A STUDY OF MOTOR ACTIVITY LEVEL IN RESPONSE TO
MUSICAL STIMULI AS FOUND IN MENTAL RETARDATE

APPROVED:

Mark E. Donner
Major Professor

Ray W. Johnson
Minor Professor

Tromai Hengery
Dean of the School of Education

Robert B. Taulbee
Dean of the Graduate School
A STUDY OF MOTOR ACTIVITY LEVEL IN RESPONSE TO MUSICAL STIMULI AS FOUND IN MENTAL RETARDATES

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JoAnn Holloway, B.A.

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CHAPTER 1

INTRODUCTION

Since the beginning of recorded philosophy, much has been said about the response of the organism to musical stimuli. For example, as recorded in classical antiquity, Homer recommended music to overcome anger, sorrow, fear, anxiety and fatigue and as healthful recreation. Plato and Aristotle both felt music should be an educational instrument. Plato referred to music as the medicine of the soul. Aristotle said music has three functions—as a source of recreation, as an intellectual use of leisure and as a force of molding character. These theories are as modern today as they were then, having been enlarged upon and advanced by great thinkers and theorists through to the present time.

Although the range of theories is too vast to be reviewed here, it is of interest to note that Freud had no theory concerning music, although he advanced theories concerning other phases of art. When asked why this was so, he replied that he never discussed anything that he did not understand. Some of his followers have attempted to fill in this void.

Although the investigation of the response of man to musical stimuli is as popular today as it has been in the past,
there are little empirical data except on the physiological level and there are no empirical evaluations of the response of the mental retardate to musical stimuli.

In classical antiquity the subject of music was closely associated with philosophy. During that time the moral and ethical effects of music was studied. Later, the healing power of music was mentioned in the Bible. Music, unlike other arts, is invisible, and therefore related to metaphysics. It cannot be wholly understood by rational evaluation.

During the middle ages a system of scales, known as modes, was developed. Music theorists then began to familiarize themselves with composition and their interest was teaching composition and in performing music. This paved the way for the scientific and logical approach to music which followed.

Today, the study of the effect of music in the treatment of the emotionally disturbed has been of particular interest (in recent years).

The value of music in the treatment of the mentally retarded has been recognized through the method of observation. It is felt that these studies should now be expanded to include empirical data. This study is developed accordingly.
Review of Literature

Much attention has been given to the physiological responses to musical stimuli. Arrington summarized results of studies involving physiomotor and sensory reactions, as follows:

(1) Metabolism increased. (2) Breathing accelerated and regularity retarded. (3) Variable effect on blood pressure, pulse and blood volume. (4) Fatigue reduced or delayed, therefore, increased muscle endurance. (5) Various sensory stimuli thresholds increased. (6) Volume of activities (typing, writing) speeded. (7) Attention facilitated. (8) Muscle reflexes used in writing and drawing are increased. (9) Increased electrical conductivity of the body. Increased psychogalvanic index fluctuation. (10) Certain music with certain people can sustain attention to prolonged psychomotor performance, above and beyond the effects of drugs (4).

Walters describes a unique physiological experiment.

Toward the close of the last century, in 1896, to be exact, Dr. M. L. Patrici, an Italian physiologist, conducted a series of experiments to determine the influence of different kinds of music on the circulation of the blood in the brain. A thirteen year old boy named Emanuel Favre, a native of Savoy, while acting as an assistant to his employer, a woodcutter, was severely wounded in the head by a glancing blow of his ax. Through careful treatment in the hospital he was restored to health although the wound was more than three inches in length, cleaving the bone of the skull for the entire distance. When the wound was healed the bones did not fully cover over the brain, but left a small section exposed. It was possible to measure accurately changes in the blood circulation in the brain. The boy was bright and fully willing to undergo these experiments. Dr. Patrici set out to ascertain, first, if the circulation in the brain is more of less influenced than that of other parts of the body.
An apparatus was devised which consisted of a closed cylinder of glass for holding the arm in water and a registering apparatus connected with the needle of a galvanometer. For registering the pulse in the brain a cap of gutta-percha was made, with an electrical connection capable of showing the slightest modification in blood volume as well as in pulsation.

It had already been claimed by former observers that any excitement of the brain by musical sounds increases the flow of blood in other parts of the body. Accordingly, two tracings were made simultaneously, the one of the pulsation of the blood in the brain and the other of the pulse in the arm.

During the course of these experiments three phenomena were observed: (1) The volume of the pulse in the arm was elevated in the same proportion as that of the brain. (2) At times it was found that the circulation of the blood in the brain was increased while that of the arm was slowed down. (3) There were instances in which the amount of blood in the arm was not in the least influenced while the circulation of the blood in the brain was increased.

Lively music was found to cause an increase of blood in the brain as well as a livelier pulse . . . Dr. Patrici demonstrated that such soft, slow music has the effect of slowing the blood circulation in the brain and decreasing its volume (29).

Some have felt that music acts as a precipitating factor by an effect upon some specific locus in the auditory area of the temporal lobe which is primarily concerned with music, and it is noted that Penfield produced hallucinations of music by stimulation of the superior temporal gyrus.

