MUSIC AND TENSION RELAXATION POTENTIALS (TRP) OF INDIVIDUALS AS INDICATED BY PHYSIOLOGICAL AND SUBJECTIVE MEASURES

A THESIS SUBMITTED IN

PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF ARTS

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF HUMANITIES AND FINE ARTS

DEPARTMENT OF MUSIC AND DRAMA

BY

MARION ANN TERENZIO, AB

DENTON, TEXAS

DECEMBER, 1979

The Graduate School

Texas Woman's University

Denton, Texas

21 November 1979

We hereby recommend that the prepared under our supervision by Marion Terenzio entitled Music and Tension Relaxation Potentials (TRP) of Individuals as Indicated by Physiological and Subjective Measures

be accepted as fulfilling this part of the requirements for the Degree of Master of Arts.

Committee:

Donald E. Michel

Chairman

Evelyn A. Stevens

[illegible]

Accepted:

Margaret J. Ferrell

Dean of The Graduate School

TABLE OF CONTENTS

INTRODUCTION AND PURPOSE

For centuries people have said that music soothes, relaxes and calms the agitated soul, but this affirmation has not been based upon scientific research. Only in the last century have scientific endeavors been made to investigate the effects of music upon man. More research is needed concerning music and physiological responses. It is the judgment of this author that studies in this area which have been reviewed fall short in many critical areas of experimental design. One purpose for this project is to produce a study which examines physiological responses to music and to provide an extensive review of the literature.

Tension and relaxation are very important in our modern society. The purpose of this project is further focused on testing the effectiveness of music as a relaxer and exciter as measured by physiological responses and verbal reports. A person's excitability to music will be included because there does not seem to be any method which is specifically designed for this purpose. The process of stimulation is just as important as relaxation techniques to help those who are not motivated, lethargic, and depressed.

Since music will be examined for its stimulating or calming effects upon a person, the term tension-relaxation potential (TRP) has been coined to refer to music and the person. The assumption is that music can produce a TRP for any person.

The following research questions will be investigated:

1. Will precategorized sedative music decrease GSR, EMG and respiration responses?
2. Will precategorized stimulative music increase GSR, EMG and respiration responses?
3. Will all physiological measurements indicate relaxation or stimulation from music to the same degree?

REVIEW OF THE LITERATURE

This review will cover literature which validates the use of the dependent measures and points out the problems involved, examines music's effect on the physiological and subjective responses, explains the physiological processes involved with emotional arousal, studies and attempts to categorize music, and defines pertinent terms such as relaxation and tension.

> Music is easier to relax to than any other modality... Music tends to reduce or delay fatigue and consequently increases endurance. It has power to speed up voluntary activities. It increases the extent of muscular reflexes. In the case of emotional fatigue, music of a sedative quality has the power to change the state of heightened tension and pressure to one of the quiet and repose. In addition, music has the power of bringing the expenditure of emotional energy from the unconscious level to that of the conscious and intellectually controlled level. (Podolsky, 1954, p. 117)

> Music can develop tension within the listener and resolve it to varying degrees through the use of intervals of musical tones, melody, harmony and rhythm and degree of closure within a composition. (Miller, 1967, p. 367)

> Music has a stimulus value in three levels of response. The most direct is auditory sensation and reception. Affect and cognition is the second level and the third is inter-related with both one and two. This involves the eliciting of specific memories, conflicts and feelings and the listener's method of coping with them. (Brim, 1977, p. 27)

Many studies have been done to examine the effects of music upon man, and have approached the topic from different perspectives. How does music influence man physiologically, psychologically and/or behaviorally? Does one learn or concentrate better with background music? Can music elicit different mood patterns? Do the variables inherent in music (melody, rhythm), or other variables such as musical training and personality produce the effects? The results of these studies are just as varied as the questions, and in most cases add more to the list. Yet, a common factor does exist. There has been a change due to the presence of music, and a response has been elicited in one form or another.

Even though there is a large quantity of literature dealing with the influence of music, some of it is invalid because of erroneous assumptions. Certain studies assume that the dependent variables used are good, stable indicators of the phenomena under investigation when, in fact, this is not always the case. An excellent example is the use of physiological dependent variables such as electrodermal phenomena to measure arousal and other emotional components. Investigators often fail to use correct terminology and interchange the many terms which exist to describe electrical skin reponses when there exists very large and pertinent differences between them. A researcher must have a thorough understanding of the physiological event which is under investigation and the proper measurement of that event.

Diserens (1923) provides one of the earliest accounts of music's influence upon physiological events. He makes mention of a French musician by the name of Gretry (1813) who was the first to study change in heart rate and blood circulation while he sang. He felt his own pulse as he sang to himself and noticed that when he sped up the tempo, his pulse also increased. Couty and Charpentier (1874) performed the earliest controlled experiment which investigated cardio-vascular reactions in dogs. They used noise and whistling as auditory stimuli and performed the experiment twelve different times on two dogs who were injected with chloral strychnine or curare. The stimuli increased cardiac tension, pulse acceleration and cardiovascular reactions between ten to one hundred percent. The amplitudes of the reactions corresponded to the intensity of the stimuli. When the stimuli was continuous, adaptation reactions did occur. Dogiel (1880) investigated the effects of the violin, clarinet, flute and metal whistle upon the blood circulation of humans and dogs. He concluded that auditory stimulation is accompanied by oscillations in blood flow which is dependent upon pitch, intensity and timbre. Weld (1912) concluded that no correlation exists between tempo and heart rate. Binet and Courtier observed capillary circulation in the hands of four subjects and found that pulse amplitude diminished when subjects were exposed to a sudden gong sound. Doctor Patrizi (1919) concluded that, "both cerebral and peripheral circulation were increased by the singing of the Marseillaise, while a polka augmented the cerebral circulation and diminished that of the arm in the same proportion." (p. 184)

Problems and pertinent questions which are asked today were very much pondered upon seventy years ago. Patrizi goes on to say that he is, "undecided whether variations in cerebral volume are autonomic neuromuscular functions, or passive reflections of general vasomotor phenomena." (p.191)

Other investigators turned their attention to music's effect upon muscular energy. Sergi (1894) writes, "with the thumb and finger grip the greatest pressure I can exert during silence is 4 kilograms. When someone plays the <u>Giants Motive</u> from <u>Rheingold</u> my grip shows four point five kilograms. The <u>Slumber Motive</u> from the <u>Walkure</u> reduced the power to 3.2 kilograms." (p. 192)

In 1906 Johnson investigated the relation of music to physical education. She concluded that the strength of muscular contraction increases with the intensity and pitch of sounds. Bingham (1910) studies muscular movements and music. L. P. Ayres (1911) wanted to see if music influenced the performance of competing athletes during a six-day bicycle race.

It is extremely difficult to compare studies which deal with measurements of physiological changes, and this includes studies which examine the same physiological events, because of the existence of many extraneous variables. Placement of electrodes, for example, to record muscle potential (EMG), brain waves (EEG) or galvanic skin response (GSR) will have a profound effect on the type of information the investigator receives. Significant results or lack of significant differences may not be due to the independent variables but to incorrect measurement procedures. Standardization of methods, especially for electrodermal activities, must come about as well as more detailed explanations in the method sections of research articles. Without such modifications, the validity and reliability of research are in great jeopardy.

Another factor which adds to the problem is the use of music. One investigator may use classical music while another may use jazz to study the same phenomenon. To further complicate matters, they may only use short segments of the selections and fail to report the exact time segments used. If someone replicates a study and uses a different time segment, he may very well receive quite different results and either reject the previous findings or show cause to be due to the wrong variable. With this major problem in mind, the reader should remember that the object of the following review is to give a brief account of the studies which are concerned with music and tension relaxation potentials of individuals and the physiological correlates of emotional arousal. As mentioned earlier, the major significant result of these studies combined is that music does affect, and has a strong influence on physiological events. The problem arises when finer and more detailed discrimination of the causes is under investigation.

Hyde (1927) studied music's effect upon cardiac functioning and blood pressure, and was well aware of the problem of extraneous variables. He considered the fact that physiological changes due to music might be functions of either the type of music, the media of stimuli presentation (vocal, instrumental), the attitudes of the listeners, the variety of listeners or a combination of any or all of these. The three classical selections he chose for his study were: The Pathetique Symphony; The Toreador's Song from the opera Carmen; and Sousa's National Emblem March.

Dependent measures were taken before, immediately after and five to ten minutes after the music ceased. The cardiogram was recorded continuously. He concluded that those people who were fond of classical music as a rule showed a lowering of the physiological functions measured. These same functions remained unchanged for those who were not fond of classical music. He goes on to say that, "The indications are that these selections of music rendered either vocally or instrumentally exert a favorable reflex action on the cardiovascular system, have also a favorable influence upon the muscle tone, working power, digestion secretion and other functions of the body." (p. 32)

Wascho (1933) found that blood pressure and heart rate changes occurred when certain selections were played. Popular and semiclassical music tended to raise pulse and blood pressure, but marches caused the greatest rise in these physiological events. Wascho maintained that melody, rhythm, harmony and a mixture of each elicit particular physiological response patterns.

Lundin summarizes the results of studies done before 1967:

> Music tends to increase changes in breathing, cardiac blood pressure and blood supply. The tendency is more to increase the rate of these physiological processes than other kinds of compositions. (p.197)

"Music sounds the way emotions feel." (Pratt, 1968, p. 28)

"Music can portray feelings, it does not arouse or elicit emotions directly." (Rigg, 1937, p. 225)

> Music in its structure and form resembles the form of emotions and this similarity makes it possible to symbolize them... The tonal structures we call music bear a close logical similarity to the forms of human feeling... (thus) music is a tonal analog of emotive life. (Langer, 1953, p. 10)

The following studies generally agree that music does express certain emotional categories to a diversified population, but they lack statistical evaluation which affects their credibility.

Hevner (1935) reported that when using eight well defined affective states, studies which have utilized all types of music have come up with consistent responses. She goes on to say that investigators must also take into account other factors besides music. Slight differences in response, for example, may be detected between those who are trained in music and those who are not. These differences may be accentuated by employing different experimental methods. The differences in the affective character of the major and minor modes, for example, are greatly enhanced when music training is considered.

Campbell (1942) attempted to discover broad patterns most frequently used by listeners to describe the mood depicted in music. After several months of experimentation she came up with seven categories which she considered to be universal emotions. Forty students from Wells College served as subjects in a study to test the validity and reliability of the universality of the affective categories. The categories were gayety, joy, yearning, sorrow, calm, assertion and tenderness. The definition of each category was read twice. The characteristics of calm, for example, were "pastoral and meditative, inspired by a spirit of serenity and tranquility." (p. 9). A pianist played seven selections before a group of ten subjects, who were then asked to check the term which best suited the piece.

The percentage of agreement between subjects was between fifty-eight and ninety-eight except for the category of yearning which was below fifty percent. Gayety, joy and assertion obtained the highest percentage of agreement, between seventy-two and one hundred.

Campbell concluded that broad fundamental emotions are recognizable in music, but subdivisions or degrees are not. She added the categories of rage, wonder, solemnity, cruelty and eroticism to the list.

Girard (1954) maintains that,

> Music is a natural substitute for states of fantasy, anxiety and excitement. It can be used most successfully to take you out of yourself... listening to music leads to fantasy and this fantasy helps us break away from the reality situation. Music emancipates us from everyday affairs. (p. 103)

Lowe's study (1973) provides an excellent example of Girads's statement. He describes a case history of a twenty-five year old man who needed to overcome two phobias in order to do his job. They were talking to his boss and public speaking. Lowe proceeded to set up two hierarchies which began with easy tasks and proceeded to tasks, which produced greater anxiety, and began to administer a relaxation technique. The procedure did not produce a decrease in the subject's feelings of anxiety.

The subject mentioned his fondness for hard rock music and the excitement it caused inside him. So, the experimenter used the subject's excitement to the music as the inhibitor of his anxiety. Treatment consisted of the subject imagining his hierarchical scenes while he listened to hard rock music. He could augment his excitement to the music by visualizing himself performing at a live concert or watching a group perform. If the hierarchical scene evoked anxiety or his music excitement decreased, he terminated visualizing the scene and returned to the concert scene. He practiced this counter-conditioning procedure for twenty minutes each day.

Within four weeks the subject completed both his hierarchies and mini hierarchies. He was able to function without anxiety in all aspects of his job. Three to six months later he was still functioning without anxiety.

Shatin (1970) explored music's ability to alter moods along an affective continuum between two contrasting emotions such as sad-happy or bored-alert. He assumed that music could direct the movement of moods to a desired goal. He proposed that a person could start at one end of an emotional continuum, and be moved in a stepwise manner along a vector to the opposite, contrasting mood through properly selected music. The music, to begin this process, is chosen on the basis of the iso-principle which means that the music depicts the original mood state of the person. Once the music is matched to the mood, the content and quality of the succeeding musical selections will direct the person from his former mood state to the opposite or contrasting mood.

Shatin used four different affective continua: sad, depressed; gay, happy; restless, agitated; serene, tranquil; bored, listless; and active, alert. Seventy-four male college students served as subjects. They were asked to listen to the music and mark on the rating scale the way they felt emotionally from the beginning to the end of the piece. Four different sets of musical stimuli were played.

The results of the Chi square tests revealed a significant difference for each affective continuum between the music stimulus and the overt mood responses of the subjects.

> Music is an essential and necessary function of man. It influences his behavior and condition and has done so for thousands of years. (Gaston, 1968, p. 24)

THE CATEGORIZATION OF MUSIC

> Stimulative music enhances bodily energy, induces bodily action, stimulates the striped muscles, the emotions and subcortical reactions of man, and is based on such elements as strong rhythms, volume, cacophony, and detached notes...

> Sedative music is of a sustained melodic nature, with strong rhythmic and percussive elements largely lacking. This results in physical sedation, and responses of an intellectual and contemplative nature rather than physical. (Gaston, 1968, p. 143)

There have been many attempts to classify music, especially into stimulative and sedative categories, and most studies have based their classification of these categories upon the criteria set forth by Gaston. Unfortunately, the variance in results and conclusions is almost equal to the number of studies dealing with categorization.

Prueter and Mezzano (1973) presented thirteen musical selections based upon Gaston's definitions to college students in music education classes. They were all non-music majors. After hearing each selection, they were asked to write whether it was stimulative, sedative or neither. Eighty-five percent were in agreement.

The researchers then investigated the effects of stimulative and soothing music upon initial interaction during interviews. The results indicated that soothing background music promoted more interaction than the stimulative music condition or the non-music condition.

Slaughter (1954) also used Gaston's criteria to categorize stimulative and sedative music. He wanted to determine whether the two types of music would affect pupillary reflexes of hospitalized mental patients and non-patients differently. The results indicated that there were significant differences in pupil size during the two musical conditions. Schrift (1954) studied the effect of stimulative and sedative music (as defined by Gaston) upon the GSR responses of people, and found that subjects reacted significantly different to the two types of musical stimulation. Brown (1954) went so far as to prescribe certain types of classical music which would "be of value in moderating headaches due to accumulating tensions." (p. 136)

Zimny and Weidenfeller (1961) obtained significant results in their attempt to categorize music. They selected Dvorak's final movement of the New World Symphony and Bach's Air on the G String to represent stimulative and sedative music respectively. Fifty-nine undergraduate students from Marquette University served as an empirical check on the investigators' judgments. They rated each piece on a five-point calm/exciting scale. The results of the Wilcoxon matched-pairs signed-rank test showed a significant difference between the two pieces of music in the expected calm and exciting directions. The investigators then proceeded to use these two musical pieces in all of their studies dealing with music's effect on physiological responses. They obtained significant differences in all their studies which utilized a variety of physiological dependent variables on different populations.

Hevner (1935) found that slow tempos, smooth flowing rhythms and consonant harmonies were most effective in eliciting responses in the calm, serene group of adjectives. Jacobson (1970) concluded that sedative music decreased anxiety in mental patients during stressful situations. Webster (1973) showed that sedative music was very effective in producing non-arousal states in patients with heart problems.

Ferguson (1935), in a paper prepared for the Music Teachers' National Association, ascertains that there are,

> two kinds of elements basic for all music, motion suggestion and stress suggestion. The first of these, carried by tempo and rhythm, is the tendency toward movement, the impulse to follow the activity of the music at its own speed, and through its accented repetition by means of the direct bodily and motor responses. These responses are set in motion by succession of sounds. This suggestion of motion is one of the most powerful effects of music. It simply compels our attention and absorbs all of our motor activities. It pulls us into line and determines the direction of our forces... The stress suggestion, as the term implies, is a matter of intensities and extensities of response, of tensions and relaxation, of efforts and restraints. Both of these elements are strongly directed toward the bodily sounding board bringing about physiological changes in the pulse, breathing, circulation, and muscle tension. (p. 186)

Dejong and his associates (1973) were in agreement with Ferguson that tempo has an influence on the psychophysiology of the body. They assumed that music does influence heart rate, respiration rate, and skin conductance, and thus chose music with a tempi lower and higher than resting heart rate (adagio, moderato, allegro).

