promote response (see Appendix A).

Scoring

Subjects who refused to participate at the outset of the experimental procedure were eliminated from the study and not included in the results. Refusal to participate was judged by the experimenter as unwillingness to accompany the experimenter to the testing room and/or strong negative response to the task at the beginning of the experimental procedure. Subjects were given one minute in which to complete the task. If they had not done so within this period, a score of 0 was recorded. Partial completion of the task was recorded on the scoring sheet and was assumed to begin in position number 1, so that a response of red circle, yellow square, black diamond was recorded with the red circle in position 1, the yellow square in position 2, and the black diamond in position 3. A score was then assigned with the missing colored shapes counted as 0.

A scoring sheet was used by the experimenter to record the order in which each subject placed the colored shapes (see Appendix B). The instructional group, determined by random selection when the subject entered the testing room, was recorded on the score sheet. The amount of time each subject took to complete the perceptual-motor task was recorded on the scoring sheet. Finally, the sex of the subject was included on the sheet to provide an accurate count of the number of boys and girls used in the experiment.

The responses of the subjects were scored using the criterion of placement in exact position on the table and correct sequential relationship of the colored shapes to one another. A perfect score of 17 was possible on the task. A subject who performed the task without error was assigned a score of 12 for putting the colored shapes in correct position, i.e., red circle in position 1, yellow square in position 2, etc. This represents a score of 2 for each correct position. A score of 5 was further given for placing the colored shapes in the correct relationship to each other, i.e., yellow square following red circle, blue star following yellow square, etc. This represents a score of 1 for each correct sequence relationship. For example, a subject who placed the colored shapes in the order: red circle, yellow square, green triangle, orange oval, black diamond, and blue star; received a total score of 7. This represented a 4 for the correct positions of the red circle and the yellow square and a sequence score of 3 for the correct relationship of red circle to yellow square, green triangle to orange oval, and orange oval to black diamond.

Materials

The materials used in this study included a table and two chairs, a stop watch, a pitch pipe, scoring sheets, six colored geometric shapes, and a composed song. The table used in the experiment was found in the testing room and was approximately waist high for the subjects when they were seated. The chairs were placed side by side at the table with the experimenter sitting to the left of the subject. The scoring sheets were devised by the experimenter. One sheet was provided for each subject.

The six colored geometric shapes, made by the experimenter, were two dimensional. They were cut from poster board and were covered with 100 percent color absorption Bourges paper in the appropriate colors. All shapes were the same size as far as was possible and generally had the dimensions of 5" by 5". The shapes were laminated to prevent soiling and ripping (see Appendix C).

The song material was composed by the experimenter and judged for acceptability by a panel of music professors. This panel included two professors of music education from Michigan State University, a professor of music therapy from Michigan State University who has had experience working with the mentally retarded, and a professor of music education from Spring Arbor College in Spring Arbor, Michigan who has worked with mentally retarded children. The song was judged acceptable by the panel for elementary age and mentally retarded children and judged to be similar to current elementary music education literature. The song was almost exclusively syllabic, tonal, and encompassed an octave pitch range (see Appendix D). The spoken material was identical to the text of the composed song (see Appendix E).

Independent Variable

There were three independent variables established for this study which were considered main effects. The first of these independent variables was the method of presentation of the material, the task information, that the subjects learned. These two methods were presentation in a musical context and presentation in a spoken context. The second independent variable was the number of reiterations of the material during the learning process. Two groups received two presentations of the material, and two groups received one presentation of the material. The third independent variable was whether the subjects were high functioning (trainable mentally retarded) or low functioning (severely mentally retarded). The factor of sex was not used as an independent variable because of the unbalanced n.

Dependent Variable

The dependent variable was perceptual-motor learning as measured by position score, sequence score, total score, and time necessary for the subjects to complete the perceptual-motor task.

Statistical Treatment

Means and standard deviations of the scores for all four instructional groups were computed to determine the influence of the three main effects. A one-way analysis of variance and a t-test were also used on this data.

Because the four instructional groups were randomly assigned equal number of subjects, a two-way analysis of variance was used with this data. This statistic was employed to measure the effect of the two independent variables of functioning level and group on the dependent variable of motor learning. It was further used to show whether there was any interaction effects. Statistics were determined through a computer analysis.

CHAPTER IV

PRESENTATION OF RESULTS

The purpose of this study was to determine the effects of the number of presentations of task information and the type of teaching strategy, either sung or spoken, on scores for retention of a perceptual-motor task in mentally retarded subjects. Functioning level of the subjects was also considered.

Four experimental hypotheses were established for the study:

1. There will be a difference between the retention scores of the groups receiving the task information in a musical context and those receiving the task information in a spoken context.
2. There will be a difference between the retention scores of those groups receiving one presentation of the task information and those receiving two presentations.
3. The group receiving the experimental treatment involving two presentations of the task information presented in the musical context will score higher than any of the other three experimental groups.
4. There will be a difference in scores of high functioning subjects and the scores of low functioning subjects.

    This hypothesis was sub-divided into 12 separate hypotheses for statistical treatment. Three hypotheses apply to the data analysis for each of the four dependent measures.

Nineteen trainable mentally retarded children, designated high functioning in this research, and seventeen severely mentally retarded children, designated low functioning, were randomly placed in one of the following four instructional groups:

Group A - musical context presented twice

Group B - spoken context presented twice

Group C - musical context presented once

Group D - spoken context presented once

In all groups, subjects were taught the same task involving placement of six colored geometric shapes in a specified order on a table. Following instruction, subjects were asked to duplicate the order and sequence of the colored shapes. A score of 2 was given for each correct position and a score of 1 for each correct sequential relationship. There were a total of 17 possible on the task. The time necessary for each subject to complete the task was also determined.