Lashley demonstrated that an undamaged portion of the brain can take over the function of a damaged portion. For this reason, music could be of immeasurable importance in the treatment of brain-damaged persons.
Palmer states:

The areas of the brain subserving musical reception and performance are practically invulnerable except in trauma from automobile accidents, etc., against which nature has not provided adequate safeguards. In addition, neuro-anatomico-physiological arrangements (which it is beyond the scope of the paper to describe) preserve musical integration in cases of mal-development, anomalies and lesions of the brain.

I agree with the authors that in the communicatively handicapped individuals there lies behind their silence a possibility of emergent development. Their musical approach is a way of reaching past the silence to the individual in order to bring him to potential fulfillment (20).

There has been some disagreement as to whether rhythm or tone is the precipitating factor in music. Diserens is one who favors tone over rhythm.

Previous discussions stress the predominance of the rhythmic over the tonal elements in producing the observed effects in speeding up and reinforcing reactions. Analysis of this data, however, seemed to point clearly to the view that the rhythmic elements are only a regulating or coordinating factor by which tonal stimuli are brought into sufficient temporal contiguity with stimuli initiating reflexes, to produce the reinforcement demonstrated by experiment (17).

It has been demonstrated that tones initiate Beta Rhythm and also abolish them.

On the other hand, Van de Wall is representative of those who favor rhythm over tone.

Instances of sensory-motor reaction to musical stimuli are to be found in the behavior of low-type idiots. Mental defectives of this class will respond by relatively powerful rhythmic movements of body and limbs. They are especially susceptible to markedly rhythmical music. When the stimuli cease the motions at once stop... (28).
He goes on to observe, after discussing states of normal infancy, brain defect, mental disturbance, and senility,

The inhibiting function of the mentality, of which we are not always conscious, is not active. In the infant the mentality is not developed; in defective, ill and deteriorated persons it is impaired. If, then, all these persons react to musical stimuli with an involuntary sensory-motor action, that fact seems to indicate that the physiological motor responses is the most basic, the earliest, and the most lasting reaction to music (28).

Nordoff and Robbins state:

From the point of view of neurology and physiology these rhythmic responses are interesting because of the relationship they can bear to the life rhythms within the body and to the function of the brain. The complex relationship between the operation of the organism and the emotional life is immediately relevant, particularly where an emotional disturbance is related to a known physical impairment (19).

Altschuler remarks:

Man is essentially a rhythmical being. There is rhythm in respiration, heartbeat, speech, gait, etc. The cerebral hemispheres are in a perpetual state of rhythmical swing -- day and night. Even the slightest change in the body, such as opening or closing of the eyelids, causes a change in brain rhythm. These brain waves differ in emotional states, fever, intoxication, infections and such conditions as epilepsy (1).

Van de Wall (28, p.62) stresses kinaesthetic responses to music which he says consist of an awareness of muscular tension of the body. This awareness is accompanied by the impulse to release this tension through motion. "When it is remembered that a simple kinaesthetic or other sensory response may create feeling-tones that provide needed relaxation or
invigoration, these results and the kinds of music that produce them most frequently have been given a new importance."

Zimmy and Weidenfeller discuss their study on changes in GSR as a response to music.

The principal finding of the present study is that the pieces of music judged by college students to be exciting and calming were capable of producing differential changes in GSR of children of five to twelve years of age. On the assumption that GSR is a physiological indicator of emotional response, the decrease in electrical skin resistance indicates an increase in emotional excitement in response to the exciting music, and the increase in electrical skin resistance indicates a decrease in emotional excitement in response to the calming music.

Since these same pieces of music have also been found by the authors to produce similar changes in GSR of college students and of psychotics, the generality of effect of these musical stimuli appears to be quite extensive (32).

Music is used extensively and successfully as an adjunct to psychotherapy. Podolsky believes:

The potential value of music as a resocializing agent in treating mental patients is immeasurable. Music is capable of changing mood; it overcomes depressed feelings and calms over-active patients. It can change a dissatisfied and destructive mood to a satisfied and constructive one. Since music has this power it is being used quite widely on mental patients to bring them out of seclusion, relieve tensions and afford contact with reality by relaxation and the creation of an emotional outlet (22).

Altshuler (1, p.267) observes that "Music, even more than the spoken word, lends itself as a therapy because it meets with little or no intellectual resistance and does not need to appeal to logic to initiate action. It is more subtle
and more primitive and therefore its appeal is wider and greater."

Because Altshuler's "objective approach" and method of "contact with music" have been widely adopted and employed, it is reproduced in some length here.

In the eighteenth and nineteenth centuries, and especially with the arrival of the experimental method, a new orientation ensued concerning the influence of music upon the human organism. An attempt was made toward an objective approach. Interesting reports appeared in Europe and in our own country in which the effect of music upon metabolism, muscular energy, blood pressure, respiration and pulse was described. Cannon, the eminent Harvard physiologist, believes that music arouses emotions and releases adrenalin and perhaps other harmones. Clinical reports dealing with observations made on groups of mental patients also appeared. All these experiments and observations, however interesting and valuable, failed to take into consideration two fundamental factors, namely, the role of the central nervous system in musico-dynamics and the structural elements of music.