Nine pieces of music representing the Baroque, Romantic and Modern periods were presented to three groups of subjects. The first group consisted of amateur musicians from an undergraduate population. The second group consisted of undergraduates with no musical experience, and the third group consisted of students from Amsterdam Conservatory of Music. The pieces were one minute in duration, with one and a half minutes of silence between each selection. During the first exposure to music, heart rate, respiration rate and skin conductance were being recorded. The electrodes were then removed, and the subjects heard the same pieces a second time. They were asked to rate the pieces on a seven-point scale ranging from very beautiful to very ugly.

Results indicated that there were no differences in heart rate, skin conductance or respiration rate between music rated beautiful and music rated ugly, but there were significant differences found for heart rate, skin conductance and respiration rate during different tempi. The investigators concluded that tempi should always be considered when one researches the influence of music on autonomic parameters.

Taylor (1973) maintained that classification of music cannot be based upon the properties of music alone. He obtained five stimulative and five sedative musical selections by means of a table of random numbers from precategorized musical selections used in sixteen investigations. He found that neither category of music had been accurately classified, nor did it elicit the same responses in both dependent measures.

> The subjects generally did not respond in accordance with the previously assigned stimulative and sedative categorizations of music. Subject responses indicate that the physically stimulative or physically sedative classification of a musical selection may not be determined on the basis of the music alone; such classification should include consideration of the musical background as well as the response of the listener at the time he hears the music. (p. 93)

Biller and his associates (1974) did not obtain significant differences between happy versus sad music or between percussive versus non-percussive accompaniment conditions for subjects as indicated by the Spielberger State/Trait Anxiety Scales to reduce anxiety.

Wilson (1957) is in agreement with Taylor that variables other than musical elements may affect physiological and psychological responses. She classified music as stimulative or sedative based upon Gaston's criteria in order to study the effects on gastric motility. Subjects' responses were in the form of a questionnaire concerning their likes and dislikes of composers, compositions, artists and instruments. Gastric responses were recorded by gastric balloons and tubes, which were swallowed by the subjects. It was found that gastric activity subsided during both musical conditions if a certain selection was unpleasant or distressful. This study does indicate that variables other than musical elements may affect responses.

Other investigators such as Campbell (1942) made an attempt to discover broad patterns of emotions most frequently used by people when listening to music. She maintains that gayety, joy, yearning, sorrow, calm and tenderness are universal emotions.

Forty subjects from Wells College listened to seven musical selections, and were asked to state the term which best suited each piece. They were given definitions for each term.

The results indicated a fifty-five percent or above agreement on all terms except for yearning. Campbell thus concluded that broad fundamental emotions are recognizable in music, and that subdivisions or degrees of these are not.

Capurso (1952) did not obtain significant results in his attempt to categorize moods in music. One thousand seventy-five non-music students listened to one hundred five musical selections, and were asked to place the selections into one of the six mood categories. A fifty-one percent or over agreement was only reached in sixty-one pieces.

Rigg (1937), in an earlier study, investigated the categorization of sad and joyful music. He obtained a seventy-three percent agreement between subjects. Winold (1958) attempted to categorize music according to harmonic tension, and the affect upon the galvanic skin response. Harmonic tension is defined as, "the degree of dissonance in a chordal structure as determined by its component intervals." (p. 188). Six classes of chords were represented. He reported that the greatest response was to class four which was composed of seconds, thirds (major or minor) and sevenths, no tritones. There was no mention if he had obtained significant results.

OTHER VARIABLES WHICH MAY AFFECT MUSICAL RESPONSES

Researchers have addressed themselves to the question of variables other than the elements of music and their effect upon a person's response to musical stimuli. The variation in results and conclusions is just as great as the number of variables that may be involved.

> ... a musical style gives rise to an emotional response. The response is based on experiencing and not merely listening to the selection. The nature of the response of the person 'experiencing' the music will depend on his orientation. (Peretti, 1975, p. 183)

> If one wants to investigate the influence of music on autonomic parameters, it is of prime importance to take the tempo of the music into consideration. (Dejong, 1973, p. 50)

> Musical meanings are determined by constant factors in the music itself. (Brim, 1977, p. 28)

> Music stimulates feelings or thoughts within the listener apart from the preference dimension. (Brim, 1977, p. 32)

Some investigators have found no significant differences in physiological measures and subjective or affective scales across different populations, while others attributed the differences which their results revealed to variables other than the elements of music.

Hevner (1935) discusses a study which tested four hundred fifty students who had diversified musical training. Only slight differences were found in the subjects' expressiveness to music as shown by the adjective group method. Rigg (1937) also found no significant difference between groups with different musical training in their interpretation of the meanings of the musical selections. Seventy-three percent of the subjects could distinguish between sad and joyful music. The interesting phenomenon which became quite apparent is that the percentage of agreement between subjects dropped to forty-one percent when it came to further classification of the music. It seeme that the percentage of subject agreement upon more distinct classifications of music is somewhat related to musical training.

Zimny and Weidenfeller (1962, 1963) obtained similar results in all three studies dealing with sedative and stimulative music's affect upon the GSR of three different populations. According to their findings, neither age nor psychological conditions affected subjects' physiological responses to the music. They did suggest, though, that responses of subjects who are younger than five years of age may be different than those who are older.

Watson (1942) found that neither musical training, age nor intelligence interfered with subjects' ratings of meanings in music. He concluded that musical meanings are determined by constant factors in the music itself.

Payne (1967) did not find any relationship between specific types of music preference and personality factors. Fisher (1951) could not produce a clearcut difference between age, socio-economic status, or sex in music preference.

Knobloch (1964) substantiated his hypothesis that music expresses one or more of eight interpersonal tendencies which can be recognized across different populations.

> I have asked many persons..., what kind of situation does Stravinsky's Rite of Spring might denote. The answers are various: a herd of wild elephants in panic, a Dionysian orgy, mountains being formed by geological processes, dinosaurs in conflict. But there is no suggestion that it might denote a quiet brook or lovers in the moonlight, or the self's tranquility. (p. 259)

One hundred thirty-four high school and college music teachers were asked to rate one hundred five musical selections on a six category mood scale in a study done by Capurso (1952). One thousand seventy-five non-music students then listened to the musical selections which were limited to instrumental music (solo or ensemble), vocal music in foreign languages and a specified length of time to control for extraneous variables. Time was allowed to elapse between the selections to avoid serial effects, and conversations about other areas besides music was encouraged. The students reached over fifty-percent agreement on sixty-one of the one hundred five selections.

Biller, Olson and Breen (1974) evaluated the effects of happy and sad music, and active participation with these musical selections on anxiety. The two selections differed in meter, rhythm and timbre, and were judged by independent observers as either happy or sad.

The experimental design contained six treatment conditions: happy music - percussive accompaniment; no music - accompaniment; no music - no accompaniment; sad music - accompaniment; sad music - no accompaniment. The <u>Spielberger STAI</u> was used to measure anxiety. Sixty volunteer students from an introductory psychology class at California State University served as subjects.

The results of the trait anxiety scale showed no significant difference between accompaniment versus no accompaniment conditions, or between happy music versus no music versus sad music conditions. The state anxiety scale analysis indicated that accompaniment conditions did not differ significantly, and no significant interaction existed between the accompaniment and music conditions. There was, however, a significant difference among the happy, sad and no-music conditions. It can be concluded from this study that participation by the subject did not affect increases or decreases in anxiety, but the music itself caused these changes.

Ries (1969) wanted to determine if general personality variables or response tendencies partially accounted for the differences in people's responses to music. GSR and breathing amplitude were used to measure the physiological reactions. An extroversion-introversion scale was administered to the subjects immediately prior to the experiment. During the treatment the subjects listened to the music, and then rated the selections on a five-point scale ranging from very much like to very much dislike, and on another five-point scale ranging from very much effect to no effect.

The results did not provide conclusive evidence that the personality variable of extroversion-introversion appreciably affected the correlations between the physiological and affective responses to the music.

Henkin's study (1957) dealt with the prediction that the behavior, response patterns to music, which were found in a previous study, involved the esthetic categories of music and listeners' preferences. Henkin preselected compositions as either completely or partially based upon melody, rhythm, harmony or orchestral color. Listener preferences were made with respect to these compositions. A close relationship was found both mathematically and musically between the experimenter's judgments and listener preferences. Henkin thus concluded that listeners depend upon esthetic categories such as melody, rhythm or orchestral color upon which to make affective judgments.

In a previous study, Henkin tried to show that verbal responses of listeners to melodically loaded compositions differ from rhythmically loaded compositions, and that their responses to these musical components are independent and vary systematically from other, non-verbal responses such as the galvanic skin response. The results did not provide substantial evidence, but did indicate that melody was more effective than rhythm in determining subject preferences. He further hypothesized that the melodic factor would be more effective than the rhythmic factor in determining the physiological response. Both assumptions were generally shown to be true as indicated by the results.

The question that Henkin wanted to answer was, does there exist a relationship between the factor pattern (definition of music in terms of musical factors) and physiological response patterns (definition of music in terms of physiological responses to music). He used the same set of compositions in order to relate the physiological responses to melody and rhythm. He chose GSR as the physiological measurement.

An idealized set of curves which could indicate changes in the subjects' resistance to selected auditory musical stimuli was devised. Five musical selections were tested and placed into one of the five esthetic categories; strongly loaded melodic component, strongly loaded melodic component containing a strong rhythmic loading, silence and a strongly loaded rhythmic component with a small melodic loading. The musical selections used were representative of a diversified cross-section of musical style and composition.

The results substantiated the hypotheses,

> Upon examination of the results and the above graphs it is apparent that those recordings previously found to be melodically loaded produced subject responses which tend toward the positive end of the scale, the melodic end; those previously found to be loaded rhythmically produce subject GSRs, which tend toward the negative end of the scale, the rhythmic end. There are statistically significant differences between these two classes of subject response.
>
> The curves show that the slope of the melodic response pattern is greater than that of the rhythmic response pattern. This empirical statement substantiates earlier hypotheses derived from the preliminary studies, and if the compositions chosen were representative ones then the melodic effects are, in general, greater than those produced by rhythm. This may be an important phenomenon of subject response. However, it is also possible that this result is dependent upon the stimuli chosen and may change with the introduction of other stimuli. (p. 119)

This study provides clearcut evidence that esthetic elements of music can be used to organize it, and that these elements can be the basis for musical composition and preference. It also demonstrates that these elements can be identified with consistency by a factoral analysis of verbal responses as well as physiological responses. It is one of very few studies which give good evidence of a positive relationship between verbal reports and physiological responses.

> Because objective relationships have been established by the preceding study we now have evidence for a valuable and powerful technique for analysis of general esthetic categories of music. This has been accomplished by showing that (a) music can be organized in terms of esthetic elements; (b) these elements form the basis for musical composition

> and musical preference; (c) these elements can be consistently identified by a factor analysis of verbal responses; (d) these same elements can be shown by analysis of a physiological response; and (e) one can predict the form of one from a knowledge of the other. Thus these techniques can be used to determine objectively the characteristics of musical sound and also the effects of music on the listener. (p. 120)

Dejong, van Mourik and Schellerkens (1973) presented subjects with nine musical selections which were divided into three groups to represent three different tempi. Heart rate, respiration rate and skin conductance were recorded during the treatment. These scores were compared to subjects' ratings of the music on a scale ranging from very beautiful to very ugly. The subjects were selected from three different populations to represent three distinct approaches to music.

Highly significant differences were found for all the physiological measures during the three different tempi conditions. No differences were found in the physiological measures between music considered to be beautiful and music considered to be ugly. The musical element of tempo had a greater effect on the subjects' physiological response than did preference. The fact that significant results were obtained for all the physiological measures across the tempi conditions indicates that one's orientation to music did not affect the responses.

Brim concluded that the level of dogmatism influences listeners' evaluative responses to music. He also found that defensive attitudes do influence autonomic responses to music which is not related to the degree of emotional versus cognitive content of one's awareness to musical responses. Sensitization was found to be positively correlated with expressed anxiety in responses to music.

> Music appreciation has been described by Machlis as interaction of the physical, emotional and intellectual levels of listening response. These levels of listening response involve sensual reactions to rhythmic energy, imaginary associations conveyed by music, and esthetic evaluations of musical design and performance. The understanding of music appreciation has been impeded by the complexity of these factors. (Landreth, 1974, p. 4)

Landreth and Landreth (1974) investigated the effect learning and repetitive exposure to music had on subjects' physiological response to the first movement of Beethoven's fifth symphony. Heart rates of twenty-two subjects from a college level music appreciation class were recorded before, during and after the experimental treatment. The results indicated that heart rate response to music was found to be associated with the presence or absence of learning and repetitive exposure.

Peretti (1972) found significant differences in the emotional responses between music and non-music majors. In another study (1974), he and Swenson substantiated the hypotheses that music can influence anxiety, that differences in response to music are found between music and non-music majors, and between males and females. Dibner (1958) maintained that responses to music are based upon a person's orientation to music and not on the fact that one merely listens to music.

Breger (1970) found that men and women rated music and complex sounds similarly in pleasantness. It has been shown that men score lower on musical aptitude tests, and generally show less interest in esthetic appreciation for music than women. If this is true, one would suspect that a sex difference in emotional responsiveness to music may exist. Hart and Cogan (1973) examined this supposition. Sixty non-music majors enrolled in a music literature course served as subjects. They had to indicate how familiar they were to classsical music, and if the musical selections they heard were stimulating, triumphant or joyous to them.

The Chi square analysis revealed that positive responses to the music were functions of sex and familiarity.

> Men reported less familiarity with classical music than did women, and women reported more positive responses to music than did men. However, men with low familiarity with music reported more positive responses than men with high familiarity with music while women with low familiarity with music reported fewer positive responses than women with high familiarity with music. The data suggest that while sex and familiarity seem to affect positive responses to music, there may also be an interaction between sex and familiarity. (p. 1170)

MUSIC AND EMOTIONS

> In the language of the emotions, music is a medium that will bring us into closer fellowship with one another. Music speaks to the heart. It comes from the heart. Music knows no race, creed or color. It is the universal language of mankind.
>
> Music has a beneficient effect upon the physical, mental and spiritual life of a child. It has a high value as a socializing force and as an emotional outlet. (Saetveit, 1961, p. 7)
>
> Music is derived from the tender emotions. (Gaston, 1968, p. 24)

What is this thing called emotion upon which music influences and from which music is derived? Scientists have been grappling with this phenomenon since Darwin, but people have understood its meaning since the time of the Greeks.

In his book, Brain and Behavior, Brown (1976) provides a brief overview on the history of attempts to define emotions. Darwin (1872) adhered to the theory that facial expressions and body postures were indicators of emotional states. Dogs, for example, bare their teeth when they are hostile, and wag their tails when they are friendly. William James (1894) believed that emotions originated from physiological components such as internal organ changes in stomach contraction, heart beat and respiration which are mediated by the autonomic nervous system. These changes occur as a result of overt behavior. "We feel sorry because we cry... not that we cry...because we are sorry..." Lange (1922) arrived at the same conclusion as did James, but he only paid attention to changes in blood circulation.

> We owe all the emotional side of our mental life, our joys and sorrows, our happy and unhappy hours, to our vasomotor system. If the impressions which fall upon our senses did not possess the power of stimulating it, we would wander through life unsympathetic and passionless, all impressions of the outer world would only enrich our experience, increase our knowledge, but would arouse neither joy nor anger, would give us neither care nor fear. (p. 169)

Cannon (1927) was in disagreement with both James and Lange. He contended that a complete separation of viscera from the central nervous system does not alter emotion, and that the same changes in the viscera occur during different and non-emotional states. He further challenged Lange's and James' beliefs by showing that artificial induction of the visceral changes which are involved with strong emotions did not produce those emotions.

Cannon provided an alternate theory concerning the origins of emotional arousal. He postulated that the thalamus was the integrating center for emotion.