Data Analysis

A two-way analysis of variance was used in this study to determine the effects of instructional group and the functioning level of the subjects on the four measures of the dependent variable; position score, sequence score, total score, and time score. Descriptive statistics, a one-way analysis of variance, and a t-test were also used. A .05 level of confidence was established for this research.

All computations for analyzing the data in this study were done at Michigan State University Computer Center using the Control Data

Table 1. Mean and Standard Deviation Scores for the Four Instructional Groups on the Four Dependent Measures

	Group A	Group B	Group C	Group D
Position Score	$\overline{X}$ = 5.33	$\overline{X}$ = 5.11	$\overline{X}$ = 7.33	$\overline{X}$ = 5.11
	SD = 4.90	SD = 5.58	SD = 4.90	SD = 3.48
	Range = 0-12	Range = 0-12	Range = 0-12	Range = 0-12
Sequence Score	$\overline{X}$ = 1.78	$\overline{X}$ = 2.44	$\overline{X}$ = 2.89	$\overline{X}$ = 1.57
	SD = 1.99	SD = 2.13	SD = 2.09	SD = 1.42
	Range = 0-5	Range = 0-5	Range = 0-5	Range = 0-5
Total Score	$\overline{X}$ = 7.11	$\overline{X}$ = 7.56	$\overline{X}$ = 10.22	$\overline{X}$ = 6.67
	SD = 6.83	SD = 7.62	SD = 6.94	SD = 4.72
	Range = 0-17	Range = 0-17	Range = 0-17	Range = 0-17
Time Score	$\overline{X}$ = 31.06 sec.	$\overline{X}$ = 28.56 sec.	$\overline{X}$ = 29.17 sec.	$\overline{X}$ = 34.11 sec.
	SD = 6.83	SD = 18.63	SD = 20.16	SD = 21.99
	Range = 12-60 sec.	Range = 9.5-60 sec.	Range = 12-60 sec.	Range = 11-60 sec.

Computer No. 6500 and appropriate SPSS programs.

The raw data are contained in Appendix F.

Results

Descriptive Data

Examination of the descriptive statistics found in Table 1 shows that the means of Group C, musical context presented once, were higher than the other three groups on variable of position score, sequence score, and total score. Of further interest is the nature of the range of scores which is the same for all groups on the variables of position score, sequence score, and total score. This seriously limits variance in scores and creates large standard deviations without much range.

Two-Way Analysis of Variance

Position Score. A statistical hypothesis in null form was established for the analysis of variance for position score. The hypothesis states that there will be no difference on position score between instructional groups, functioning level of the subjects, and the interaction of group and functioning level.

The F value of .586 for the effect of instructional group on position score was not significant at the .05 level of confidence and indicates that the differences in scores for the four instructional groups was probably due to chance.

The F value of 13.436 for the effects of functioning level of the subjects on position score was significant at the .001 level indicating that difference in position score was due to the functioning level of the subjects.

Table 2. Two-Way Analysis of Variance of Position Score by Group and Function

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	
Group	29.642	3	9.881	.586	
Function	226.689	1	226.689	13.436	p<.001
Group x Function	30.689	3	10.230	.606	
Residual	472.400	28	16.871		
Total	761.222	35			

The F value of .606 for the effects of the interaction of group by function was not significant at the .05 level of confidence.

Sequence Score. A statistical hypothesis in null form was established for the analysis of variance on sequence score. This hypothesis states that there will be no difference on sequence score between instructional groups, functioning level of the subjects, and the interaction of group and functioning level.

The F value of .934 for the influence of instructional group on sequence score was not found to be significant at the .05 level of confidence. This suggests that the type of instruction received by the subjects did not influence the sequence score and that any differences were probably due to chance.

The F value of 6.247 for subjects' level of functioning was found to be significant at .019 level of confidence indicating that differences in sequence were probably due to level of functioning based on I.Q.

scores rather than to chance.

The F value of .758 for the effect of the interaction of group by function was not significant at the .05 level of confidence.

Table 3. Two-Way Analysis of Variance of Sequence Score by Group and Function

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	
Group	9.118	3	3.039	.934	
Function	20.335	1	20.335	6.247	$p<.019$
Group x Function	7.404	3	2.468	.758	
Residual	91.150	28	3.255		
Total	129.000	35			

Total Score. A statistical hypothesis in null form was established for the analysis of variance on total score. This hypothesis states that there will be no difference on total score between instructional groups, functioning level of the subjects, and the interaction of group and functioning level.

The F value of .611 for the effects of instructional group on total score was not found to be significant at the .05 level of confidence. This indicates that the differences in the total scores for the four types of instructional groups were probably due to chance and not to the different teaching techniques.

The F value of 11.265 for the effects of functioning level on the total score was significant at the .002 level of confidence. This indicates that the differences in total scores were due to the subjects' functioning level and not due to chance.

The F value of .650 for the effects of interaction of group of function on the total score was not significant at .05 level of confidence.

Table 4. Two-Way Analysis of Variance of Total Score by Group and Function

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	
Group	62.263	3	20.754	.611	
Function	382.812	1	282.812	11.265	p<.002
Group x Function	66.304	3	22.101	.650	
Residual	951.550	28			
Total	1469.556	35			

<u>Time Score</u>. A statistical hypothesis in null form was established for the analysis of variance on the time necessary for the subjects to complete the task. This hypothesis states that there will be no difference in time score between the instructional groups, functioning level of the subjects, and the interaction of group and functioning level.

The F value of .174 for the effect of group on the time score was not significant at the .05 level of confidence which indicates differences in time scores were probably due to chance and not due to instructional technique used.

The F value of 4.840 for the effect of subjects' functioning level on the time score was found to be significant at .036 level of confidence. This indicates that the subjects' faster response time was due to functioning level and not due to chance.