Various brain centers, viz. hypothalamus, thalamus, cerebellum, in addition to the cerebral hemispheres, the master brain, take part not only in metamorphosing tone and rhythm into music, but in giving it an emotional and mental content. The understanding of the anatomy and physiology of these brain centers is therefore indispensable. The hypothalamus exercises influence upon such physiological processes as metabolism, sleep, rhythm, etc. It is connected by nerve pathways with the thalamus and through it with the other brain centers. One can see thus how music can influence the body, that is, via thalamus and hypothalamus.

The thalamus is a subcortical brain center made up of gray matter, lying below the master brain. It is the main relay station of emotions, sensations and feelings. It is believed that even aesthetic feelings are relayed by the thalamus to the master brain by nerve pathways, and the stimulation of the thalamus almost simultaneously arouses the master brain. Once the master brain is aroused, it sends impulses back to the thalamus and so a reverberating circuit is set in motion.
Now this is an important finding. There are nervous and mental patients who cannot be reached through the spoken word (that is, the master brain), because these patients are either inattentive, distractible, confused, depressed, hallucinated, or in a state of anxiety which makes verbal contact next to impossible. It is precisely here that music makes itself useful. Music, which does not depend upon the master brain to gain its entry into the organism, can still arouse by way of the thalamus—the relay station of all emotions, sensations and feelings. Once a stimulus has been able to reach the thalamus, the master brain is automatically invaded, and if the stimulus is continued for some time, a closer contact between the master brain and world of reality can be thus established.

In the management of nervous and mental patients this is important. In order to be able to initiate psychotherapy, the removal of states of inattention, anxiety, tension and morbid moods is essential. That temporary contact with the patient through music can be established is seen from the fact that patients considerably disturbed or confused will respond to music by either tapping the foot, swaying the body or nodding the head. Such responses are known as thalamic reflexes. When the music tempo is changed one can observe that the tempo of the tap, even in the most confused and disturbed patients, is correspondingly affected. The phenomenon of the thalamic reflex is important in another respect; it can be utilized in objective study of the effect of music upon nervous and mental patients. Clinical experiences indicate that the mood and the mental tempo of psychotic patients can be influenced more readily by music if a special approach is employed. Thus, when a patient is depressed, sad music (in minor keys) will capture his mood more readily than gay music. Gay music may in the beginning even irritate him. Hypomaniacal patients, whose emotional tone is raised and who think fast, talk fast and walk fast, can be more easily "captured" by music with a fast tempo.

Only after one has worked himself musically into the mood or tempo of the mental patient, can a shift to a different mood or tempo be made; this of course, by the employment of special music. This maneuver is known as the "iso" principle (1, p.270-272).
Francis Paperte (21), after many hundreds of cases treated with music at the Walter Reed Hospital recommends the following:

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<th>Diagnosis</th>
<th>Type of Music</th>
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<tr>
<td>Psychoneurosis, conversion hysteria</td>
<td>Stimulating</td>
</tr>
<tr>
<td>Psychoneurosis, anxiety type</td>
<td>Soothing, relaxing</td>
</tr>
<tr>
<td>Schizophrenia, paranoid type</td>
<td>Soothing</td>
</tr>
<tr>
<td>Schizophrenia, hebephrenic type</td>
<td>Stimulating</td>
</tr>
<tr>
<td>Manic depressive psychosis</td>
<td>Soothing</td>
</tr>
<tr>
<td>Psychoneurosis, mixed type</td>
<td>Relaxing</td>
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Podolsky (22, p.22-23) relates successful studies on the use of music in reducing anxiety, anger, depression, emotional fatigue, emotional disturbances, acute grief, tension headaches, psychosomatic gastric disorders, emotional high blood pressure, functional heart ailments, athetotic tremors and personality disorders. He also offers selections of music proved beneficial with each of these disorders.

Bradley states:

Children of low intelligence-quotient and disturbed personality who cannot be approached in any other way are susceptible to musical influence. It has been found that such youngsters often have a strong sense of rhythm, and can be taught to follow a conductor's beat. Utilizing music as an initial means of arousing interest and attention to further mental and emotional development in such retarded children can be accomplished by slow and patient stages (5).

Alvin, who has worked extensively with handicapped children, states:

Remedial music may help the mental, perceptual, or emotional growth of the handicapped child, irrespective of his musical aptitude or ability. Even the most severely handicapped child has normal basic needs for love,
acceptance, security, and success, and he must also find means of self-expression at his own level. Music may be the only way he can realize himself. Music may represent to him a non-threatening world with which he can communicate, where he has known no failure, where he can integrate and identify himself. It may be a field in which he can use the restricted physical or mental means he possesses, however weak or deficient. Musical activities can also help him towards the awakening of perceptual awareness, the development of auditory discrimination and motor control. . . . The ideal which has guided me throughout the work is a conviction based on fact, that music should be a creative experience, and that it should help to discover or exploit to the full any ability the child possesses, and to suit any mental, emotional or physical handicap. Even at the infant or pre-school stage, for instance, music can be an admirable means of non-verbal communication with the handicapped child (3).