> Head (1920) had described several cases of unilateral thalamic lesions in which the patients reacted excessively to very slight stimulation. If the stimulus was mildly disagreeable, such as a pin prick or chill, the patient manifested extreme dis-

> comfort. If the stimulus was mildly agreeable, such as music or warmth, the patient manifested extreme delight, often to the point where the delight was itself unbearable. It felt so good the patient could not stand it! From these observations, Head concluded that the lesions released the thalamus from cortical inhibition. (p. 169)

Bard (1939) provided the experimental evidence to support Cannon's conceptions. He demonstrated that with the removal of the hypothalamus from a cat only certain components of a rage response could be obtained.

> An intact hypothalamus is necessary for integrated emotional behavior... fully developed rage, reflected by such behavior as hissing, scratching, biting, and attack, could be elicited by pinching a cat's tail, even with all brain tissue above the hypothalamus surgically removed. Once the hypothalamus itself was abated, however, only certain components of the rage response could be obtained. Specifically, these were the components mediated by the autonomic nervous system, which involved such behavior as snarling, spitting, tail lashing, piloerection, increased blood pressure and heart rate, and sweating. Bard called this response symdrome sham rage, not to imply that the rage was false in any sense, but rather to emphasize that no subjective aspects were involved. The rage behavior was not part of a fully integrated pattern of directed attack. The animal was angry, but not angry at anything.

Papez (1937) investigated the neural aspects of emotion and noticed that a relationship existed between lesions in subcortical structures of the brain and changes in emotions.

> ...the essential lesions of rabies, or hydrophobia, have their site of predilection in the hippocampus

> and the cerebellum and since the disease is characterized by intense emotional convulsive and paralytic symptoms, there seems to be offered an important clue to the probable location of the emotive mechanism. The prodromal symptoms - insomnia, irritability and restlessness - usher in the stage of excitement and profound emotional perturbation. There is extreme hyperesthesia to all forms of stimuli, such as light and sound, and every stimulus situation provokes great apprehensiveness and paroxysms of fear. The patient presents the appearance of intense fright and of mingled terror and rage. (p. 173)

Kluver and Bucy (1937) agreed with Papez and provided further evidence by demonstrating that emotional changes took place in monkeys who had lesions on subcortical areas of the temporal lobes. Papez combined both approaches to describe the pathway stimuli travel which leads to emotional changes.

> In this circuit, sensory impulses, such as sound and sight, travel to the thalamus and hypothalamus which act as relay stations and regulators. Here, the impulses are joined by those from the cortex via the hippocampus. The cortical contribution stimulates the hypothalamus with what Papez calls "psychic activity" (such as thought and imagination). Then the confluent impulses stream into the cingulate gyrus, which gives rise to the experience known as emotion. (p. 174)

Further research in this area has discovered that sensory (sight, sound, touch, smell) activity and activity in various parts of the brain must use the same activating pathway. Such a pathway has been labeled the reticular formation.

> The reticular formation awakens the brain to consciousness and keeps it alert; it directs the traffic of messages in the nervous system; it monitors the myriad of stimuli that beat upon the senses, accepting what one needs to perceive and rejecting what is irrelevant; it tempers and refines muscular activity and bodily movements...it contributes in an important way to the highest neural processes - the focusing of attention, introspection and doubtless all forms of reasoning. So sensations can be considered to be conscious, even though a person is not aware of them. (p.175)

> The cortex can stimulate the reticular formation which in turn can produce either further cortical activity or exert an inhibiting influence on it ...ideas or thoughts can produce autonomic changes and alterations of muscular tone by downward discharge from the cortex to reticular formation and then to the autonomic motor and sensory centers. (French, 1957, p. 62)

Most scientists today agree that the physiological components which are related to emotion are oriented in the central nervous system, which includes the autonomic functions. Sternbach (1967) discusses central nervous system activity and autonomic functioning. The central nervous system (CNS) includes the brain, brain stem and spinal cord. The peripheral nervous system (PNS) contains the nerve fibers which leave and enter the brain stem and spinal cord to and from the rest of the body.

Autonomic functions which are commonly used as measures of peripheral effects and emotional changes are GSR, heart rate, blood pressure, respiration and gastric motility. Direct CNS activity is measured by the electroencephlogram or peripherally by the electromyogram. Based upon the review of the literature which discussed the psychophysiology of emotion, this researcher chose GSR, respiration and EMG measurements as the dependent variables in this study. The GSR and respiration recordings represented autonomic activity and the EMG recording represented peripheral CNS activity. It is the intent of this author to demonstrate that music effects the entire human physiological system.

THE PSYCHOPHYSIOLOGY OF TENSION AND RELAXATION

> Individuals under stress frequently report increases in heart rate, sweating, breathing and other autonomic physiological responses as well as feelings of anxiety. (Brown, 1976, p. 75)

What is stress or tension? Most researchers define it in terms of psychophysiological changes in the body. Increases in the various physiological structures activities indicate the presence of tension. Langbien (1969) describes tension as "an inherent part of daily decision making whether related to a profession or to interpersonal relationships. The stressful components, anxiety and emotion, are associated with one component - tension." (p. 175). Jacobson (1967) defines tension in terms of muscular contraction, whether grossly visible or microscopic. M. Langbien (1969) contends that tensions which originate in the muscles are influenced by the reticular formation in the brain.

What are the differences between tension, excitation, arousal or effort? According to those who have examined these terms, increased psychophysiological functioning is an indicator for all of them. The examination of each condition is beyond the scope of this review, however, such consideration is imperative. Different schools of thought use different classification systems as well as different definitions of the terms which lead to different forms of measurement and analysis. Strict behaviorists, for example, disallow verbal reports of anxiety and rely on physiological indicators. Cognitive psychologists, on the other hand, accept self reports as relevant indicators of internal emotional states and dismiss physiological measures.

Many investigators have used physiological measures to indicate the presence of relaxation. Generally a decrease in the physiological activities signified a relaxed state.

> Physiological studies of Yogis, Zen Masters and students of transcendental meditation indicate that proficiency in meditation is characterized by a predominance of alpha waves plus such changes as a lowered respiratory rate... Independent studies

> in India and Japan agree that there are physiological patterns strongly related to deep meditation, especially EMG and EEG. (Duffy, 1930, p. 32)

> Respiration loses the slight irregulatities, the pulse rate may decline to normal, the knee-jerk diminishes or disappears along with the pharyngeal and flexion reflexes and nervous start, the esophagus...relaxes in all its parts, while mental and emotional activity dwindle or disappear for brief periods. (Ornstein, 1976, p. 76)

Davidson and Schwartz (1976), in Mostofsky's book, Behavior Control and Modification of Physiological Activity, provide an excellent review on relaxation and related components. They maintain that three components must be included when defining or discussing relaxation. They are the somatic, cognitive and attentional components. The attentional and cognitive components have been greatly neglected by researchers because they assumed that all relaxation techniques are the same. Considerations should be taken into account for the role of imagery and cognition in voluntary control of autonomic processes, or self-generation of specific sensory and cognitive events in specificity and patterning of biological processes. Davidson and Schwartz contend that in fact "relaxation procedures do differ in their effectiveness, depending upon the mode in which tension or anxiety of the person is experienced." (p. 30)

Jacobson (1938) held a firm position that the generation of thoughts and feelings cannot be realized if the bodily parts involved are relaxed. Such a position has been challenged by others who have performed studies on animals which have shown that an animal can learn to avoid a conditioned stimulus which has been paired with shock under complete curarization. Thus, it has been concluded from these feelings and others that relaxation should be defined as both reduced peripheral muscle activity and reduced efferent motor commands.

> Under normal circumstances, when an individual engages in a technique to relax himself, he inhibits efferent motor commands, which, in turn, reduces activity in the musculature. Davidson (1966) addressed this issue and concluded that "in a person relaxing his own musculature, the efferent activity from the cortex would be quite different from that during muscle contraction, i.e., it would entail inhibitory efferents which would block activity in the actual efferents that innervate the muscles. (p. 402)

Davidson and Schwartz go on to say that another variable besides the cognitive/somatic difference warrants attention. They termed this factor as the "activity-passivity continuum. (p. 412)." They have found that some relaxation techniques require self-generation of behavior, while others only require self-regulation of attention to occuring biological events such as respiration. A classifications scheme has been devised to categorize the predominantly used relaxation techniques based upon the active/passive and cognitive/ somatic variables. According to the scheme Jacobson's progressive relaxation technique, the most extensively used procedure, involves primarily the somatic system, and utilizes both active and passive components. It entails a systematic focus of attention on different music groups in the body. "The major emphasis of this technique is on the self-generation, somatic behavior and self-regulation of attention to somatic events. The tensing of each major muscle group increases the aliency of somatic cues, enabling subjects to passively attend to specific body parts, thus facilitating complete somatic relaxation." (p. 411)

Experimental research on relaxation has not provided consistent data due to various factors. The assumption on the part of the investigators that all relaxation techniques are essentially the same has prohibited any systematic exploration of the area. The lack of knowledge and understanding of both independent (relaxation techniques) and dependent (physiological processes) variables also adds to the problem.

Several authors have commented that cognitive and somatic distinctions may also exist in anxiety, thus different relaxation techniques will be more effective in reducing the different anxiety modes (cognitive vs. somatic). "An extreme case of cognitive-low somatic anxiety occurs when an individual is somatically tired and lying down, but can't fall asleep because his mind is 'racing.' Assuming that this individual's body is relatively relaxed, it is clear that a cognitive/somatic anxiety ratio would yield a result greater than 1. In this situation, the most efficient type of relaxation would be a cognitive procedure which would reduce unwanted cognitive activity." (p. 417)

According to this model soothing music would be most effective for people who have high cognitive, low somatic anxiety. This author contends that music will also be an effective relaxer for people who have high somatic anxiety. As shown earlier in this paper, the physical elements of music do influence physiological processes without interaction from the cognitive component. She also assumes that stimulative music will produce both cognitive and somatic excitement. These two suppositions are examined in the present study.

The model provides a very good explanation of the relaxation and tension phenomena. It not only incorporates the mind/body relationship, but also describes why certain people engage in athletics to relax while others find it more relaxing to read. Many investigators claim that people do not know how to relax, but maybe they do. However, there may be one area in which people need to become more aware and that is recognizing tension in the muscles. Jacobson asserted that people are not aware of the tensing or releasing of their musculature. His technique teaches people to feel the differences, and has proven to be highly successful.

For the most part the literature does provide enough evidence that physiological indicators are valid means for measuring relaxation and/or tension in people. This researcher chose GSR, EMG and respiration measurements as dependent variables in her study to detect the presence of tension and/or relaxation as results of the music stimulus being heard.

THE GALVANIC SKIN RESPONSE (GSR) AS AN INDICATOR OF TENSION AND/OR RELAXATION

The literature provides enough evidence to suggest that the galvanic skin response is an acceptable dependent variable to use in studies. The problem arises in the fact that it is a complex phenomenon, and has not been treated as such.

As mentioned earlier, one major cause for the wide range of disagreement and discrepancies in the studies is the naivety on the part of the investigators concerning the electrodermal phenomenon and its measurements. Nomenclature is probably one of the biggest problems. In several studies the authors state that the different terms to define electrodermal activity are interchangeable. This, however, is not the case.

> It is particularly distressing that many different names and symbols are used to describe these two phenomena. Standardization of symbols and terminology is still the subject of considerable debate, even though the phenomena have been investigated for almost a century.
>
> There is no standardization for the term used to describe the conductive and voltaic properties of the skin. Terms employing 'reflex' and 'response' such as galvanic skin reflex or response (GSR), psychogalvanic reflex or response (PGR), skin potential reflex or response (SPR), skin resistance (SR), skin resistance level (SRL), skin resistance response (SRR), skin conductance (SC), skin conductance level (SCL), skin conductance response (SCR), and many others are used, often imprecisely. (Cromwell, 1973, p. 27)

In an attempt to standardize terms, Venables and Martin (1967) have advocated the use of the following description of electrodermal activity.

SRR - skin resistance response
SRL - skin resistance level
SCR - skin conductance response
SCL - skin conductance level
SPR - skin potential response
SPL - skin potential level
(Geddes, 1968, p. 490)

"SRL and SPL refer to basal levels of resistance, whereas SRR and SPR refer to changes in these levels which occur with characteristic waveforms as a result of stimulation." (Refer to Figure I)

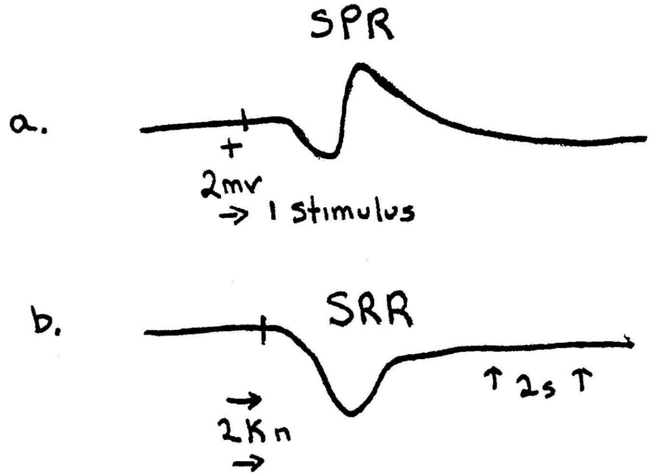


Figure I. (a) representation of a SPR response waveform
(b) representation of a SRR response waveform
(Redrawn from A. Cleary, Instrumentation of Psychology, N.Y.: John Wiley and Sons, 1977)

"Both phenomena (resistance and conductance) are thought to be due to the activity of the eccrine sweat glands, the parts of the body having the highest concentration of sweat glands (e.g., palms and soles) showing lowest SRL and most frequent SRR.

The SRR was at one time thought to be due to the emergence of sweat causing a moistening of the skin, but it has been shown that the response occurs before the emergence of the sweat, and depends rather on the presecretory activity of the semipermeable membrane in the sweat glands. (Cleary, 1977, p. 198)

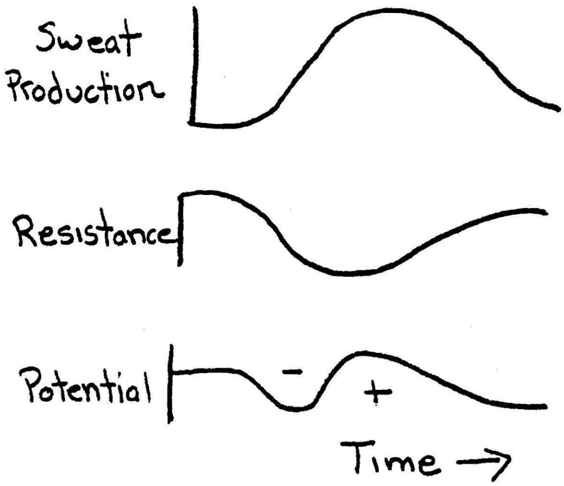


Figure II. Representation of the simultaneous recordings of sweat production, resistance and skin potential responses during a strong emotion-provoking stimulus. (Redrawn from A. Cleary, Instrumentation of Psychology, N.Y.: John Wiley and Sons, 1977)

Measurement of these phenomena is another problem area which adds to the inconsistencies and discrepancies in experimental results. The factors in measurement which require special attention are the electrodes, electrolytes and electrode placements. Any of these factors can greatly affect the outcome of the results in a study.

In conjunction with these two types of measurements, electrode placement must be considered. There are two types of electrode recording, bipolar and unipolar. Bipolar recording involves the placement of two electrodes on active sites, or sites with a high concentration of sweat glands. In unipolar recording one electrode is placed on an active site and the other is placed on an inactive site, or an area with very little or no sweat glands present. The electrodes for either recording should be placed on the same side of the body to avoid a large current to pass through the subject's heart and to eliminate cardio activity artefacts.

Venables and Christe provide several reasons why bipolar placement is more advantageous than unipolar when measuring skin conductance.

> There are several reasons for employing bipolar placement: (a) (as explained in Section III.B.3 and 5) bipolar placement minimizes interference of SC measurement by SP; (b) the use of two active sites means that changes in conductance are twice as large as with a single site; (c) there is no need for abrasion to achieve an inactive site, (d) with a constant voltage method of measurement, the voltage is divided approximately equally across the two sites and the figure for a threshold for nonlinearity of .5 V across a single site recommended by Edelbert (1967) can therefore be doubled, thus allowing the use of a higher V_n with consequent further improvement and size of signal and freedom from endosomatic contamination. (Prokasy, 1973, p. 67)

They go on to say that bipolar recording may be more advantageous, but unipolar placement may be more convenient especially if the subject has to be active. In bipolar recording the hand movement artefact would be doubled by having the two electrodes on the hands.

If an investigator is measuring skin potential, unipolar placement is imperative, otherwise the two skin potentials will tend to cancel each other out. To obtain a true zero potential reference point, recording of activity at an active site must be measured against recording the chances of error measurement from fifty percent to ten percent. This researcher employed unipolar recording in her study to measure skin potential.