The F value of 1.410 for the effects of the interaction between the instructional group and functioning level were not significant at .05 level of confidence.

Table 5. Two-Way Analysis of Variance of Time Score by Group and Function

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	
Group	174.487	3	58.162	.174	
Function	1617.001	1	1617.001	4.840	$P < .036$
Group x Function	1412.857	3	470.952	1.410	
Residual	9354.475	28	334.008		
Total	12552.722	35			

One-Way Analysis of Variance

A one-way analysis of variance was used to determine differences in total scores between the four instructional groups. The F value of .525 was not significant at .05 level of confidence. This indicates that differences between total scores of the four instructional groups were probably due to chance.

Table 6. One-Way Analysis of Variance of Total Scores Between Instructional Groups

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Between Groups	68.8889	3	22.9630	.525
Within Groups	1400.6667	32	43.7708	
Total	1469.5556	35		

t-Test

A t-test was used to determine if significant differences existed between the two groups (A and B) presenting task information twice and the two groups (C and D) presenting it once. The t of .49 was not found to be significant at the .05 level of confidence which indicates that differences in scores of groups receiving two presentations and those receiving one presentation were probably due to chance.

Table 7. t-Test Analysis of Differences Between Two Presentations and One Presentation of Task Information

Group	No. of Cases	Mean	SD	df	t
One Presentation	18	8.4	6.04		
				34	.49
Two Presentations	18	7.33	7.02		

Review of Hypotheses

The statistical hypotheses, stated in null form, were as follows:

Hypotheses 1 and 2

1. There will be no difference between the retention scores of the groups receiving the task information in a musical context and those receiving the task information in a spoken context.

2. There will be no difference between the retention scores of those groups receiving one presentation of task information and those receiving two presentations.

The F value and t scores stated above reveal that there were no significant differences in the scores of any of the four types of instructional groups. Therefore, hypotheses 1 and 2 failed to be rejected.

Hypothesis 3

3. The group receiving the experimental treatment involving two presentations of the task information presented in the musical context will not score higher than any of the other three experimental groups.

The F values stated above for the one-way analysis of variance reveal that there was no significant difference for total score between the four instructional groups. Therefore, hypothesis 3 failed to be rejected.

Hypothesis 4

4. There will be no difference in the scores of high functioning subjects and the scores of low functioning subjects.

The F values stated above reveal that there were significant differences in the position scores, sequence scores, total scores, and time scores for high and low functioning subjects. Therefore, hypothesis 4 was rejected.

The sub-divisions of hypothesis 4 were reviewed as follows:

1. There will be no difference between groups in position score. Hypothesis 1 failed to be rejected.
2. There will be no difference between functioning levels in position score. Hypothesis 2 was rejected.
3. There will be no interaction between group and functioning level on position score. Hypothesis 3 failed to be rejected.
4. There will be no difference between groups on sequence score. Hypothesis 4 failed to be rejected.
5. There will be no difference between functioning level on sequence score. Hypothesis 5 was rejected.
6. There will be no interaction between group and functioning level on sequence score. Hypothesis 6 failed to be rejected.
7. There will be no difference between groups on total score. Hypothesis 7 failed to be rejected.
8. There will be no difference between functioning level on total score. Hypothesis 8 was rejected.
9. There will be no interaction between group and functioning level on total score. Hypothesis 9 failed to be rejected.
10. There will be no difference between groups on time score. Hypothesis 10 failed to be rejected.

11. There will be no difference between functioning levels on time score. Hypothesis 11 was rejected.
12. There will be no interaction between group and functioning level on time score. Hypothesis 12 failed to be rejected.

Discussion

The statistical results show that musical presentation of task information was no more effective than spoken presentation in facilitating learning in the mentally retarded and that two presentations of task information were not more effective than one presentation. Further, it was shown that there was no interaction between musical or spoken presentation of the task information and the number of presentations.

The statistical results demonstrated that the subjects' functioning level was the only factor to influence significantly the scores on the perceptual-motor task for the mentally retarded subjects.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this investigation was to determine the effects of the type of presentation of task information, either musical or spoken, and the number of presentations of the information, either once or twice, on perceptual-motor learning in severely and trainable mentally retarded children. Thirty-six subjects, 19 trainable mentally retarded or high functioning and 17 severely mentally retarded children or low functioning, were used in this study. Experimentation took place in a two week period during the summer of 1977. Subjects were randomly placed in one of the following instructional groups: text sung twice, text spoken twice, text sung once, and text spoken once. All testing was done individually by the experimenter in one ten-minute period for each subject.

Subjects in all four instructional groups were taught the same perceptual-motor task involving the placement of six colored geometric shapes in a specified order on a table. Following their designated instruction, subjects were asked to replicate the order of the colored shapes within one minute.

A score of 2 was assigned to each correct position score and a score of 1 was given to each correct sequence score. A total score of 17 was possible on the task. The time necessary for subjects to complete the task was also determined and recorded.

A t-test was used to evaluate the effects of the number of presentations of task information on the total score. A one-way analysis of variance was used to determine the differences in total scores between the four instructional groups. A two-way analysis of variance was conducted to determine the effects of instructional group, functioning level, and the interaction of functioning level and group on position score, sequence score, total score, and time score. The analysis was directed toward determining the following:

1. Whether musical presentation of task information was a better facilitator of learning than spoken presentation.
2. Whether two presentations of task information facilitated learning better than one presentation.
3. Whether there was any interaction between the two variables of musical, as opposed to spoken, presentation and variables of one, as opposed to two, presentations.
4. Whether high functioning subjects had better retention scores than low functioning subjects.

Conclusions

The conclusions drawn from this study apply only to the sample used in this investigation and are applicable only to the type of musical and spoken material used. Based on the results of this study and the statistical analysis of those results, the following conclusions have been drawn:

1. The musical context used to present task information in this study did not significantly improve retention of the

perceptual-motor task.