Heckel, et al. present the following summary of their study:

An experiment was performed to determine whether rate of speech in group psychotherapy could be influenced by the introduction of background music of different tempi. Music played at a rapid tempo increased rate of speech an average of twenty-two percent over the rate of speech during music played at a slow tempo (14).

Stein (26) reports that "gradually, in the course of work with very disturbed patients, it appeared that work in music could help to restructure patterns of thinking and thus facilitate psychotherapy."

Goertzel, et al. point out the importance of disturbances of body image and self-identity in the etiology and treatment of schizophrenia. In discussing their treatment, called body-ego technique (BET), they state:

A pianist assistant works closely with the therapist, providing a rhythmic musical background specially
selected for the particular patient or group and varied and adapted continuously during the session according to the development of the patient-therapist interaction. In individual sessions with severely autistic patients, the therapist establishes contact by identifying and entering into the patient's spontaneous movements, such as rocking, pacing or gesturing. These spontaneous movements are subsequently elaborated or extended along patterns flexibly determined by subsequent interaction. Although typical sessions may follow a similar general pattern or organization and sequence, the therapist is free to use a flexible approach adapted to the patient's current level of functioning. Most patients respond to rhythm and, except for patients who are extremely out of contact, this seems to be the most acceptable way to start a session.

They review the remainder of the treatment and summarize as follows:

In this first controlled clinical trial of its use with chronic regressed schizophrenic patients, the therapists felt that they could establish contact and elicit cooperation in a high proportion of cases. Those treated with BET did significantly better than the controls in terms of independent psychiatric ratings of overall improvement and affective contact and nursing ratings of motility and general functioning (12).

As indicated by the foregoing studies and observations the variety of benefits of music as a tool can be extensive. There are many studies of the benefits of music as an adjunct to psychotherapy and of the physical changes accompanying musical stimuli. The following pertinent studies indicate further how extensive the area of research with music can be, as well as the potential value of psychological research into the effects of music on the mentally retarded.
Pertinent Studies

Recent articles on the effects of music include a study by Rieber.

The activity of five and six year old children was measured in a specially designed playroom under conditions of silence and two types of music, fast and slow. Activity rates were higher during the intervals when music was played, with fast music having the more marked effect. Music did not affect the variability of activity, which showed a steady decline during the time spent in the room (23).

In his study of the activity level of twins and singletons, Simons (25) found that the activity level of singletons was greater than that of twins, but of more importance for the purpose of this study, he found that music had a stimulating effect on nine-to thirty-one month old children and that their increased activity level was a function of the type of music played.

Luckey, et al. (16) report on the response to rhythm band instruments by severely retarded adults with the following conclusion: "Rhythm band activities provided an effective means of stimulating gross rhythymical motor responses in institutionalized severely retarded adults." He describes striking behavior changes in the participants.

Goldstein, et al. demonstrated:

(1) interpretive or creative movement can serve as a means of sublimating inappropriate emotional feelings or responses, (2) nonverbal communication can be used
as an effective means of group unification, and (3) benefits which can be derived when adjunctive therapists from different disciplines combine their knowledge and talents in unified effort (13).

A study of the response of severely retarded children to music is reported by Alvin. Working with three groups of severely retarded, which were designated "Older", "Younger" and "Day Care and Readiness" groups, the following conclusions were offered.

We have achieved the results aimed at during the experiment, and we were satisfied that: (1) Music had proved to be a means of communication with each of the children. (2) The response to music was: a. Physical, through rhythmical or imitative movements. b. Verbal. c. Emotional; we observed visible signs of interest, pleasure, satisfaction and happiness. (3) There was some development in sense perception and a substantial increase in the span of attention. (4) Social integration took place in each of the three groups (2).

Fields, (3) in a study of music as part of the treatment of brain damaged patients, feels that "improvement in coordination among twenty-four of twenty-eight patients treated suggests the value of the use of music as an adjunct in treatment for selected brain-damaged patients in the area of coordinated motion".

Murphy (18) conducted a large scale of music therapy program with 1100 low grade and middle grade defective males, residing in eleven cottages at the State Colony at Woodbine, N.Y. Desirable outcomes were self-initiated group participation, voluntary self discipline, development of desirable interpersonal attitudes, efforts at pronunciation of the words of the
songs by others, vocabulary development as more words and phrases of familiar songs are learned, development of gross motor coordination, and enjoyment of music as a source of recreation. She also relates that the charge attendant of a Dorm for one hundred twelve boys, "(M.A. range three months to four years ten months; C.A. range twelve to twenty; I.Q. range less than ten to thirty-two)", reported that wetting and soiling seldom occurred during the music presentation, even though approximately half of the cottage residents had not completed toilet training.

Weigl reports the results of functional music classes as follows:

Approximately ten percent of the children who have participated have not changed perceptibly; about twenty percent have shown improvement in class but little carry-over into home and school; about seventy percent have shown positive changes in behavior and attitudes. Most important results have been on the emotional and social levels, but improvement in posture, muscular control, rhythmic coordination and speech have also been gratifying. Many of the children seem to have been helped to overcome their isolation and to have derived some feeling of belonging and adjustment to the group and to other children (30).