> The most common method of dealing with this situation is to oppose the SPL with an equal and opposite calibrated suppression or backing off voltage. The zero reading of the recording pen is then at the value of this backing-off voltage and the value of SPR, now recorded with an adequate gain, is measured as deviation from this voltage level. If the backing off is absolutely accurate and SPL is stable, then no current can flow in the circuit and the input resistance of the amplifier is effectively infinite. (Prokasy, 1973, p. 67)

The type of electrode and the electrolyte used are two other factors which can alter or distort electrodermal measurement.

The silver/silver chloride electrodes are preferred by many psychophysiologists. There are three types of silver/silver chloride electrodes, the disk, the sponge, and the pellet. The disk type is most commonly used and is the type utilized in this study.

The electrolyte is the conductive medium in the interface between the electrode and skin surface. When dealing with skin potential measurement, the electrolyte is partially involved with the skin potential's activation. Sodium chloride or potassium chloride electrolytes are mainly used because they are compatible with the human biological system, and their concentration levels do not greatly change when they come in contact with other biological solutions such as perspiration.

Most authorities agree that sodium chloride electrolytes are compatible with silver/silver chloride electrodes, and many psychophysiologists use this combination quite frequently. Such a combination was used in this study.

Prokasy (1973) mentions other factors which should be taken into account when an investigator uses electrodermal activity as a dependent variable. The subjects being tested and the environment should be considered. Subjects' age, sex and race are a few of the pertinent factors which can influence electrodermal measurement. Prokasy cites many studies which have examined the effects age and sex have on electrodermal activity. The general consensus seems to be, "... like the effects of age, the sex variable is complex, implicating biosocial aspects of experimenter-subject interaction, hormonal and central nervous system relationships, and the modulating effect of the endocrine system on accrine sweat glands." (p. 201)

Environmental considerations such as temperature, humidity and length of exposure to the electrodes must be attended to since these factors could have direct effects on electrodermal activity. The experimenter's behavior and interaction with the subjects, as well as the time of day the experiment takes place, are other variables that may influence physiological reactions.

Most experts in this area seem to agree that the galvanic skin response is a valid measure of emotional arousal, but investigators need to thoroughly understand the terminology and mechanisms involved to assure accurate recording and analysis.

Studies which utilized the electrodermal phenomenon as a dependent variable when examining the effect of music or sound stimuli on subjects made the assumption that the galvanic skin response was a reliable, valid measure of the presence or absence of emotional arousal.

Zimny and Wiedenfeller (1962, 1963) performed three studies examining the effects of music upon GSR of three different populations. The experimental procedure and materials were the same for each study. The only variable that changed was the subject population which consisted of college students for one experiment, depressives and schizophrenics for another, and normal children (ages 5-12) for the third.

The general response to the music by all groups was similar. Exciting music produced positive GSR values which indicates a decrease in electrical skin resistance and an increase in emotional excitement. Sedative music produced negative GSR values which indicates an increase in electrical skin resistance and a decrease in emotional excitement. Specific differences were found between each group, but the general effect seems to be quite extensive. Such results provide significant evidence to the validity of GSR as a measurement of emotional response.

Unfortunately, this is not always the case. Other studies have come up with confusing or contradictory results. Phares (1934) did not find any relationship between GSR and verbal reports, or that GSR was a useful measure when examining musical appreciation. Ries (1969) concluded that GSR was not related to either affective or effective reactions to music. However, when subjects were categorized according to their extroversion-introversion scores, a GSR pattern was evident. In the Traxel and Wrede (1959) study, GSR reactions were present, but no correlation existed between them and subjective reports. Wilson and Aiken (1977) found that GSR responses failed to distinguish between the two intensity levels of specific hard rock musical selections and between the selections themselves. However, the mean GSR responses were recorded in the negative direction, which indicates emotional arousal.

Other studies make the basic assumption that GSR responses are good indicators of emotional arousal. Peretti and Swenson (1974) investigated music's effect on anxiety as measured by skin responses. If there was a decrease in the GSR response this meant a decrease in anxiety. Schrift (1954) concluded that GSR was a reliable measurement of bodily responses to sensory stimuli.

MUSCLE POTENTIAL (EMG) AS AN INDICATOR OF THE PRESENCE OF TENSION AND/OR RELAXATION

> ... we have in this technique of the measurement of muscular tensions a very promising approach to a study of individual differences to emotional tendencies... It seems entirely consistent with psychological fact and theory to conclude that individual differences in tension of the skeletal muscles are associated with differences in emotional tendencies. (Duffy, 1930, p. 158)

This quotation reflects the views of many researchers who have investigated muscular tension and emotional arousal.

The number of studies which deal with muscle potential and music are few, but they provide significant data to support the position stated by Duffy. They make the valid assumption that muscular tension is a good indicator of emotional reactions.

In his article, Diserens (1923) discusses the earliest documented studies which dealt with the influence of auditory stimuli on muscular energy. In 1885 Fere and Lonele found that muscular energy does increase with the intensity and frequency of tuning forks. In 1887 Lombard found that the knee jerk varies directly with the intensity of the auditory stimulus. Tarchanoff (1888) found that music can either increase or decrease the force in his hand as measured by an ergograph.

A later study done by Bruno (1971) on intensity levels and muscular tension produced the same results found almost 100 years earlier. He wanted to investigate the relationship of perceived tension of loudness to the magnitude of sustained muscular contractions, and to validate these findings through a cross-modality matching of tension to loudness.

The EMG electrodes were placed on the muscles which adduct and abduct the little finger of the right hand which fulfilled two pertinent conditions. The EMG is taken from a muscle which is the only one involved in executing a particular movement and the contraction is isometric. Thus it can be assumed that the area under the electrodes is linearly related to the force of the voluntary muscular contraction.

The subjects heard a 70 dB modulus which was assigned the value of 10. They then heard a comparison stimulus picked randomly from a series of 11 tone intensities. They were asked to select a number which stood in ratio to 10 as a comparison ratio to the loudness of the modulus. There were 11 trials in all.

The results produced exponential slopes which were smaller than the predicted slopes, but which adequately fitted the power functions. The subjects heard the same 11 tone intensities in random order once more, and were asked to press against the scaling bar until they felt that the tension produced matched the intensity of the tone.

The results suggested that perceived muscular tension does follow a power law.

> If perceived tension is a power function of EMG magnitude with an exponent t and if subjective loudness is also related to its physical stimulus by a power function but with an exponent 1... then when tension values are equated to values of loudness at a number of levels during the matching procedure, the prediction is that EMG magnitude will be related to tone intensity by a power function whose exponent is the ratio of the 2 original exponents... The matching function should be a straight line whose slope is 1/t. The slopes are indeed this but smaller than predicted. (p. 60)

Duffy (1932) studied the use of muscle tension as an indicator of emotional tendencies and found that differences in muscular tension cannot be explained by differences in muscular strength. It was also noted that habituation to a particular situation tends to decrease emotional tension. Subjects with a higher emotional tension score tended to press the reaction-key with greater force. These same people rated lower on stability and degree of adjustment to the environment.

Thus it is safe to conclude that differences in tension of skeletal muscles are associated with differences in emotional tendencies. Further clarification of emotional tendencies as well as excitation and aroused states is warranted.

Epstein (1974) and his associates used music and biofeedback on a thirty-nine year old male subject who had been experiencing tension headaches for at least sixteen years. The music presentation was contingent upon low EMG levels of the frontalis muscle. An A-B-A-B withdrawal design, with A as the baseline condition and B as the feedback phase was used for evaluation. Each phase consisted of six sessions which were conducted in three-day periods. Self-reports of headache occurances were collected during all phases of the study.

The subject was habituated to the equipment one week before the experiment began. His favorite music was tape recorded for presentation as feedback during this time. Each session lasted twenty minutes, ten minutes for adaptation, and ten minutes for recording. The subject received the following instructions, "The music will be played when you have low levels of tension on your forehead. Try and keep the music on." (p. 60). When EMG responses were kept below the criterion level, music was provided. Termination of the music occurred when the response went above the criterion level. A return to below-criterion level resulted in resumption of the music.

During baseline high EMG activity was recorded, which decreased during the first feedback phase. A return to baseline resulted in an increase of EMG activity which did decrease again during the final feedback phase. A statistical analysis of the results indicated a significant difference between baseline and feedback conditions. The self-reports were consistent with laboratory EMG changes, but no correlation was performed.

Studies dealing with relaxation training and/or the induction of anxiety have also been based upon the assumption that muscular tension indicates arousal. They provide more evidence that a relationship does exist between tension and muscular activity, and strongly support the view that muscular activity and thought processes are interrelated and play a major role in tension and relaxation phenomena.

Chaney (1970) found that the subjects who were capable of controlling neuromuscular tension could reduce tension during the performance of specific skills significantly greater than subjects who did not learn neuromuscular relaxation. She also found that the relaxation training group scored higher on the mental test under induced tension than did the placebo or exercise group.

Basmajian (1957) showed that people can voluntarily control neuromuscular tension through learning to relax. Grim (1971), in an attempt to investigate whether self-induced muscular contraction and noise could increase anxiety, obtained results which indicated this to be the case when the anxiety level was initially low. When it was initially high, muscular contraction and noise decreased the level. Paul (1969) utilized the EMG as a dependent variable in his study which compared the effectiveness of hypnotic suggestion and the abbreviated version of Jacobson's relaxation training technique. Effectiveness of the two procedures was determined by the reduction levels of physiological arousal, in this case EMG, and subjective distress. He found that the abbreviated relaxation training produced lower physiological and subjective distress levels, and thus concluded that this was a more effective technique than hypnotic suggestion.

Jacobson (1968) describes relaxation as, "relaxation is the minimum of tension in the muscles requisite for an act." (p. 5). His entire progressive relaxation technique is based upon the contracting and releasing of muscles.

Cratty (1964) defined tension as an, "... overt muscular contraction caused by emotional state or increased efforts." (p. 23). Lyons and Lufkin (1967) demonstrated that subjects were able to lower muscle tension significantly through EMG bio-feedback as well as improved their ability to control neuromuscular tension.

> Our evidence suggest that at the moment of occurrence of any form of mental activity, the physiological circuits include not only associative, afferent and efferent brain neurons, axons and dendrites, but also afferent and efferent nerve activities and peripheral activities chiefly in the form of muscle contractions. (Jacobson, 1964, p. 40)

Jacobson (1967) found that mental activity such as imagination caused a measureable increase in contraction of the specified muscle. If a person, for example, was imagining himself swinging a tennis racket, those muscles involved in such an action would be stimulated. He went on to say that during a particular mental activity the muscles of a person trained to relax remained inactive, except for those muscles specifically associated with the eyes and mouth. He also discovered that relaxation of specific muscle contractions normally present during a particular mental activity can bring about a disappearance of that activity.

Other investigators such as Mogoun and Moruzzi provide further evidence to substantiate the presence of a relationship.

What does EMG measure? EMG or electromyography is the study of electrical activity in muscles. It is not a direct measure of muscular contraction or tension. It measures the action potential of a muscle.

> The amount of muscular activity in the body as a whole is influenced by emotional and motivational factors. Measures of activity in individual muscles or muscle groups can be of value in the study of tracking behavior and other skilled tasks. (Cleary, 1977, p. 213)

> Like neurons, skeletal muscle fibers generate action potentials when excited by motor neurons via the motor end plates. They do not, however, transmit the action potentials to any other muscle fibers or to any neurons. The action potential of an individual muscle fiber is of about the same magnitude as that of a neuron and is not necessarily related to the strength of contraction of the fiber. The measurement of these action potentials, either directly from the muscle or from the surface of the body, constitutes the electromyogram.

> Although action potentials from individual muscle fibers can be recorded under special conditions, it is the electrical activity of the entire muscle that is of primary interest. In this case, the signal is a summation of all the action potentials within the range of the electrodes, each weighted by its distance from the electrodes. Since the overall strength of muscular contraction depends

> on the number of fibers energized and the time of contraction, there is a correlation between the overall amount of EMG activity for the whole muscle and the strength of muscular contraction. (Cromwell, 1973, p. 248)

The normal method employed in human subject attachment to electrodes is bipolar recording. The muscle most commonly used for electrode placement for EMG when examining tension and/or relaxation are those which are easily influenced by stress or tension, such as the frontalis, muscles of the forearms or thighs, the trapezius or the masseter muscle. The frontalis is used quite often, because investigators assume that when it is in a state of relaxation then all the other muscles are as well. This study employed bipolar recording of the frontalis muscle.

> We examined whether some muscles are better than others for promoting general bodily relaxation and low arousal. Since preliminary work had suggested that when subjects reach very low EMG levels on the frontalis, then other muscles, especially of the upper body, are also likely to be relaxed, we decided to compare a forehead (frontalis) feedback group with a forearm (extensor) feedback group. These results confirmed our hypothesis regarding superiority of the frontalis muscle over the forearm muscle for feedback training purposes. The data showed that only the frontalis feedback subjects decreased on both frontalis and forearm EMG levels. In other words, when the frontalis is low, the forearm is also likely to be low. But the reverse relationship does not hold. (Motofsky, 1976, p. 379)

Respiration rate is another physiological phenomenon which has been used as a dependent variable to measure tension and/or relaxation in people.

> Respiration, also a somatic measure, has been frequently employed in relaxation studies. Aspects of the respiratory cycle appear to vary with a subject's overall level of arousal. It can be assumed that the variability of respiratory minute volume (RVM) decreases if emotional stimuli are suppressed or if the subjects' attention is diverted from them. (Motofsky, 1976, p. 406)

In their study dealing with the comparison of two forms of relaxation, Burns and Ascough (1971) assumed that respiration and cardiac rates were reliable physiological indicators of aroused or relaxed states in subjects. They compared general relaxation suggestion technique to hypnoidal induction during induced anxiety to see which procedure was more effective. No significant differences were found in the respiration rates of subjects between the two procedures, but the cardiac rate under hypnoidal treatment was significantly greater than under general relaxation suggestion. They thus concluded that general relaxation technique was more effective than hypnoidal suggestion to reduce tension.

Grim (1971) wanted to investigate the effectiveness of respiration feedback as a technique to reduce anxiety. The MAACL Scales for anxiety (A), depression (D), and hostility

(H) were used as the dependent variables, and were administered immediately before and after the experiment. The four treatment conditions were: general relaxation with respiration feedback, general relaxation with no feedback, relaxation of the masseter muscle only and sustained tensing of the masseter muscle. During the respiration feedback condition subjects listened to their amplified breath sounds. The comparison group in the general relaxation condition listened to amplified background noise. In both conditions subjects were told to relax their entire bodies by letting go of all muscle tension. The jaw-tense condition required subjects to hold their teeth clenched, but at a comfortable level which would be maintained throughout the session. Subjects in the jaw-relax condition practiced alternate tensing and relaxing until they could perceive the difference and continued to relax for the rest of the session.

The results indicated that no significant differences between groups were obtained for the D and H scales of the MAACL. Respiration feedback, however, reduced anxiety as indicated by the A scale for all subjects, except for those who had initially low A scale pre-test scores. A slight positive correlation between respiration rate and the MAACL scales was evident at the beginning of the experiment, and increased considerably at the end.

Several studies investigating music and its effect on physiological processes as indicators of emotional arousal have employed a respiration rate as a dependent variable.

Ries (1969) presented musical selections to subjects while recording GSR and breathing amplitude. The subjects were required to rate the musical stimuli in terms of their affective and effective reactions to music.

GSR was not related to affective reactions to the music, but was related to the effective element when the personality variable of extroversion and introversion was considered. There was a significant correlation between breathing amplitude and both affective and effective reactions to the music. Ries concluded that this physiological measure was very appropriate to use in research which examines emotional reactions to music through physiological measures.

> The relationship between the modal breathing amplitude and affective responses to the musical stimuli was found to be highly significant ($r = .48$, $df = 132$, $p < .01$) and indicates that the more a S reports liking a musical selection, the deeper his breathing tends to become. This trend was apparent in 17 of the 19 Ss. The relationship between the modal breathing amplitude and effective responses was also significant ($r = .31$, $df = 132$, $p < .01$) and indicates that the more a S reports he is being affected by the music, the deeper his breathing becomes. It may be noted that this correlation is of essentially the same magnitude as was found with the GSR; but it seems to indicate a more universal tendency, that is, categorizing the Ss in terms of their extroversion-introversion scores did not appreciably affect the correlations. (p. 62)

The purpose of the Wilson and Aiken Study (1971) was to examine the physiological responses of GSR, heart rate and breathing rate, and subjective response measured by the Gough Adjective Check List to hard rock music to see if a generalization across music types exist, and to discover if rock music causes any unique responses from the listeners. In general, the physiological measures produced similar patterns as found in studies using classical musical selections. The subjective measures, in contrast, did differentiate between selections.