2. The number of presentations of task information did not significantly effect retention of the perceptual-motor task.
3. There was no interaction between number of presentations and type of presentation of task information so that a musical context presented twice facilitated learning no more than any other instructional technique.
4. The functioning level of the subjects was the only variable that influenced scores on the perceptual-motor task. High functioning subjects scored higher on all four dependent variables than low functioning subjects.

Discussion

This investigation was undertaken to determine the effects of music, and number of presentations of material, on facilitation of learning. Functioning level of the subjects was not originally a consideration. Subjects were drawn from two schools creating the two functioning levels because of the limited availability of appropriate subjects at the time the experiment was undertaken. Though randomization procedures were designed to eliminate any effects of the two types of subjects, this factor of functioning level did significantly effect all four measures of the dependent variable of perceptual-motor learning. The statistical results show that there was no significant interaction of functioning level and any particular instructional group and that functioning level influenced all scores in the four instructional groups.

However, examination of the raw data reveals that Group C, musical context once, had more high functioning subjects than the other groups and had the highest means on position score, sequence score, and total score. The strong influence of the factor of high and low functioning level may have generally effected these results thus projecting a somewhat inaccurate picture of the effects of the four types of instruction. Any trends that might have emerged were probably weakened by the strong influence of functioning level on all the scores for the four instructional groups.

In general, the task did not appear to be a good measure of retention for the low functioning group. Though low functioning people tested in a limited pilot study were able to do the task, the experimenter observed that many of the low functioning subjects were confused and unsure when asked to duplicate the task. Many were unable to place the colored shapes in a line on the table and some actually tried to duplicate the random scattering of the colored shapes done by the experimenter before the test for retention. Most of the low functioning subjects pulled the colored shapes down to the edge of the table in some order but with little consideration. The use of a second identical set of colored shapes for the subjects to place during the task might have eliminated some of these problems. In contrast, subjects in the high functioning group usually picked up each colored shape and examined it before placing it in a position on the table.

The experimenter further observed behavior in both groups that indicated emotional disturbance in some of the subjects. General resistance and withdrawal were behaviors noted. One boy put his head down on the table when asked to do the task. Several other subjects were distracted and hyperactive. One boy was so distracted by the stop watch he was unable to attend to the task. Three to four of the low functioning group displayed a variety of autistic behaviors including rocking, self-stimulation, and extreme withdrawal. The presence of emotional disturbance in some of the subjects would tend to interfere with learning and affect the results of a learning task.

As pointed out earlier, an examination of the raw data (Appendix F) shows that Group C, musical presentation once, had higher means for position score, sequence score, and total score than the other three instructional groups. This may possibly show a trend toward some facilitation of learning by the musical presentation of task information but certainly does not show any significant differences. Since predicted results were not substantiated, either the measuring instrument failed to support the theory or there was some error or weakness in the actual theoretical basis of the research that would account for this failure to support these predicted results.

One possible area of weakness in theory was the role of opposite hemispheric mediation for music and speech in formation and facilitation of the memory trace for a perceptual-motor task. It has been shown that music is mediated in the right hemisphere, while speech is mediated in the left. The effect this has on facilitation of learning has not been established through research. For the purposes of this study, it was assumed the paired stimulus of music and task information would increase general neural arousal thus reinforcing the memory trace. This, however, may not have been the case. The paired input may have actually created two separate memory traces; a trace for the musical stimulus in the right hemisphere and a trace for the task information in the left. In this situation, no facilitation of learning would occur.

Another possibility would involve perception of the stimulus presented. Perhaps the words of the song were not perceived as spoken, meaningful stimuli and were seen as part of the tonal context. In this case, a memory trace would have been created only in the right hemisphere. The subject would then have had little memory for the task but would remember the tonal stimulus. It is also possible that the paired input of music and task information did create some general neural arousal but not enough to significantly improve retention. Also, the need for the subjects to perform the motor act of placing the colored shapes on the table may have interferred with the memory process.

A further, and perhaps the most important, possibility is the specific nature of cerebral function and hemispheric mediation. Though melodic elements of music are mediated in the right hemisphere, some evidence suggests that the rhythmic elements of music are mediated in the left. This has been proposed by Harold Gordon who writes ". . . there is mounting evidence that temporal and sequential order has been found to depend on the integrity of the left hemisphere not only for auditory but for visual and tactile stimuli. . . . It is hypothesized that the right hemisphere superiority is concerned with successive pitch interval comparisons, or, said another way, the musical space between tones. Melody recognition becomes less of a right hemisphere task, however, as the time and rhythm factors become more salient for distinguishing the tone patterns."[1] It would appear

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[1]Harold G. Gordon, "Auditory Specialization of the Right and Left Hemispheres," in Hemispheric Disconnection and Cerebral Function, ed. by Marcel Kinsbourne and W. Lynn Smith (Springfield, Ill.: Charles C. Thomas, 1974), p. 134.

then that the musical framework or context used in this study which was tonal and not highly rhythmical could not facilitate retention as predicted. However, a musical framework that is highly rhythmical may facilitate learning as theorized. This contention is supported by Staples (1967) who found that rhythmic framework increased learning of a paired-associative task for mentally retarded children, while a melodic framework did not. It would seem likely, then, that the musical stimulus used in the current research was incapable of facilitating the memory trace for the task. It may be possible to conclude that a musical stimulus that is highly rhythmical in nature, such as a chant, could facilitate the retention of task information with which it is paired.