Murphy also conducted a study in which she attempted to elicit active participation from two groups of mental defectives, one group which expressed rhythm with spontaneous rocking movements and one which responded to musical rhythm with handclapping.

The group engaged in rocking movements performed at a lower level than did the clappers. The clappers were capable of engaging in socialized group activity and specialized motor responses. Of special importance
was the author's suggestion that observation of rhythmical response of low and middle grade mental defectives could be most helpful in evaluating social emotional levels of development (17).

Getz, (11) concluded that "It does not appear to be necessary, from the results of this study, to present selections of a simplified or different nature to students of lower intelligence or musical ability than to students who are average or above average in these areas."

Slaughter (24) in an unpublished master's thesis, University of Kansas, reported that "no significant differences were found in the pupillary responses of mental patients and normals. When stimulative music was played, pupillary dilation was significant. A general trend toward constriction of the pupil was shown when sedative music was played."

Wilson in an unpublished master's thesis, University of Kansas, also studies effects of stimulative and sedative music, but on gastric activity.

Generally, there was a greater reaction to the sedative music than to the stimulative. The only outstanding difference between the reactions of musicians and non-musicians was that the male non-musicians as a group showed less gastric activity during stimulating music. An interesting phenomenon which occurred without exception was the immediate cessation of gastric activity when a selection was played which irritated the listener. The theory that the automatic nervous system operates as a unit, not only affecting the inner organs, but all those autonemically innervated, was supported by the findings of this thesis (31).
The following excerpts are taken from an article by Gaston (10): "Rhythm is the primitive, dynamic, driving factor in music. It stimulates muscular action. It induces bodily movement." "Melodic passages of a sustained nature in which the percussive element is lacking produce very different response—for even though there may be rhythm, it is at a minimum. The responses induced are not physical, not tension of the striped musculature, but more intellectual, more contemplative, the result is much more that of sedation rather than stimulation."; "Notice how the notes are separated in a march well played."; "When a quiet, simple rhythm is repeated over and over again in the same style, and a sustained melody is superimposed, it will produce a sedative often hypnotic effect."

Furrer (9) of Switzerland grouped "severely feebleminded" children "homogeneously as 'torpid' and needing stimulation or 'erethic' and needing calming down." The series of activities in one session is described in minute detail for these two types of mental defectives. Music therapy is believed to be an effective adjunct in modifying behavior of the feebleminded.

Sutermeister (27) feels that "a theoretical approach to musicology and the psychology of music is still lacking. To understand the psychomatic effects of music, two neuro-physiological concepts are introduced: emotional resonance
and release phenomena, allowing a new perspective in these fields. The deep reaching effects of rhythmical elements in melody, harmony and measure are due to the rhythmic organization of the brain-stem."

Statement of the Problem

As mentioned previously, there are no empirical evaluations of the response of the mental retardate to musical stimuli. The purpose of this study is to investigate, empirically, the response of the severely mentally retarded to different types of music, tonic and sedative, as well as responses during "quiet" periods. These responses during periods of no music are considered to be spontaneous activity levels and in order to investigate the bearing this has on response, the interaction between spontaneous activity level and responses to the two types of music will be empirically evaluated.

As indicated by the foregoing studies, empirical research involving the response of the mental retardate to musical stimuli is overdue. Through the use of music, there have been improvements in functioning (as reported after observation over a period of time) to the point that maximum functioning was thought to have occurred—which is the goal of all who work with the mentally retarded.
Statement of the Hypotheses

1. If both tonic music and sedative music are presented to all subjects combined during the experiment, then the activity level (as measured by the free space transversal method) during presentation of the sedative music will be significantly different from the activity level during presentation of the tonic music.

2. If both periods of music and periods of no music are employed with all subjects combined, the activity level during periods of music will be significantly different from the activity level during periods of no music.

3. If the interaction among "high spontaneous activity level", "low spontaneous activity level" and "activity level during tonic music", "activity level during sedative music" is evaluated, then significant differences will occur.

Because of the lack of empirical studies, there are not enough data upon which to base a prediction of the direction of differences, therefore, this is omitted in these hypotheses.
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CHAPTER II

METHOD

Subjects

A total of twenty-four subjects participated in this experiment. All were male residents of one dormitory at the Denton State School. Chronological ages ranged from seven years one month to ten years four months, with a mean of nine years. Mental age ranged from one year nine months to four years one month, with a mean of two years four months. Social Quotients, as measured by the Vineland Social Maturity Scale ranged from thirteen to forty-four with a mean of twenty six. The Stanford-Binet has been attempted and discontinued with each of the subjects.

Experimental Design

A t-test was applied to determine the significance of the mean difference between scores during periods of no music (quiet) and periods of music. A t-test also was applied to determine the significance of the mean difference between scores during periods of tonic and sedative music.