STATEMENT OF THE PROBLEM

1. Ho Precategorized sedative and stimulative music will not cause a change in the GSR response.

   Hi Precategorized sedative and stimulative music will cause a change in GSR response.

2. Ho Precategorized sedative and stimulative music will not cause a change in respiration rate.

   Hi Precategorized sedative and stimulative music will cause a change in respiration rate.

3. Ho Precategorized sedative and stimulative music will not cause a change in EMG.

   Hi Precategorized sedative and stimulative music will cause a change in EMG.

4. Ho The three physiological measures will indicate relaxation or stimulation to the same degrees.

   Hi The three physiological measures will not indicate relaxation or stimulation to the same degrees.

METHOD

Subjects:

Twenty subjects (four males, sixteen females) were selected from volunteer students and staff at Texas Woman's University.

Design:

Experimental Conditions

Music I	0_1	X_1	0_2	X_2	(11 subjects)
Music II	0_1	X_2	0_2	X_1	(9 subjects)

X_1 = sedative music

X_2 = stimulative music

Eleven subjects were exposed to the Music I condition and nine subjects were exposed to the Music II condition.

The statistical analysis used was the analysis of variance repeated measures design. (Treatment X subjects design)

Materials:

1. Twelve precategorized musical selections, six sedative (A) and six stimulative (B) were used. They were randomly picked from a population of thirty selections previously used in studies which categorized sedative and stimulative music. The following table lists the musical selections used in this study.

MUSICAL SELECTIONS USED IN PRESENT STUDY

Sedative (A)

Number	Selection Title	Composer	Recording
1	Air on a G String	Bach	Columbia Stereo MS 7501
2	Prelude to the Afternoon of a Faun	Debussy	RCA Stereo 18 11 0034
3	Claire de Lune	Debussy	RCA Stereo 18 11 0034
4	Sixth Symphony (Second movement)	Beethoven	RCA Victor LM-6901 Red Seal
5	Pavane d'une Infante	Ravel	RCA Stereo 18 11 0034
6	Adagio	Barber	RCA Stereo 18 11 0034

Stimulative (B)

1	William Tell Overture	Rossini	RCA Victor Red Seal VCM-7001, 1963
2	Thunder and Lightning Polka	Strauss	Voy/Stereo STPL 512.470
3	Fifth Symphony	Beethoven	RCA Victor LM-6901 Red Seal
4	Stars and Stripes Forever	Sousa	RCA Stereo CRL2-3383 Red Seal
5	Light Calvary Overture	Suppe	RCA Stereo CRL2-3383 Red Seal
6	New World Symphony (first movement)	Dvorak	Columbia/Stereo MS-6343, 1962

Each musical selection was counterbalanced for each subject to eliminate ordering effects. Subject four, for example, heard Prelude to the Afternoon of a Faun (A2) first, and then heard the Light Calvary Overture (B5). Subject six heard Stars and Stripes Forever (B4) first, and then heard Pavane Une'd Infante (A5). The following table lists the selections that each subject heard.

LIST OF MUSICAL SELECTIONS HEARD
BY EACH SUBJECT IN PRESENT STUDY

Subject	01	X	02	X
1		A1		B1
2		B6		A3
3		B5		A4
4		A2		B5
5		A6		B2
6		B4		A5
7		B2		A1
8		A4		B4
9		B3		A2
10		A6		B5
11		A3		B6
12		A5		B1
13		B3		A1
14		A2		B4
15		A4		B2
16		B5		A1
17		A3		B5
18		B5		A2
19		B2		A6
20		A1		B3

The first three minutes, of each selection was recorded for the experiment.

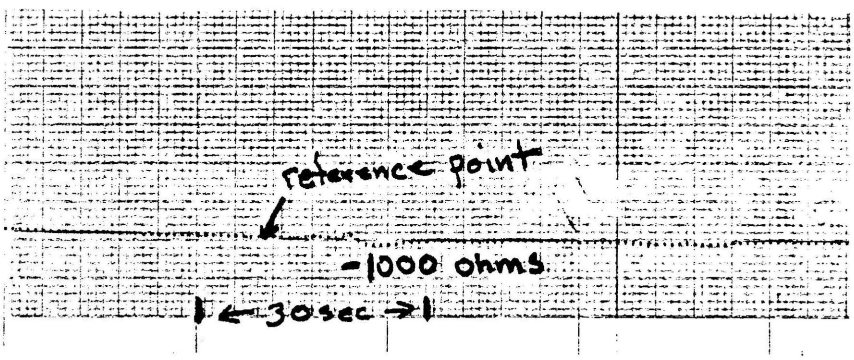
2. The Beckman R611 Dynograph, and the following components were used: the GSR (skin potential) coupler 9892-A, the respiration coupler 9853A, the EMG coupler 9857, silver/silver chloride electrodes and the strain gauge belt. The paper speed equaled 1mm/sec. Each coupler was calibrated for each subject.
3. Two twenty-point continuum scales to measure calm (0) and excited (20) states and dislike (0) and like (20) preferences were used. (Refer to Appendix II)
4. A lounge chair.
5. A Panasonic cassette tape deck Model PS347 and
6. A McIntosh Stereo system with the following components were used: McIntosh preamplifier C28, McIntosh Amplifier DNC2150 and McIntosh speakers with an eight-ohm impedance.
7. A typed sheet of instructions. (Refer to Appendix I)
8. A General Radio type 1551-C sound level meter. All musical selections did not exceed 92 decibles nor fall below 82 decibles.

Procedure:

The experimenter greeted the subject when he entered the room, and asked him to remove any jewelry on his fingers and wrists. The subject then sat in the lounge chair which was positioned in such a way that the experimenter and equipment were out of his range of vision.

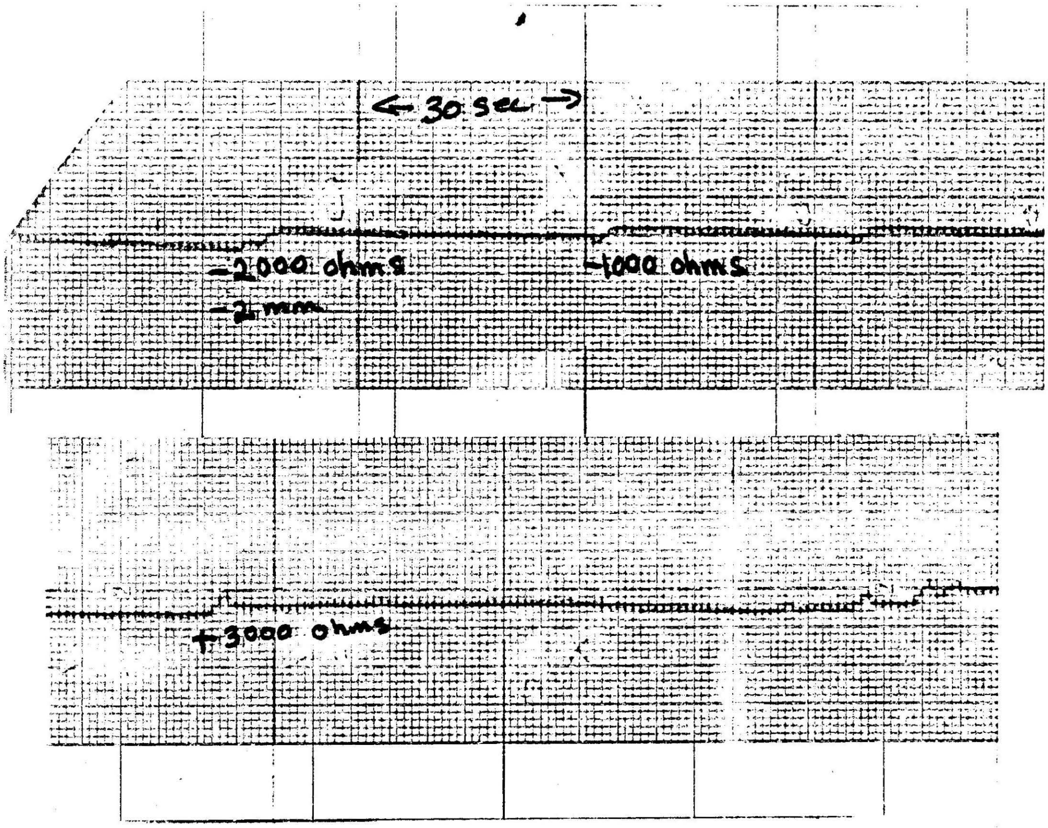
The electrodes were attached to the subject immediately to allow enough time for them to stabilize (thirty minutes). Each subject was connected to the electrodes and strain gauge belt. The EMG active electrodes were attached to the frontalis muscle (bipolar recording). Each electrode was placed one inch above the middle of each eye. The GSR active electrodes were attached to the palm and dorsum of the right hand to measure skin potential (unipolar recording).

The GSR coupler was calibrated for each administration of the experiment. This procedure permitted a reference point of zero to be set. The calibration guaranteed that a pen deflection (up or down) of 1 millimeter from the zero reference point was equal to a one thousand ohm rise or fall of electrodermal activity. The three zeros were dropped in order to make the data easier to analyze. Thus, a -2 means a drop of 2000 ohms in electrodermal activity, and a +.5 means a rise of 500 ohms in electrodermal activity.



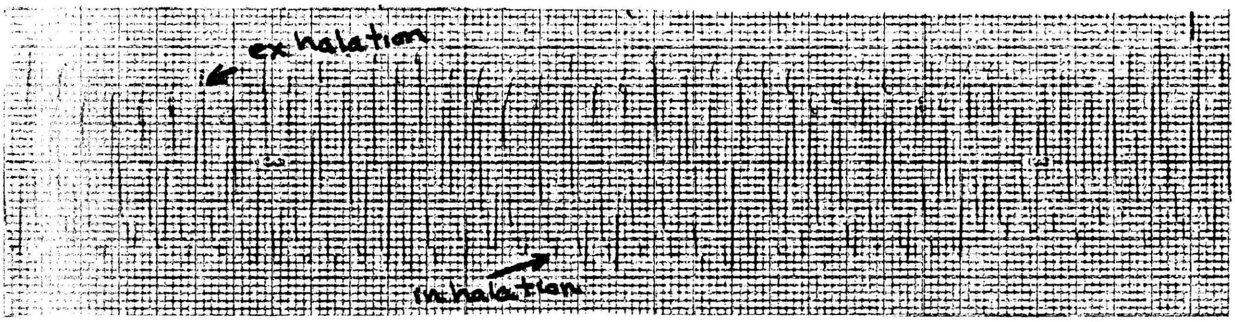
GSR response of a subject with a pen deflection of 1 mm which equals 1000 ohms a.

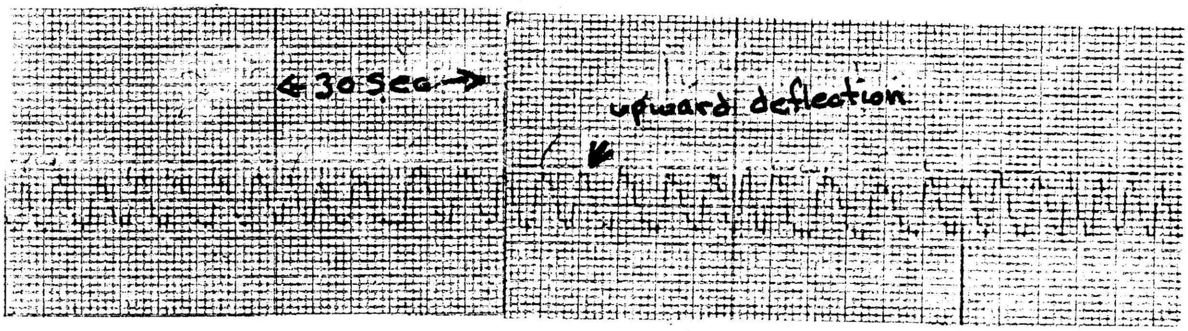
b.



GSR responses of two subjects: (a) illustrates a downward deflection; and (b) illustrates an upward deflection.

The respiration strain gauge belt was placed over the ribs directly under the sternum of each subject. The respiration coupler was calibrated before each administration of the experiment. The only adjustment made with this coupler was to increase the sensitivity in order to make the respiration peaks large enough so they could easily be distinguished from each other. The respiration peaks were representations of exhalation/inhalation. The upward deflection was exhalation and the downward deflection was inhalation.





Respiration rate of subjects in present study. Exhalation is represented by upward pen deflections, and inhalation is represented by downward pen deflections.

The subject read the instructions and filled out the questionnaire. He continued to make a check mark on the scales immediately after each musical selection that he heard.

The recording time of the physiological events for both baselines (01, 02) was two minutes. Each treatment condition

(X1, X2) lasted three minutes. The presentation order of stimulative and sedative music was counterbalanced as well as the selections themselves.

After the treatment was administered, the experimenter turned off the equipment. She disconnected the electrodes and belt from the subject, and thanked him for his cooperation.

The subjects were tested at different times during different days of the week. The administration of the entire experiment for each subject took one hour.

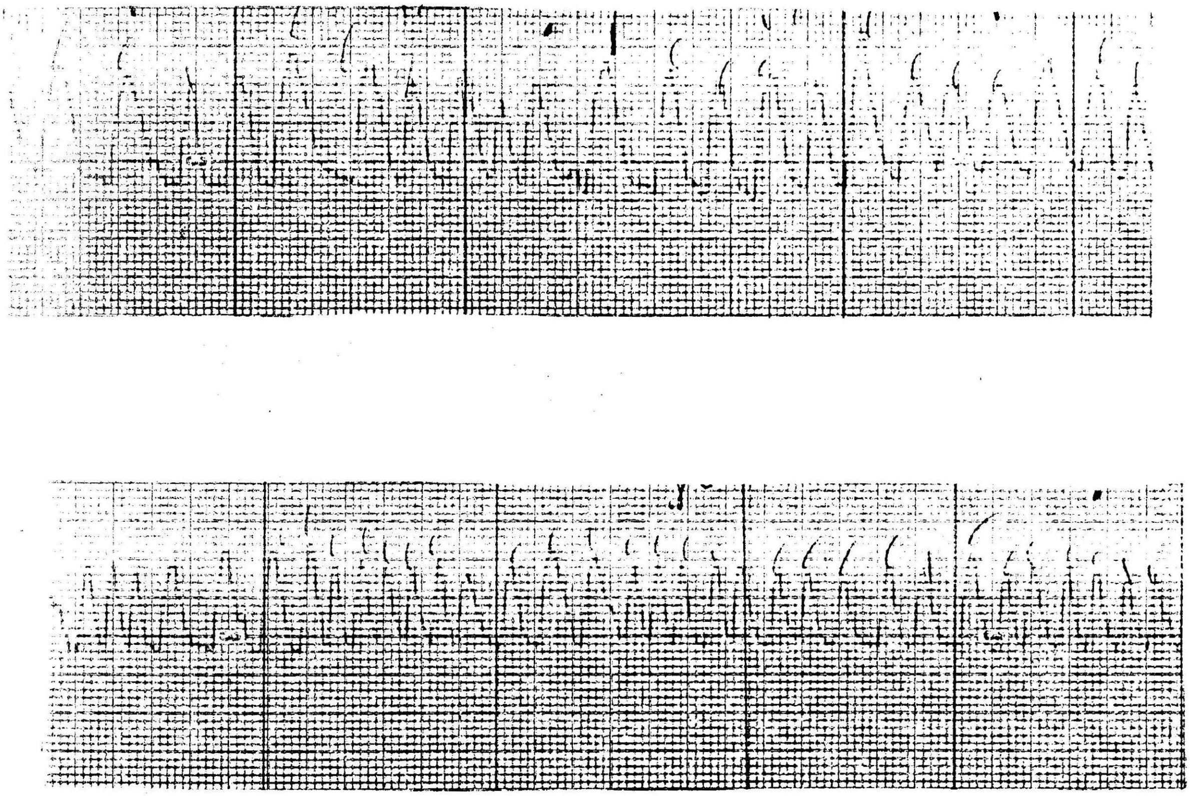
RESULTS

Continuous recording of GSR and respiration took place. The data used in the experiment were obtained at every thirty second interval for both baselines (01, 02) and music time segment (X1, X2). Thus sixteen scores were obtained for each physiological measurement for each subject.