The lack of significant differences in scores of subjects who received one presentation of task information and those who received two is somewhat surprising. However, these results may be due to the defect in short-term memory of the mentally retarded proposed by Baumeister and Ellis (1963) and Hermelin and O'Connor (1964). The latter postulated that memory trace decays rapidly in the mentally retarded and suggests that ". . . . fading of the stimulus trace may have begun before the first repetition of the material could take place."[2] If this is true, the five second delay between the presentation of the task could have allowed the trace to decay totally. The second reiteration of the material would then have the same effect on the subjects as did the first. No facilitation or reinforcement of

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[2]Beate Hermelin and N. O'Connor, "Short-term Memory in Normal and Subnormal Children," American Journal of Mental Deficiency, 69 (1964), 125.

the first memory trace would occur since the trace would have already decayed and disappeared. In a situation like this, each presentation of the task would be separate and unrelated at the time of the retention test so that subjects receiving two reiterations of the task actually had the same degree of input as those subjects receiving the task information once. It would be as if the first presentation had not occurred at all. This situation would help explain why in this study there were no significant differences in scores between subjects who received musical context twice and those who received musical context once and between subjects who received spoken context twice and those who received spoken context once. Based on the theory of rapid short-term memory decay in the mentally retarded, the subjects in all four instructional groups essentially received only one presentation of task information.

Recommendations for Future Research

Based on the findings of this research, it is recommended that:

1. The study be repeated with the following changes:
    a. use subjects with narrower I.Q. ranges to eliminate the high and low functioning dichotomy
    b. develop more individual variance
    c. give a test of sorting ability and aptitude for linear movement prior to experimentation
    d. eliminate the five second time period between presentation of task information and before the retention test

e. improve scoring method to create more variance and eliminate the large standard deviation

2. Further research should be designed to compare rhythmic and melodic musical frameworks as well as a framework that is both highly rhythmical and melodic.

3. Further research should be designed to compare different methods and time intervals for the second presentation of task information. One possibility would be to repeat each item in the task immediately before going on to the next item. For example, present the task as red circle goes first, red circle goes first, yellow square goes next, yellow square goes next, etc.

It is strongly recommended that more research be done in the use of music as a facilitator to learning in the mentally retarded. There is a lack of well controlled, experimental research in this area and such research is needed. It is the opinion of this experimenter that music can be an effective educational technique for use with the mentally retarded and that the neuro-physiological theory reported in this investigation supports this contention. Further research in the area of musical facilitation of learning and the type of musical context that would produce that facilitation would be beneficial, interesting, and worthwhile for the investigator.

APPENDICES

APPENDIX A

STANDARDIZED DIRECTIONS

ADMONISHMENT TO COMPLETE THE TASK

Standardized Directions

At the beginning of the experimental sequence:

Hello (name), please sit down in this chair next to me. We're going to play a game together now. O.K? I want you to listen and watch very carefully. I am going to put these different colored shapes in a very special order on the table. Listen and watch carefully because I will ask you to put them in the same order I do. You will put these shapes down on the table just like I do, so watch and listen carefully.

(Instructional sequence)

Following instruction:

Now (name) you put these colored shapes down on the table just like I had them. Put them in the same order. Do the best you can. Go ahead.

Admonishment to Complete the Task

(name) please put the shapes down on the table as best you can. I just want you to try. Give it a try.

APPENDIX B

SCORING SHEET

Group ___________ Sex ___________

________ ________ ________ ________ ________ ________

1 2 3 4 5 6

Time _______ sec.

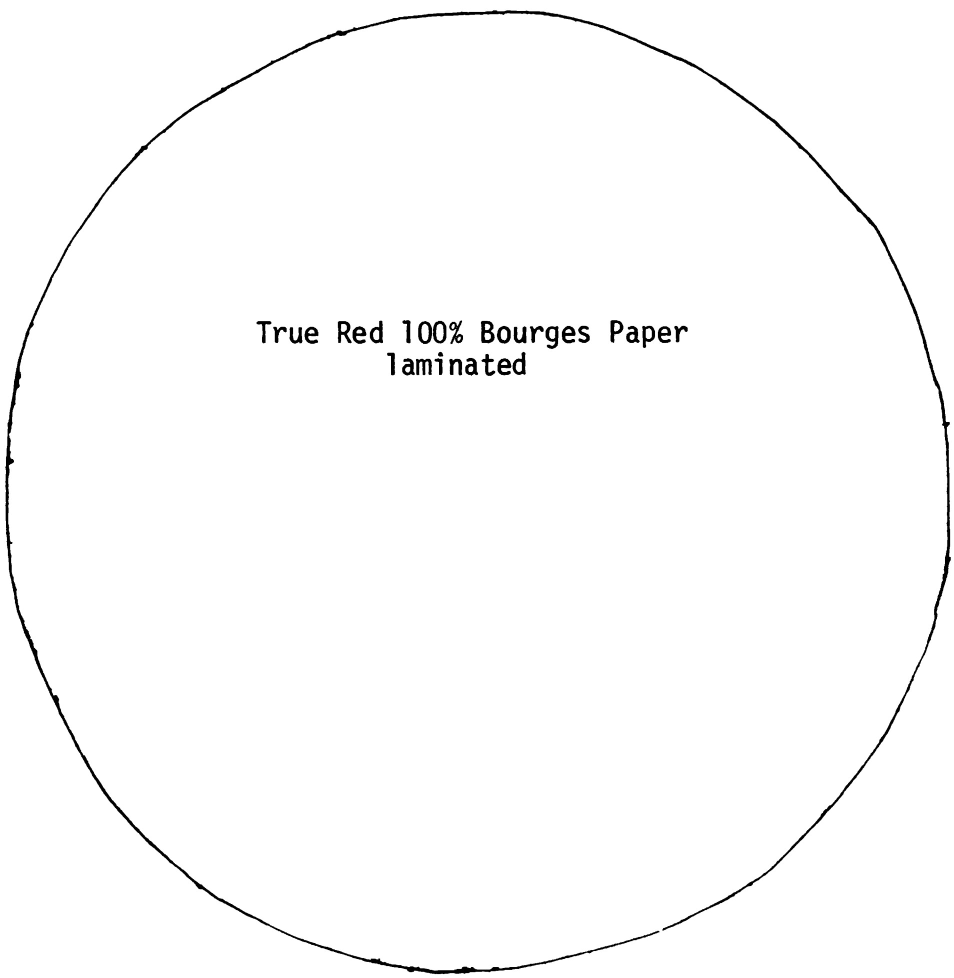
Code:

Red = R
Yellow = Y
Green = G
Blue = Bl
Orange = O
Black = Bk

APPENDIX C

COLORED GEOMETRIC SHAPES

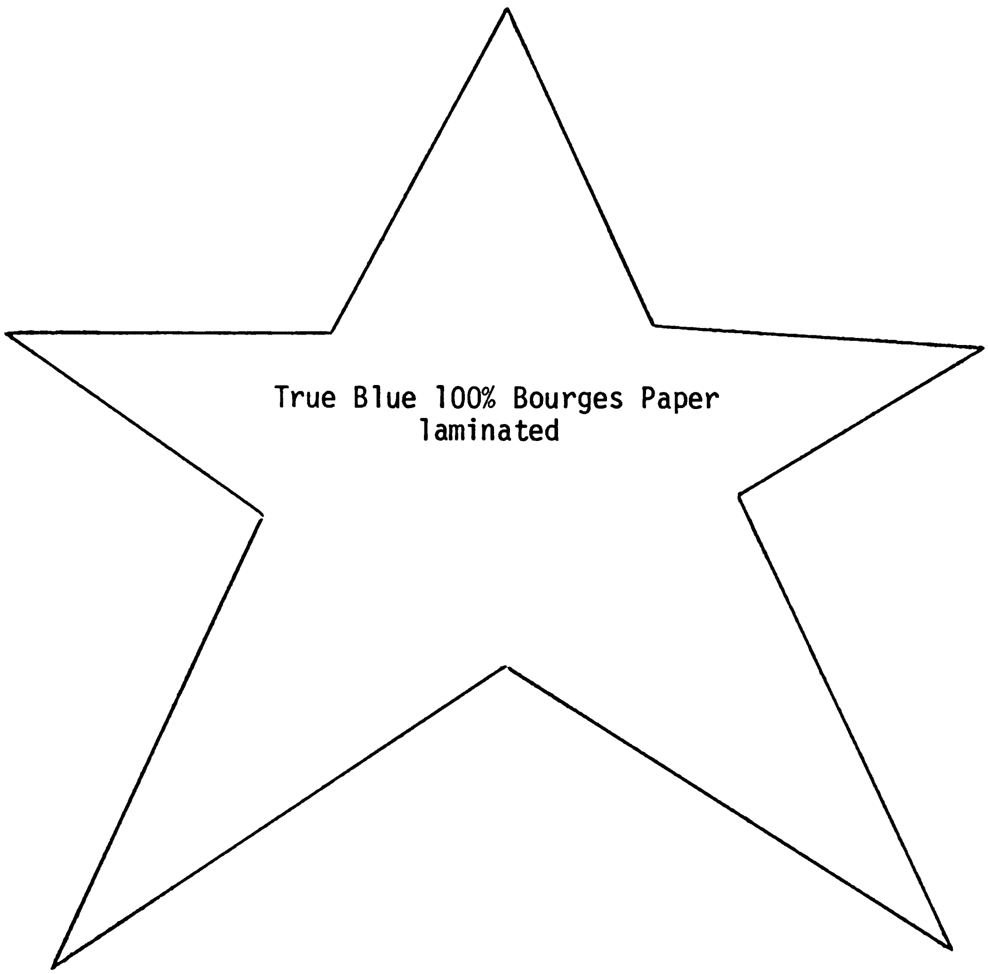
Red Circle



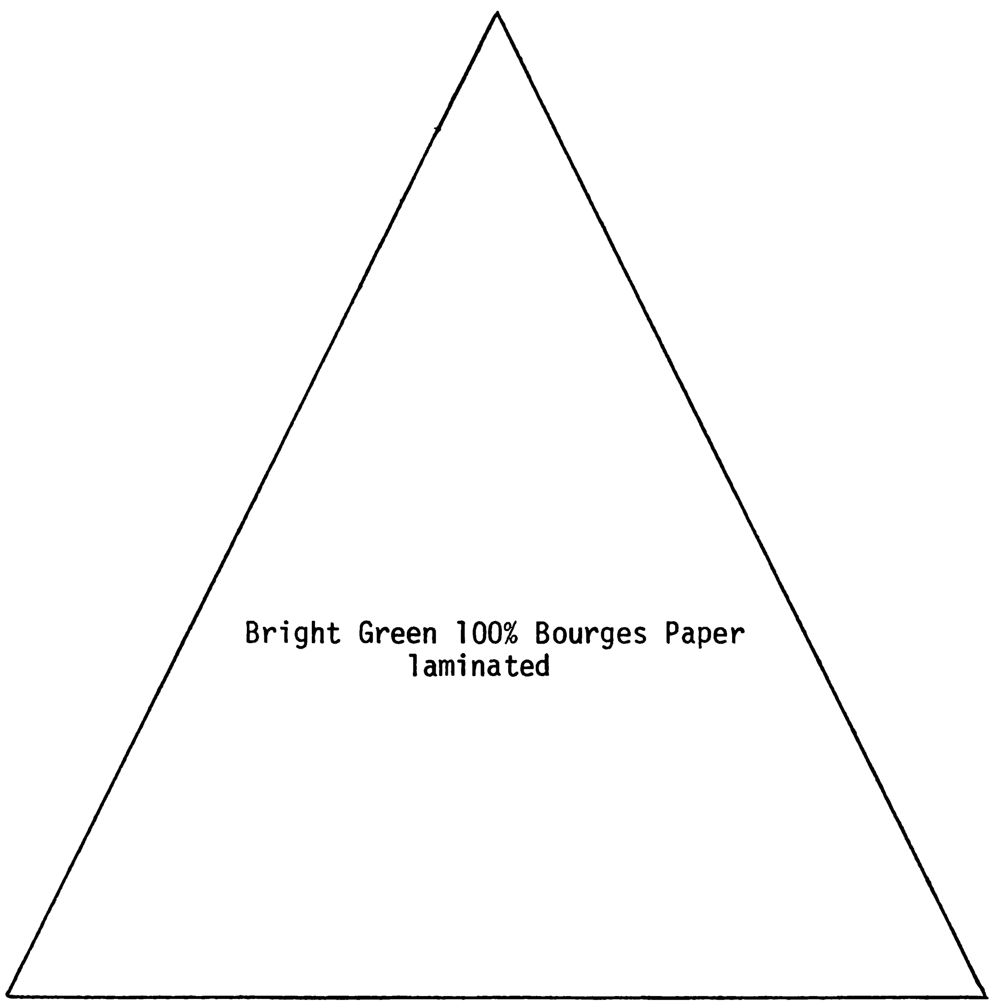
Yellow Square

Bright Yellow 100% Bourges Paper
laminated

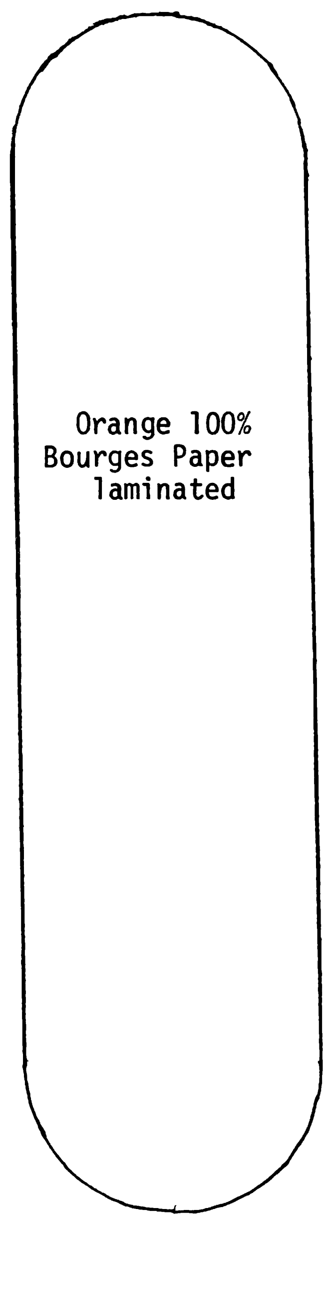
Blue Star



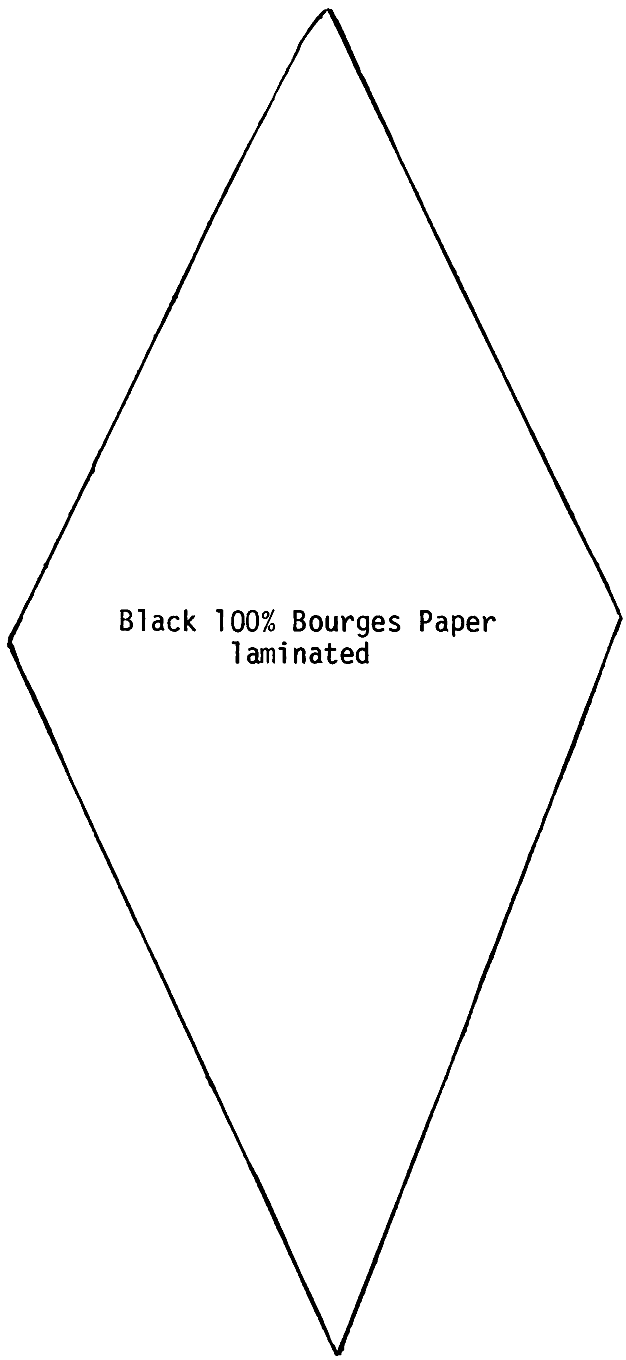
Green Triangle



Orange Oval



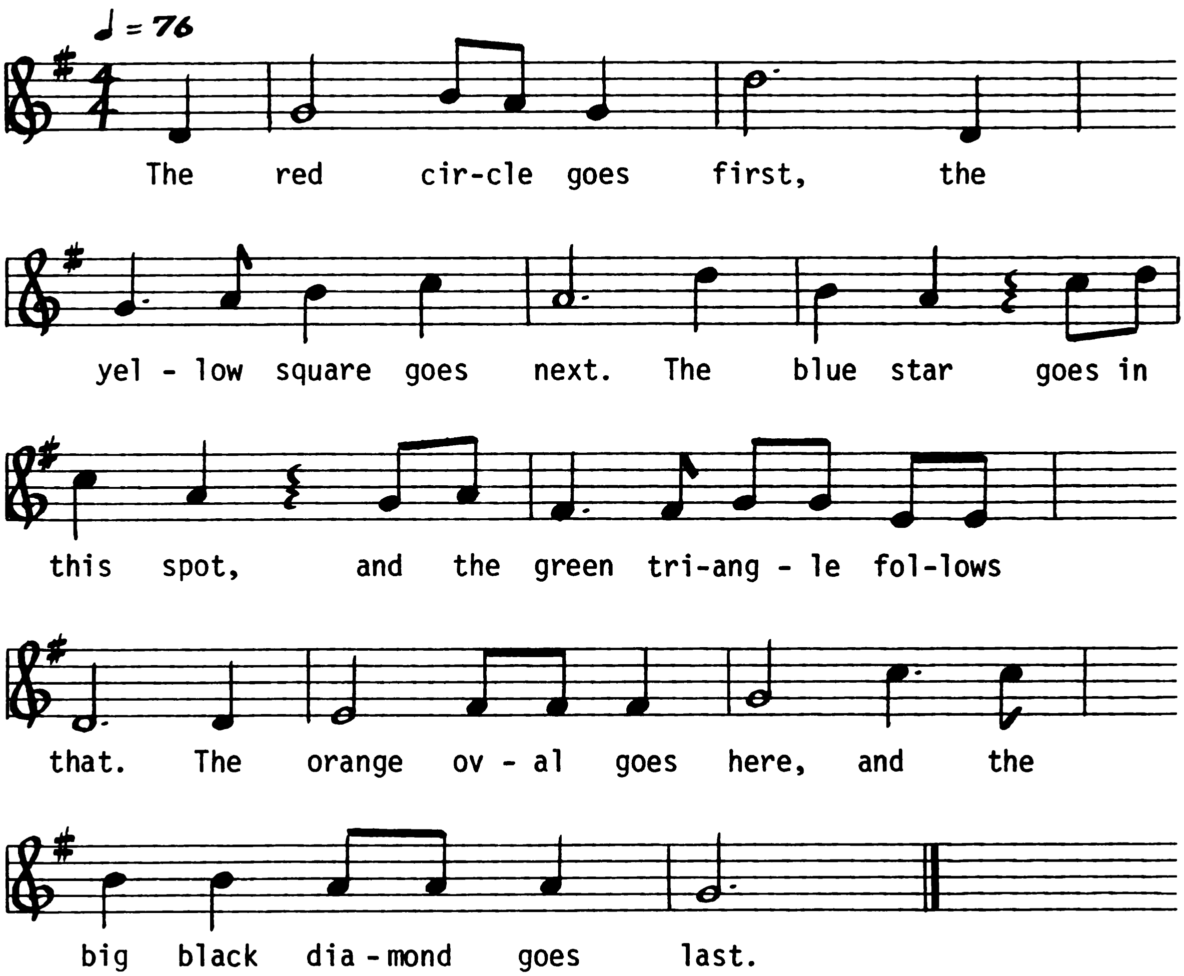
<u>Black Diamond</u>



APPENDIX D

COMPOSED SONG MATERIAL

Composed Song



APPENDIX E

SPOKEN MATERIAL

The red circle goes first
the yellow square goes next.
The blue star goes in this spot,
and the green triangle follows that.