A median of scores was determined. The children's scores falling below this median were treated as high spontaneous activity level and the ones falling above this median, low
spontaneous activity level. Because of the limited number of subjects, it was impossible to have a control group. Therefore, each child acted as his own control in regard to variables. An analysis of variance of high spontaneous activity level and low spontaneous activity level groups, activity level during "tonic and sedative" music was used to determine the significance of the difference.

Task and Procedure

Eight children were seen individually for twenty minutes a day on five consecutive days. The time of day each was seen was held constant. This pattern was followed until three "blocs" of eight, or twenty-four children had participated. Each child had been assigned to his week and time of day by the method of random numbers.

A dormitory classroom from which all furniture had been removed was used for the experiment. On the first day of each of the three five-day periods, each of the eight children was taken into the room at his scheduled time. No music was played during this session. Each subject was told "I have some work to do and you can play if you like". The experimenter then measured activity while standing at the place in the room to be occupied throughout the experiment. This measurement was not used in the analysis, but it afforded the child an opportunity to become accustomed to his surroundings and to the activities of the experimenter.
On the succeeding four days a ten minute quiet period during which no music was played and a ten minute period of music were employed. A tape recording was used to present the types of music. The music that was played had been chosen from lists of music, "musical tonics" and "musical sedatives", as compiled by Arrington (1, p 286). Musical tonics are the faster, more stimulating selections, and musical sedatives are the slower, more relaxing ones. From Arrington's lists, the following selections were made. Musical tonics (MT): Tchaikowsky—3rd Movement, Sixth Symphony (because of the time factor, an excerpt consisting of the last one minute, forty-nine seconds was used); Bizet—"Toreador Song"; Sousa—"Military Marches" (Semper Fidelis, The Stars and Stripes Forever, and Manhattan Beach were selected). Musical sedatives (MS): Beethoven—"Moonlight Sonata"; Debussy—"Clair de Lune"; Mascagni Intermezzo; and Brahms—"Lullaby" (which was repeated twice.

Each of these two types of music was taped and timed at exactly ten minutes. The quiet periods were timed at exactly ten minutes.

The order of music presentation, by types, and the quiet (Q) were counterbalanced among the children in such a way that the order of presentation was changed from day to day. Table 1 presents the schedule that was followed with each of the three blocks of children.
TABLE I

ORDER OF PRESENTATION OF MUSICAL TONICS, MUSICAL SEDATIVES AND QUIET PERIOD

<table>
<thead>
<tr>
<th>SUBJECTS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Q</td>
<td>Q</td>
<td>MS</td>
<td>Q</td>
<td>MT</td>
</tr>
<tr>
<td>2</td>
<td>Q</td>
<td>MS</td>
<td>Q</td>
<td>MT</td>
<td>Q</td>
</tr>
<tr>
<td>3</td>
<td>Q</td>
<td>Q</td>
<td>MS</td>
<td>MT</td>
<td>Q</td>
</tr>
<tr>
<td>4</td>
<td>Q</td>
<td>MS</td>
<td>Q</td>
<td>Q</td>
<td>MT</td>
</tr>
<tr>
<td>5</td>
<td>Q</td>
<td>Q</td>
<td>MS</td>
<td>Q</td>
<td>MT</td>
</tr>
<tr>
<td>6</td>
<td>Q</td>
<td>MS</td>
<td>Q</td>
<td>MT</td>
<td>Q</td>
</tr>
<tr>
<td>7</td>
<td>Q</td>
<td>MS</td>
<td>Q</td>
<td>MT</td>
<td>Q</td>
</tr>
<tr>
<td>8</td>
<td>Q</td>
<td>MS</td>
<td>Q</td>
<td>MT</td>
<td>Q</td>
</tr>
</tbody>
</table>
The independent variable was the type of music played and the dependent variable was the activity level, or response, as measured by the free space transversal method. As discussed by Ellis (2), the free space transversal method consists of a measurement of the number of marked-off squares a child traverses in a given period of time.

The floor of the classroom was designed in such a way that the floor was divided into three-foot squares. The room measured 9' x 12', so consisted of a total of twelve squares. Each time a child moved from a square it was counted as "1" movement. When a child was walking, it was counted when both feet moved from a square; if crawling forward, when both knees moved from a square; if crawling backward, when both hands moved from a square; when scooting or rolling, when the buttocks moved from a square. When a child crossed diagonally from one square to another, it was counted as "1" movement, even though a foot might have been in each of the two adjoining square prior to entering a square diagonally, it was counted as "2". His total score during each condition of music was his activity level, or response, for that type music. His total score during quiet periods was considered his spontaneous activity level.

Although the experimenter counted the squares that each child traversed, this is such an objective form of measurement that it is not felt that experimental bias could be a factor.
CHAPTER BIBLIOGRAPHY


CHAPTER III

RESULTS AND DISCUSSION

Results

Originally, it was anticipated that the total dormitory population of thirty males would participate. However, two subjects were rejected prior to experimentation because of frequent severe seizures, two subjects because of deafness; one subject, because of blindness; and one subject, because of transfer to another dormitory.