The GSR data which were analyzed were the number of millimeters the pen had deflected from the zero reference point at every thirty second point.

a.

b.



(a) Respiration rate of a subject in the present study during the sedative music stimulus condition. (b) Respiration rate of the same subject during the stimulative music stimulus condition.

The respiration scores equaled the total number of peaks during a thirty second time interval.

The scores were then computed in rates by dividing the number of upward peaks (each score) by thirty seconds. Thus a score of nine (nine upward peaks during a thirty second interval) became .30 peaks/sec.

The EMG measurement was discarded due to the malfunctioning of the equipment.

The Pearson correlation or product-moment correlation coefficients were obtained for the following pairs of scores: GSR and respiration, .038; GSR and the calm/excited scale, .146; and respiration and the calm/excited scale, .474. The correlation coefficient for the respiration and subjective scores indicates that a strong relationship may exist between these two measures. A larger subject population would be needed to see if this is the case.

There seems to be no strong relationship between the two physiological measures. Such information may suggest that the physiological measures do not indicate tension and/or relaxation to the same degree.

The following table contains background information on the twenty subjects. This data will not be analyzed because the subject population is rather small and this investigator assumed by inspection that the backgrounds are homogeneous. The examination of extraneous variables such as age, sex and musical training in this study was not the intent of the study.

BACKGROUND INFORMATION ON SUBJECTS IN THE PRESENT STUDY

SS	Age	Sex	Yrs. of Formal Music Training	Instrument	Occupation	Degrees Held
1	21	F	10	voice guitar	student	-
2	22	F	4	guitar	student	-
3	28	F	5	piano	teacher	BS
4	21	F	-	guitar	student	-
5	44	F	1	piano	instructor	BS
6	28	F	4½	trumpet	student	BA
7	25	F	5	piano guitar	student	-
8	29	M	6	trumpet	student	BM, MA
9	23	F	11	violin guitar	secretary	AB
10	27	M	-	guitar	student	BA
11	22	F	5	cello	student	-
12	26	F	-	-	computer programmer	BS
13	24	F	5	voice	student	-
14	22	F	10	piano French horn	student	-
15	22	F	4	violin viola, piano	student	-
16	53	M	7	violin	professor	PhD, MME, BS, BME
17	26	F	4	clarinet	student	BMED
18	35	F	5	-	professor	BS, MED, PhD

SS	Age	Sex	Yrs. of Formal Music Training	Instrument	Occupation	Degrees Held
19	22	F	-	piano, harp	student	-
20	23	M	6	percussion	student	BMED

Four one-way analyses of variance with repeated measures (treatment X subjects) were administered to the following groups of data: GSR scores of eleven subjects who were exposed to design 01 X1 02 X2; GSR scores of nine subjects who were exposed to design 01 X2 02 X1; respiration scores of eleven subjects who were exposed to design 01 X1 02 X2; and respiration scores of nine subjects who were exposed to design 01 X2 02 X1. The results of the analyses and cell mean scores are presented in the following tables.

TABLE III. ANOVA with repeated measures (treatment X subjects) for GSR scores of subjects who heard sedative music first (01 X1 02 X2)

Source	df	SS	MS	F
Treatments	3	431.07	143.69	*6.62
Subjects	10	1486.24	148.624	
Treatment X Subjects	30	650.44	21.68	
Total	43	2753.21		

* $p < .05$

TABLE IV. GSR cell means of subjects who heard sedative music first (01 X1 02 X2)

Subject (Row)	Treatment (Column) 01	X1	02	X2	Row Mean
1	2.1	-6.4	-5.3	.5	-2.2
2	-7.5	-2.9	-2.4	-1	-1.7
3	.25	-2.6	.12	1.6	-.16
4	1	2.1	3.1	3.1	2.3
5	-4.6	-9.0	-10.9	-9.6	-8.5
6	-.38	-1.9	2.6	2.6	.73
7	0	-3.3	-2	2.5	-.7
8	-2.9	-3	-5.4	-1	-3
9	-2	-9.3	-6.8	5.3	-3.2
10	-.75	-2	-1.75	-1	-1.3
11	-3.5	-7.25	-6.5	-6.9	-6
Column Mean	-1.1	-4.14	-3.2	-.35	General Mean -2.2

TABLE V. ANOVA with repeated measures (treatment X subjects) for GSR scores of subjects who heard stimulative music first (01 X2 02 X1)

Source	df	SS	MS	F
Treatment	3	347.87	115.96	*9.60
Subjects	8	69.77	8.72	
Treatment X Subjects	24	58.83	2.45	
Total	35	586.57		

*$p < .05$

TABLE VI. GSR cell means of subjects who heard stimulative music first (01 X2 02 X1)

Subject (Row)	Treatment (Column) 01	X2	02	X1	Row Mean
1	0	.38	0	-.56	-.05
2	-3.1	-4.6	-5	-6	-4.68
3	-.5	-.63	-1	-1.3	-.86
4	-1.1	1.1	.25	-.25	0
5	-.25	2.25	-.75	-4.6	-.84
6	-3.4	.75	-2.3	-3.5	-2.1
7	1.5	2	-.25	1.13	-1.10
8	0	0	.38	-.56	-.05
9	-.5	-.5	-.63	-1.3	-.86
Column Mean	-.82	.11	-1.11	-1.89	General Mean -.93

TABLE VII. ANOVA with repeated measures (treatment X subjects) for respiration scores of subjects who heard sedative music first (01 X1 02 X2)

Source	df	SS	MS	F
Treatment	3	.09	.03	*15.00
Subjects	10	.52	.052	
Treatment X Subjects	30	.07	.002	
Total	43	.50		

* $p < .05$

TABLE VIII. Respiration scores of subjects who heard sedative music first (01 X1 02 X2)

Subjects (Row)	Treatment (Column) 01	X2	02	X1	Row Mean
1	.26	.25	.26	.29	.27
2	.11	.13	.13	.18	.14
3	.26	.27	.29	.29	.28
4	.25	.29	.27	.34	.29
5	.20	.26	.27	.28	.25
6	.15	.15	.18	.24	.18
7	.14	.14	.16	.14	.15
8	.17	.27	.22	.31	.24
9	.25	.22	.21	.33	.25
10	.27	.29	.25	.29	.28
11	.30	.27	.28	.31	.29
Column Mean	.21	.23	.23	.27	General Mean .24

TABLE IX. ANOVA with repeated measures (treatment X subjects) for respiration scores of subjects who heard stimulative music first (01 X2 02 X1)

Source	df	SS	MS	F
Treatment	3	.05	.017	3.4
Subjects	8	.39	.049	
Treatment X Subjects	24	.11	.005	
Total	35	.64		

TABLE X. Respiration cell means of subjects who heard stimulative music first (01 X2 02 X1)

Subject (Row)	Treatment (Column) 01	X2	02	X1	Row Mean
1	.25	.30	.26	.18	.25
2	.23	.29	.25	.28	.26
3	.26	.29	.27	.26	.27
4	.24	.20	.24	.28	.24
5	.27	.33	.33	.33	.32
6	.26	.28	.27	.27	.27
7	.26	.38	.29	.38	.33
8	.27	.34	.24	.31	.29
9	.11	.18	.13	.13	.14
Column Mean	.24	.29	.25	.27	General Mean .24

CONCLUSION AND DISCUSSION

As indicated by the Tables, significant results were obtained for all analyses except for the respiration scores of subjects who heard stimulative music first (Table IX).

Based upon these results, the null hypotheses in Statements 1 and 4 in the Statement of the Problem were rejected. Due to the fact that significant results were not obtained for the analysis performed on respiration scores for subjects who heard stimulative music first, the null hypothesis in Statement 2 was accepted.

The acceptance of the null hypothesis in Statement 4 is based upon the fact that significant results were obtained for all GSR scores, but not for all respiration scores. This is further supported by the fact that the correlation coefficient for GSR and respiration scores across all experimental conditions was relatively low.

The analyses did not demonstrate that precategorized sedative or stimulative music decreased or increased, respectively, physiological activity, but significant results in the treatment effect indicate that differences did exist across all four experimental treatments which are probably not due to chance alone.

A brief investigation of the cell means in Tables IV, VI, VIII and X indicates that large differences do exist. The column means in Table IV, for example, are the mean scores for each subject combined in each experimental condition. As a whole, they went from a baseline mean of -1.1 to a mean of -4.14 during the sedative music time segment, which is an average drop of 3000 ohms. During the second baseline, their GSR mean score raised to -3.2, and continued to do so during the stimulative music condition to -.35. This is a higher score than the initial mean score, which means that GSR activity increased.

These results depict the situation for the entire subject population. They do not deal with individual responses. Since one of the intentions of this study was to investigate the possibility of a person's tension-relaxation potential (TRP) in response to music, an examination of individual subjects is warranted.

Appendix III contains graphs for individual subjects upon which raw scores for GSR and respiration during the four conditions were plotted, and graphs of individual subject responses on the subjective scales for the calm-excited continuum and for preference. (For the calm-excited graph zero represents extreme calm, and twenty represents extreme excitement. Zero represents a great dislike, and twenty represents an extreme like for the musical selections on the like-dislike preference graph.)

According to their subjective evaluations, eight subjects (V, VII, VIII, IX, X, XI, XIII, XIX) were affected by the musical stimuli along a calm-excited continuum. The baseline score for subject XIII, for example, was five. He heard the sedative musical selection first which lowered his score to zero. The stimulative musical selection then raised his score to ten. The same progression can be seen for subject X. His initial score was six, which was lowered to four by the sedative musical selection, and then raised to nine by the stimulative music. The opposite progression occured for subject IV, who heard sedative music first. His baseline score was two. The stimulative musical selection raised it to twelve, and the sedative music lowered it to zero.

The evidence is not as cleancut in subjects I, II, VI, XVII and XVIII, but the musical selections definitely altered the subjects' feelings of arousal. Subjects I and IV initially had a low baseline score. The sedative music raised their scores instead of lowering them, but the stimulative music raised them higher than the sedative music. Sedative music did not lower the subjects' feelings of arousal from the baseline score, which was rather low to start. One explanation for this occurance may be that the auditory stimulus of music aroused the subjects more than the silent baseline condition.

The other three subjects (II, XVII, XVIII) heard stimulative music first. In all three cases the stimulative music raised the scores, and the sedative music lowered them, but not to the original baseline or lower. This evidence may suggest that stimulative music has a greater affect upon a person's feelings of relaxation and tension than does sedative music.

There is no evident relationship between preference and subjective feelings of arousal. Some subjects disliked a selection, but indicated feelings of calm, while others indicated feelings of excitement for both types of musical stimuli. Certain subjects who liked the musical selections indicated that they were calm, and others became excited. Thus, this researcher concludes that preference did not consistently affect a person's subjective response to sedative or stimulative music.

The graphs in Appendix III indicate that nine subjects (II, IV, V, VI, VII, VIII, X, XIV, XVII) were affected by precategorized stimulative and sedative music along a tension-relaxation potential (TRP) continuum. The physiological and subjective data for subjects V, VII, VIII, and X indicate the same results, which demonstrates that a relationship exists between the subjective and physiological responses. But, this relationship is a low one since it only occured in four out of twenty subjects, and the correlation coefficient is low.

The graphs which depict respiration rate of subjects for all conditions provide very little evidence that a tension-relaxation potential (TRP) continuum exists for people in response to music. Only four graphs (I, V, VI, IX) indicate that stimulative and sedative music produced tension and relaxation respectively in subjects. Of the four graphs, only two (V, VI) are in accordance with the other two measurements.

The graphs also demonstrate that preference does not seem to affect the subject's arousal level as measured through GSR and respiration.

The question arises as to which dependent variable is more reliable. This researcher tends to rely on the subjective responses of this study, and thus concludes that a tension-relaxation potential (TRP) for people relative to music does exist. Thirteen of twenty subjects were affected by music along a calm-excited continuum as indicated by subjective evaluations. There is a slight concern as to the reliability and validity of the physiological measurements due to the sensitive nature of both the machinery and measurements themselves. As discussed earlier, GSR is an extremely difficult physiological activity to accurately measure. Respiration is easier to record, but many variables other than music can affect its outcome.

This study had many problems, the most eminent one being the existence of confounding variables such as the procedure involved with the physiological measurements and the sensitivity of these measurements, the age, sex and musical training of the subjects, the size of the subject population, and demand characteristics. Anyone of these variables could have affected the outcome of this study.

Another problem existed with the independent and dependent variables in that they in themselves are very complex phenomena. Any one of their components could have affected the outcome. GSR and respiration, for example, are indicators of the presence of absence of tension, but they are also indicators of other 'biological events'. Each element of music by itself (melody, timbre, rhythm, style, etc.) can cause pronounced alterations in a person's response.

Problems also existed in the design. The treatment conditions were not totally counterbalanced, which caused a problem in finding the correct statistical analysis.

This author maintains that even though the experiment has flaws, it was a very worthwhile endeavor and an excellent learning tool.

APPENDIX I

INSTRUCTIONS

This experiment will investigate relaxation and tension potentials of music for people. The experimenter will be measuring your respiration rate, muscle potential and galvanic skin response. The electrodes placed on you are non-toxic and will not cause any skin discoloration or discomfort.

Please stay seated for the duration of the experiment. It is imperative that you move as little as possible. The electrodes are very sensitive and will easily detect artifacts such as motion. The experiment will only take thirty minutes once we begin.

You will be listening to two selections of music. Remember that the segments of silence between each selection are just as important as the music itself. The initial two minutes will be in silence.

After you have read these instructions, please fill out sections I and II of the questionnaire which is on the table beside you. Please fill out sections III and IV after the first selection has finished, and sections V and VI after second selection has finished.

After the treatment is over the experimenter will enter the room to turn off the equipment, and disconnect the electrodes. Please do not move until the experimenter disconnects you. The experiment will be officially over.

Thank you for your cooperation. If you wish to know the results, the experimenter will gladly review them with you.

APPENDIX II

QUESTIONNAIRE

I.

1) Age __________ Sex __________

2) Do you play a musical instrument? _______

3) If so, what instrument? ____________________

4) Length of time you have been playing __________

5) How many years have you taken formal lessons? __________

6) Have you had formal music training? __________

7) If so, how long? __________

8) Occupation __________

9) If student, year and major ____________________

10) Degrees held, in what major? ____________________

II. How do you feel?

Calm 0 — 5 — 10 — 15 — 20 Excited

III. How do you feel?

Calm 0 — 5 — 10 — 15 — 20 Excited

IV. Rate how you liked the selection.

Disliked 0 — 5 — 10 — 15 — 20 Liked

V. How do you feel?

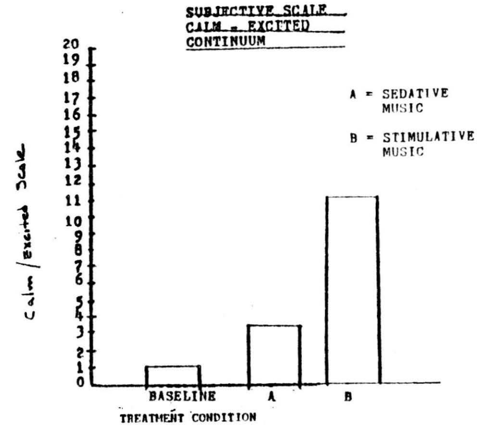
Calm 0 — 5 — 10 — 15 — 20 Excited

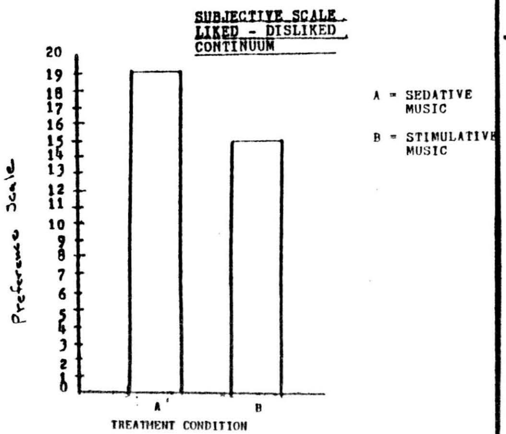
VI. Rate how you liked the selection.