The orange oval goes here,
and the big black diamond goes last.

APPENDIX F

RAW DATA

Instructional Group A

Subject	Functioning Level	Sex	Position Score	Sequence Score	Total Score	Time in Seconds
1	High	F	8	2	10	49
2	High	M	12	5	17	17
3	High	F	4	1	5	18
4	High	F	12	5	17	16
5	Low	M	0	0	0	12
6	Low	M	0	0	0	23
7	Low	M	0	0	0	37
8	Low	F	4	1	5	60
9	Low	M	8	2	10	47.5

Instructional Group B

Subject	Functioning Level	Sex	Position Score	Sequence Score	Total Score	Time in Seconds
10	High	M	12	5	17	25
11	High	M	12	5	17	23.5
12	High	M	0	0	0	60
13	High	M	4	1	5	18
14	High	F	12	5	17	27
15	Low	F	0	0	0	60
16	Low	F	0	1	1	9.5
17	Low	F	0	2	2	14
18	Low	M	6	3	9	20

Instructional Group C

Subject	Functioning Level	Sex	Position Score	Sequence Score	Total Score	Time in Seconds
19	High	M	8	2	10	12
20	High	M	12	5	17	21
21	High	M	4	1	5	14.5
22	High	M	12	5	17	15
23	High	M	12	5	17	10.5
24	Low	M	12	5	17	58.5
25	Low	F	2	1	3	17
26	Low	F	4	2	6	48
27	Low	F	0	0	0	60

Instructional Group D

Subject	Functioning Level	Sex	Position Score	Sequence Score	Total Score	Time in Seconds
28	High	M	6	1	7	12
29	High	M	8	1	9	23
30	High	M	0	0	0	60
31	High	F	12	5	17	24
32	High	F	4	1	5	12
33	Low	M	6	2	8	45
34	Low	F	4	1	5	60
35	Low	M	2	1	3	60
36	Low	M	4	2	6	11

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