Of the twenty-four subjects employed, the results of one subject's participation were not included because of his preoccupation with running into the hall during attempted measurement. He was allowed to participate each day since he approached the experimenter at his scheduled time and indicated that he wanted to go with her. However, if the door were locked, he screamed and fell to the floor, kicking. The tape recorder was played for him each day in an unlocked room, but on each day but one, measurement was impossible.

Aside from this, experimentation proceeded smoothly and without incident.

All Subjects Combined

It was hypothesized that all subjects combined would display a significantly different activity level during sedative music from that displayed during tonic music.
The mean of the activity level during each condition is presented in Figure 1. The mean response during sedative music is 77.43 while during tonic music it is 77.78.

![Graph showing mean number of responses for sedative and tonic music](image)

Fig. 1—Mean number of responses of all subjects combined during sedative music and during tonic music.

As may be anticipated from Figure 1, there was no significant difference between activity levels of all subjects combined during the two types of music.

To measure the significance of the difference, a t-test for correlated differences of the means was applied. A critical level of significance of $p = .05$ was adopted. The mean, standard deviation, and results of the t-test are presented in Table II.
TABLE II
DIFFERENCE BETWEEN MEANS DURING SEDATIVE AND TONIC MUSIC

<table>
<thead>
<tr>
<th>Response during sedative versus tonic</th>
<th>N</th>
<th>MEAN DIFF.</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23</td>
<td>-.3478</td>
<td>78.6768</td>
<td>-.0207</td>
</tr>
</tbody>
</table>

Note—Coefficient of risk of p=.05 level used for tests of significance.

A t-ratio of 2.080 is necessary for significance at the .05 level. The t-ratio of -.0207 reflects no significant difference in activity level during periods of sedative music as opposed to activity levels during periods of tonic music.

It was also hypothesized that there would be a significant difference in activity level during periods of music presentation as opposed to the spontaneous activity level during periods of no music.
The mean activity level for each condition is presented in Figure 2. The mean spontaneous activity level during periods of no music was 150.52 and the mean activity level during combined conditions of music was 155.22.

Fig. 2—Activity level of all subjects combined during periods of music presentation and periods of no music.
A t-test for correlated differences was again applied. The results are presented in Table III.

TABLE III

T-RATIO FOR ACTIVITY LEVEL DURING MUSIC VERSUS NO MUSIC

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>MEAN DIFF.</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Music</td>
<td>23</td>
<td>-4.6956</td>
<td>187.1731</td>
<td>-0.1176</td>
</tr>
<tr>
<td>Versus Music</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The t-ratio of -0.1176 reflects no significant difference in the spontaneous activity level and the activity level during music, sedative and tonic, as applies to all subjects combined.

High Spontaneous Activity Level Versus Low Spontaneous Activity Level

It was of interest to study the interaction among "high spontaneous activity level", "low spontaneous activity level" and "activity level during tonic music", "activity level during sedative music".

To separate the subjects according to "high spontaneous activity level" and "low spontaneous activity level", a median of the squares traversed during periods of no music was determined. The median was 132.5. A t-test was applied to determine the significance of the differences in the means of the high spontaneous activity level group, hereafter
sometimes referred to as Group 1, and of the low spontaneous activity level group, hereafter sometimes referred to as Group 2. The results are presented in Table IV.

### TABLE IV
#### t-RATIO FOR GROUP 1 VERSUS GROUP 2

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>12</td>
<td>246.0833</td>
<td>85.0749</td>
<td>6.5984*</td>
</tr>
<tr>
<td>Group 2</td>
<td>11</td>
<td>46.2727</td>
<td>46.3800</td>
<td></td>
</tr>
</tbody>
</table>

Note—Coefficient of risk of p=.05 used for all t-tests. * p .001

A t-ratio of 3.819 was necessary to be significant at the .001 level. Therefore, the results are considered highly significant.

An analysis of variance was applied to measure the significance of the difference among "high spontaneous activity level" and "low spontaneous activity level", and responses during sedative music and during tonic music. Table V presents the means and standard deviations of each group's responses for each condition of music.
TABLE V
MEAN NUMBER OR RESPONSES
DURING EACH CONDITION OF MUSIC

<table>
<thead>
<tr>
<th>Group</th>
<th>Statistic</th>
<th>Sedative Music</th>
<th>Tonic Music</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Group 1</td>
<td>Mean</td>
<td>106.08</td>
<td>72.42</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>63.61</td>
<td>61.99</td>
</tr>
<tr>
<td>Group 2</td>
<td>N</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>46.18</td>
<td>83.64</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>64.43</td>
<td>131.58</td>
</tr>
</tbody>
</table>

The summary results of the analysis of variance data presented in Table V are presented in Table VI.