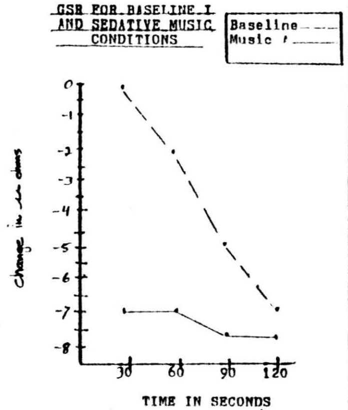
Disliked 0 — 5 — 10 — 15 — 20 Liked

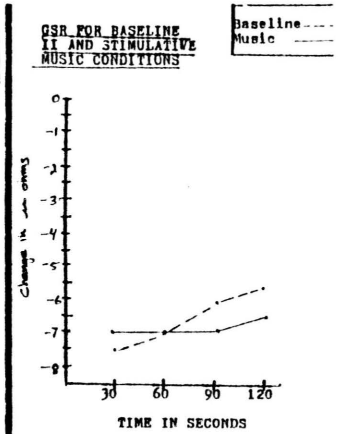
APPENDIX III

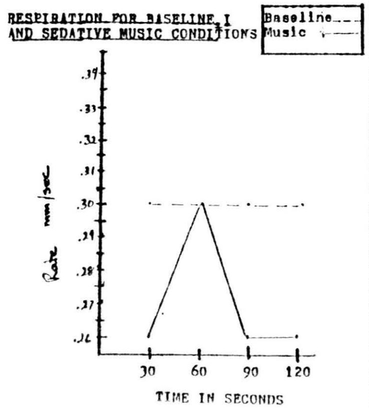
Subject 1

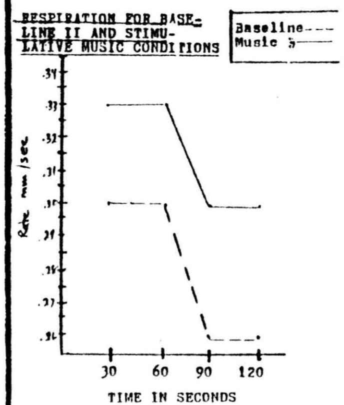

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm / Excited Scale
BASELINE
A
B
TREATMENT CONDITION


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
A
B
TREATMENT CONDITION

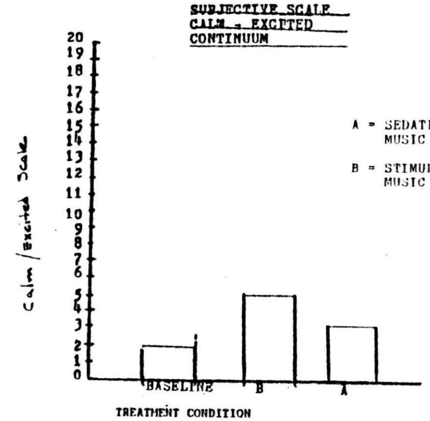

GSR FOR BASELINE I
AND SEDATIVE MUSIC
CONDITIONS
Baseline
Music
TIME IN SECONDS

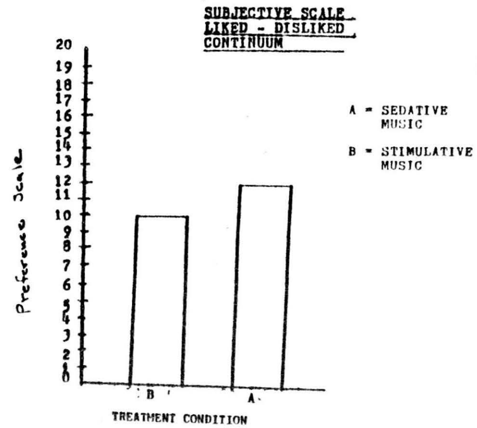

GSR FOR BASELINE
II AND STIMULATIVE
MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS

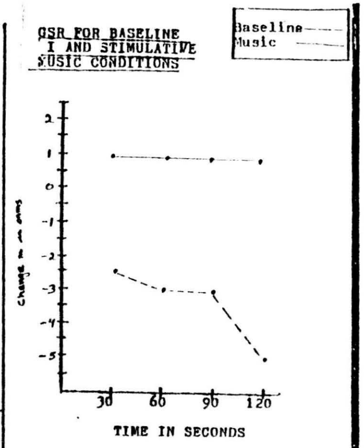

RESPIRATION FOR BASELINE I
AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

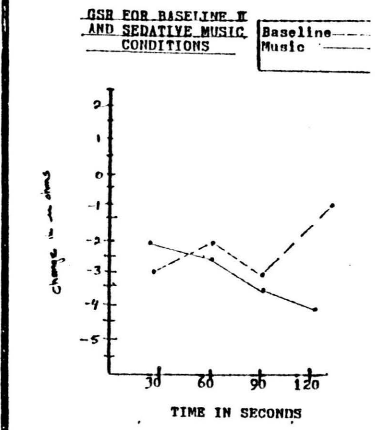

RESPIRATION FOR BASE-
LINE II AND STIMU-
LATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

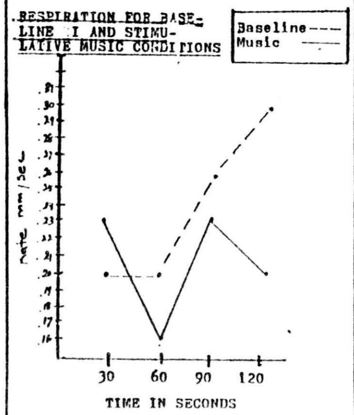
Subject 2

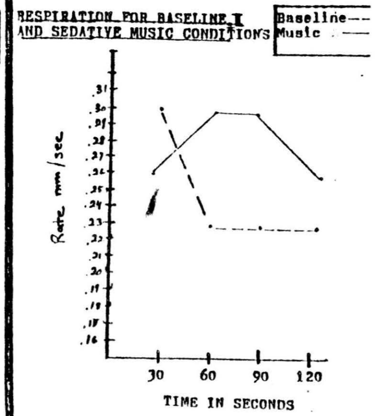

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
Calm / Excited Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
BASELINE
B
A
TREATMENT CONDITION


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
Preference Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
B
A
TREATMENT CONDITION

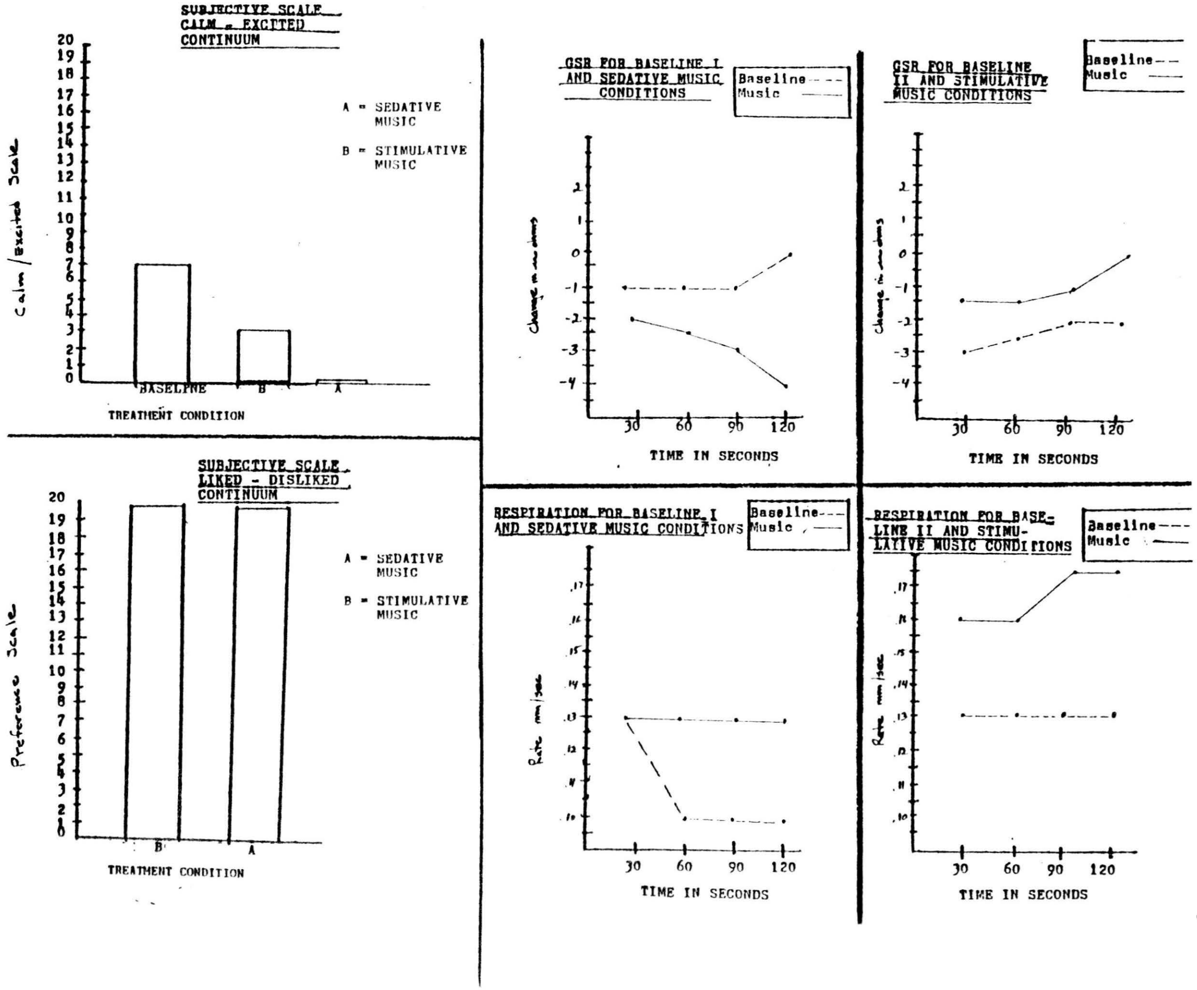

GSR FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
30
60
90
120
TIME IN SECONDS


GSR FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
30
60
90
120
TIME IN SECONDS


RESPIRATION FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
30
60
90
120
TIME IN SECONDS

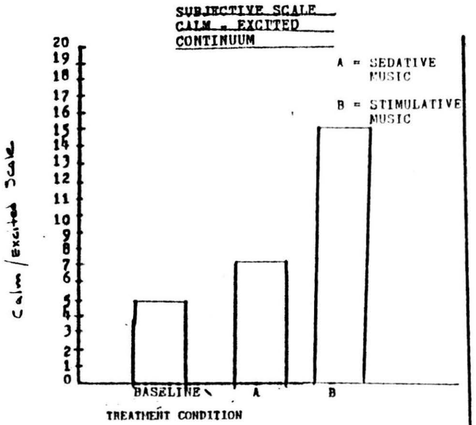

RESPIRATION FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
30
60
90
120
TIME IN SECONDS

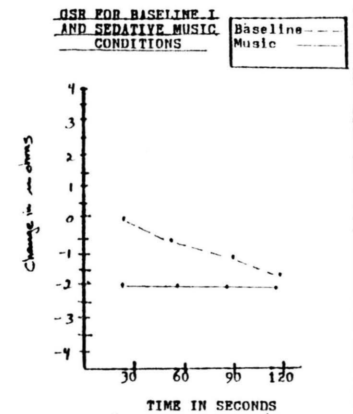
Subject 3

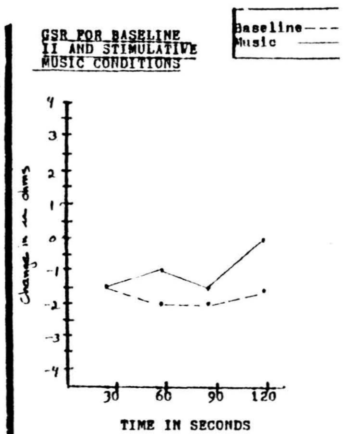


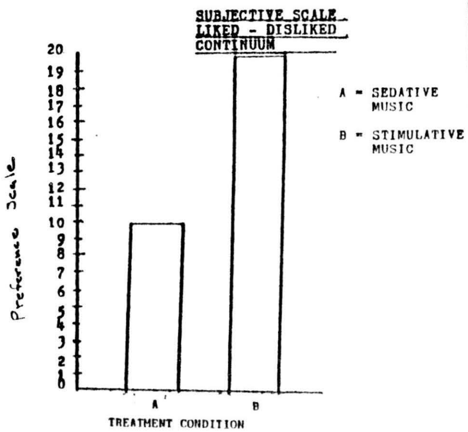
SUBJECTIVE SCALE
CALM - EXCITED CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm / Excited Scale
BASELINE
B
A
TREATMENT CONDITION
SUBJECTIVE SCALE
LIKED - DISLIKED CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
B
A
TREATMENT CONDITION
GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS

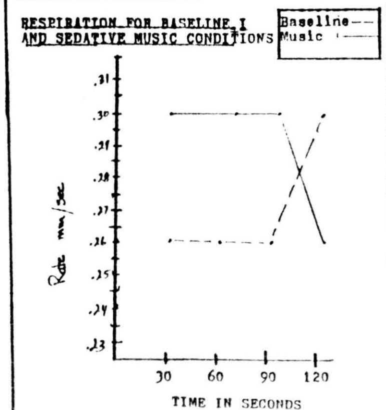
Subject 4

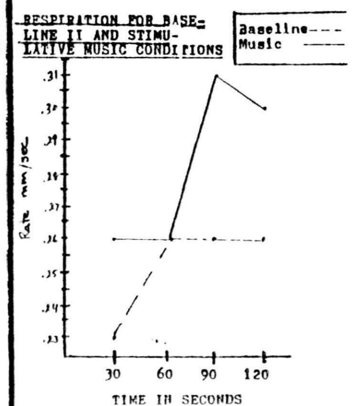

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm/Excited Scale
BASELINE
A
B
TREATMENT CONDITION


GSR FOR BASELINE I
AND SEDATIVE MUSIC
CONDITIONS
Baseline
Music
Change in mm ohms
30
60
90
120
TIME IN SECONDS

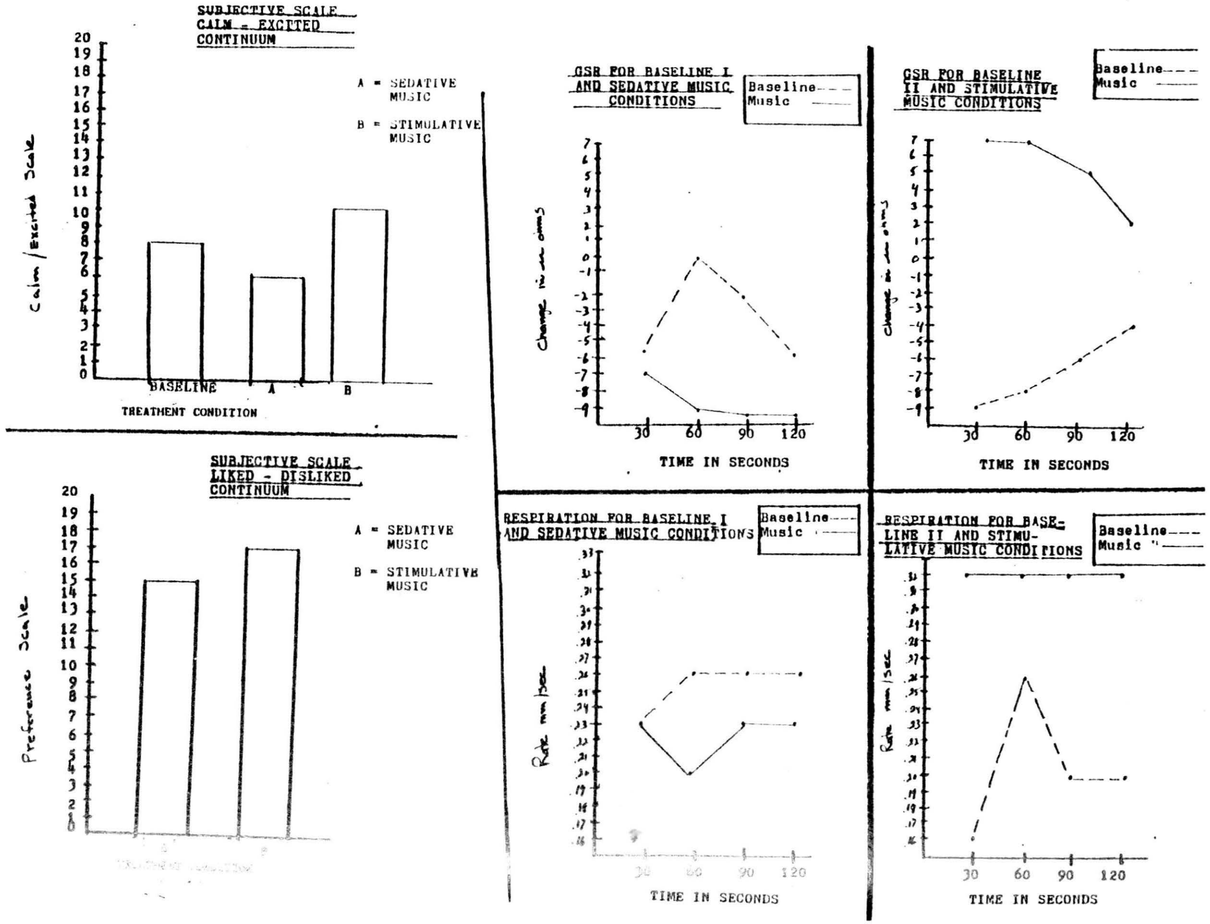

GSR FOR BASELINE
II AND STIMULATIVE
MUSIC CONDITIONS
Baseline
Music
Change in mm ohms
30
60
90
120
TIME IN SECONDS