TABLE VI
SUMMARY OF ANALYSIS OF VARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>6,771.47</td>
<td>1</td>
<td>6,771.47</td>
<td>.84</td>
</tr>
<tr>
<td>Music</td>
<td>41.62</td>
<td>1</td>
<td>41.62</td>
<td>.005</td>
</tr>
<tr>
<td>Interaction</td>
<td>14,453.46</td>
<td>1</td>
<td>14,453.46</td>
<td>1.79</td>
</tr>
<tr>
<td>Within Cells</td>
<td>339,792.03</td>
<td>42</td>
<td>8,090.29</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>361,058.58</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The F-ratios of 7.31 were necessary for significance at the .05 level. This F indicated that significant difference among the various means probably did not exist.
Discussion

The hypotheses, as stated, were rejected according to the results of this experiment. However, it is noted that although difference in activity levels of the two groups during periods of no music were found to be highly significant, the differences in the activity levels during periods of music presentation were not significant. This in itself, is felt to be an interesting result of this experiment. Therefore, further discussion of data is made to study any tendencies that might be indicated.

Table V presented means, standard deviations and t-ratios of each group under conditions of sedative music and of tonic music. The t-ratio for sedative music, Group 1 versus Group 2 was 2.14 while the t-ratio for tonic music, the Group 1 versus Group 2, was -.25. These results reveal a difference significant at the .05 level between response means during presentation of sedative music. A significant difference between these two groups, in response to tonic music, was not reached.

Figure 3 presents the mean response of each group to each condition of music. The significant difference in responses to sedative music is reflected as is the difference in direction of each group’s responses during tonic music.
As can be seen in Figure 3, there is a tendency for the two groups to approach the same activity level during presentation of tonic music. Further, there is a tendency for the low spontaneous activity level group, which is the less active during sedative music, to become more active during tonic music; and for the high spontaneous activity level group, which is the more active during sedative music, to become less active during tonic music.

As indicated earlier in this chapter, the difference in the spontaneous activity level of the two groups was highly significant at the .001 level. Figure 4 presents the mean responses of Group 1 and Group 2 during periods of no music.
and during the combined periods of music presentation. The mean number of responses during periods of no music are presented in Table IV. The mean numbers of responses during the combined periods of music were 178.50 for Group 1 and 129.82 for Group 2.

Fig. 4—Activity level of Group 1 and Group 2 during periods of no music and of music.
As can be seen, the behavior of each group is modified during periods of music presentation and more during tonic music than during sedative music.

It is felt that these findings could have important implications in the teaching programs of the mentally retarded, as well as implications for the modification of the retardates' behavior. Therefore, further studies are recommended.

However, it is recommended that a similar study extend over a longer period of time. For the first few sessions some of the subjects appeared in doubt as to what was expected of them, whereas, during the latter part of the study, there seemed to be more freedom of response. The Subjects did not watch Experimenter as closely.

Also, it is recommended that the squares used as measurement be eighteen inches rather than the three feet used in this study. An adequate method of measurement is a problem of this sort since movements of clapping, rocking and swaying, for example, are not recorded. However, in concentrating on space traversal as measurement, a more accurate measurement could be obtained. It was noted that at times the children "danced", marched, or turned in circles, rarely moving into an adjoining square. With smaller squares as measurement, these movements could be recorded more accurately.

It is recommended that brain damage versus familial causes of retardation be considered.
CHAPTER IV

SUMMARY

The present study investigated the effects of musical stimuli upon the behavior of the mental retardate. The primary objectives were (1) To determine the degree activity levels of all subjects combined differed during presentation of sedative music and of tonic music. (2) To determine the degree activity levels of all subjects combined differed during periods of music and during periods of no music. (3) To ascertain the degree to which a "high spontaneous activity level" group differs from a "low spontaneous activity level" group in regard to activity level during sedative and tonic music.

It was hypothesized that there would be significant differences in activity levels in each of these cases. The results of this study did not confirm these hypotheses.

The male residents of one dormitory at Denton State School, Denton, Texas, were chosen for this study. The mean chronological age was nine years; the mean mental age was two years, four months. Each subject was presented periods of sedative and of tonic music, as well as periods of no music. The number of squares, 3' x 3' in size, traversed during presentation of the tonic or sedative music was "activity level"
for that condition, while the number of squares traversed during periods of no music was the "spontaneous activity level".

Following separation of the subjects into two groups, according to high or low spontaneous activity level, statistical analysis revealed that the difference in spontaneous activity level was highly significant at the .001 level. It was found that the activity level of two groups, during sedative music, was significantly different at the .05 level, but not significantly different during tonic music. Analysis of variance of the responses of the two groups during sedative and tonic music revealed no significant differences.

Findings

From the results obtained in this study, the following findings were obtained.

1. All retardates combined demonstrated no significant difference in activity level during periods of sedative music as opposed to periods of tonic music.

2. All retardates combined demonstrated no significant difference in activity level during presentation of music as opposed to periods of no music.

3. The "high spontaneous activity level" group and the "low spontaneous activity level" group demonstrated no significant difference in activity level during presentation of sedative and tonic music.
Conclusion "3" seems particularly important in view of the highly significant difference in the spontaneous activity level of the two groups. Each of the two groups approached the same activity level during periods of music and more during tonic music than during sedative music. The activity level of the "high spontaneous activity level" group was less than that demonstrated during periods of no music, while the activity level of the "low spontaneous activity level" group was greater than that demonstrated during periods of no music.

While the predictions were not confirmed, the findings of this study are deemed important in that trends of behavior emerged which, it is believed, should be investigated further.
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