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
A
B
TREATMENT CONDITION

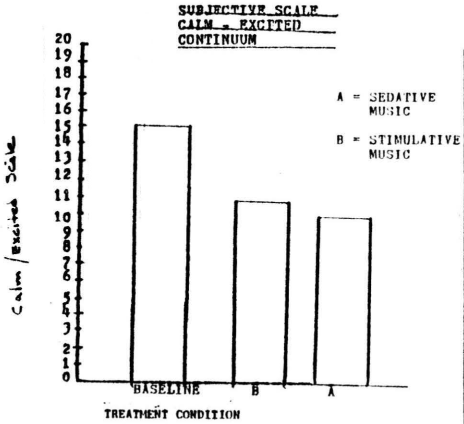

RESPIRATION FOR BASELINE I
AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
30
60
90
120
TIME IN SECONDS

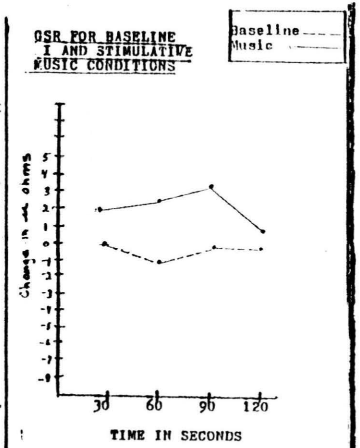

RESPIRATION FOR BASE-
LINE II AND STIMU-
LATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
30
60
90
120
TIME IN SECONDS

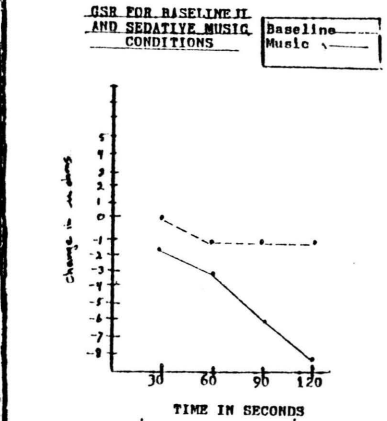
Subject 5

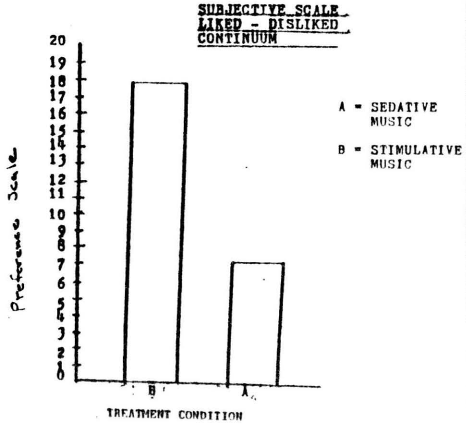

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
Calm/Excited Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
BASELINE
A
B
TREATMENT CONDITION
SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
Preference Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Change in ohms
TIME IN SECONDS
GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS
RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

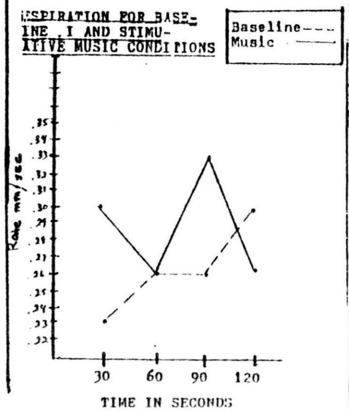
Subject 6

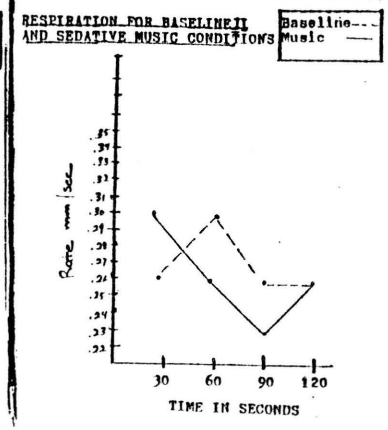

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm/Excited Scale
BASELINE
B
A
TREATMENT CONDITION


GSR FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Change in ohms
30
60
90
120
TIME IN SECONDS

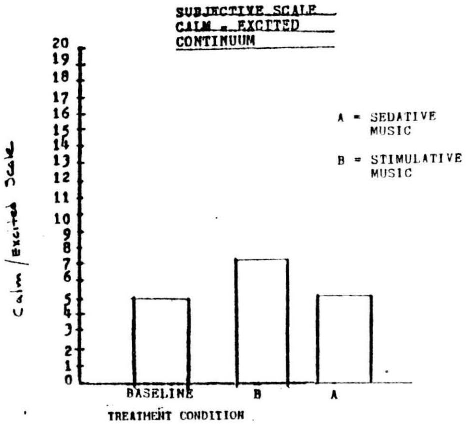

GSR FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Change in ohms
30
60
90
120
TIME IN SECONDS

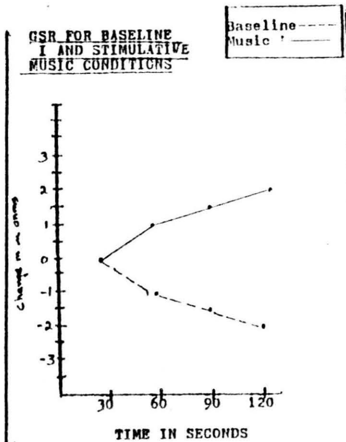

SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
B
A
TREATMENT CONDITION

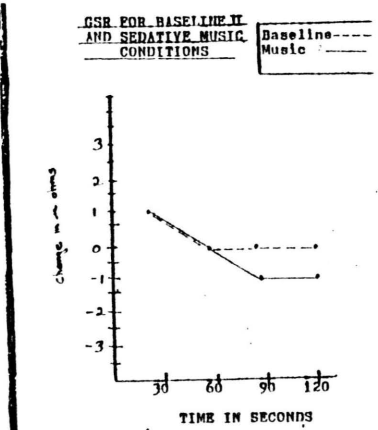

USPIRATION FOR BASELINE I AND STIMU- ITIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
30
60
90
120
TIME IN SECONDS

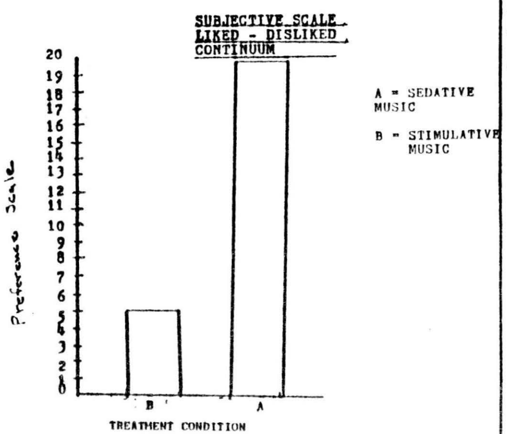

RESPIRATION FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
30
60
90
120
TIME IN SECONDS

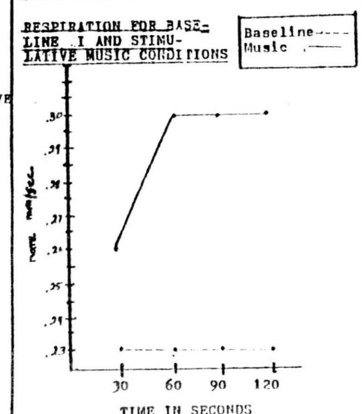
Subject 7

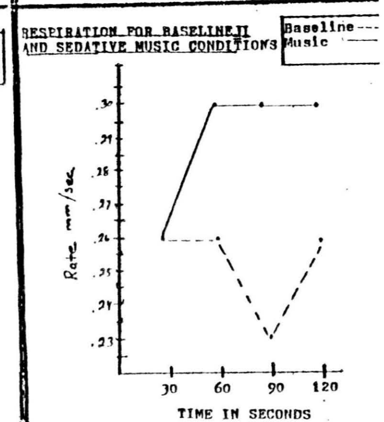

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
Calm / Excited Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
BASELINE
B
A
TREATMENT CONDITION


GSR FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline ----
Music ——
TIME IN SECONDS
30
60
90
120

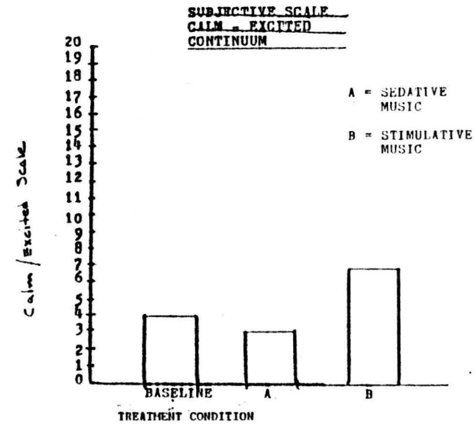

GSR FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline ----
Music ——
TIME IN SECONDS
30
60
90
120

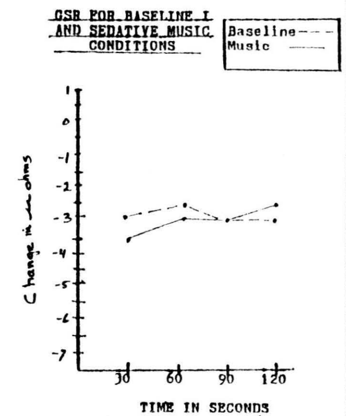

SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
Preference Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
B
A
TREATMENT CONDITION

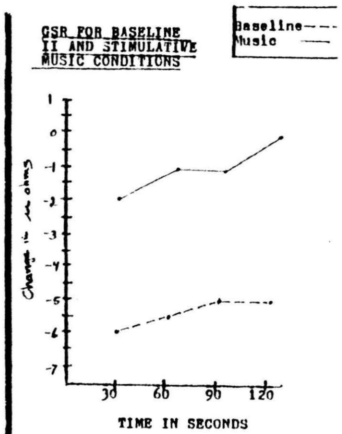

RESPIRATION FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline ----
Music ——
TIME IN SECONDS
30
60
90
120

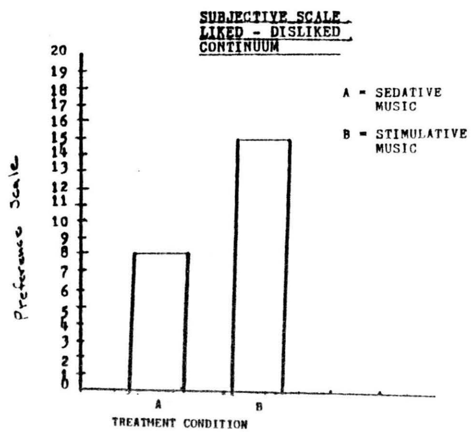

RESPIRATION FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline ---
Music ——
Rate mm/sec
TIME IN SECONDS
30
60
90
120

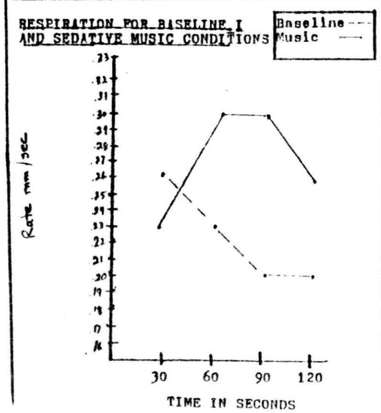
Subject 8

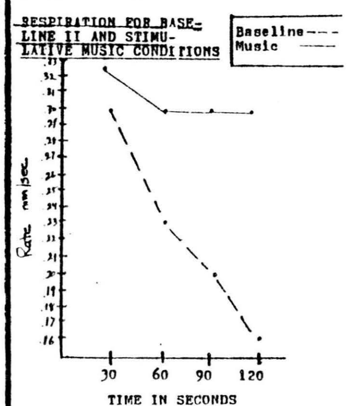

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm/Excited Scale
BASELINE
A
B
TREATMENT CONDITION


GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline - - -
Music ———
Change in m ohms
TIME IN SECONDS

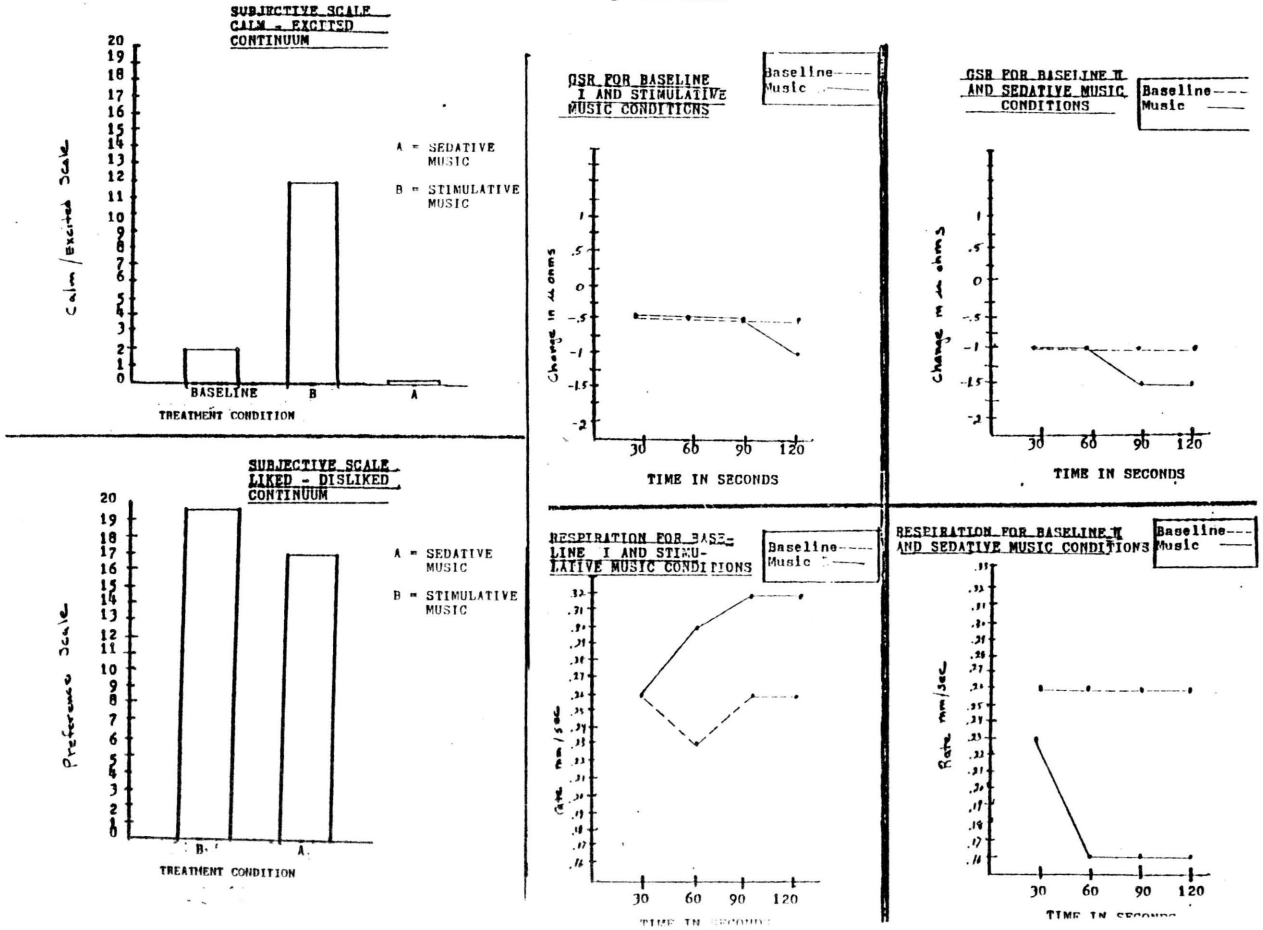

GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline - - -
Music ———
Change in m ohms
TIME IN SECONDS


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
A
B
TREATMENT CONDITION

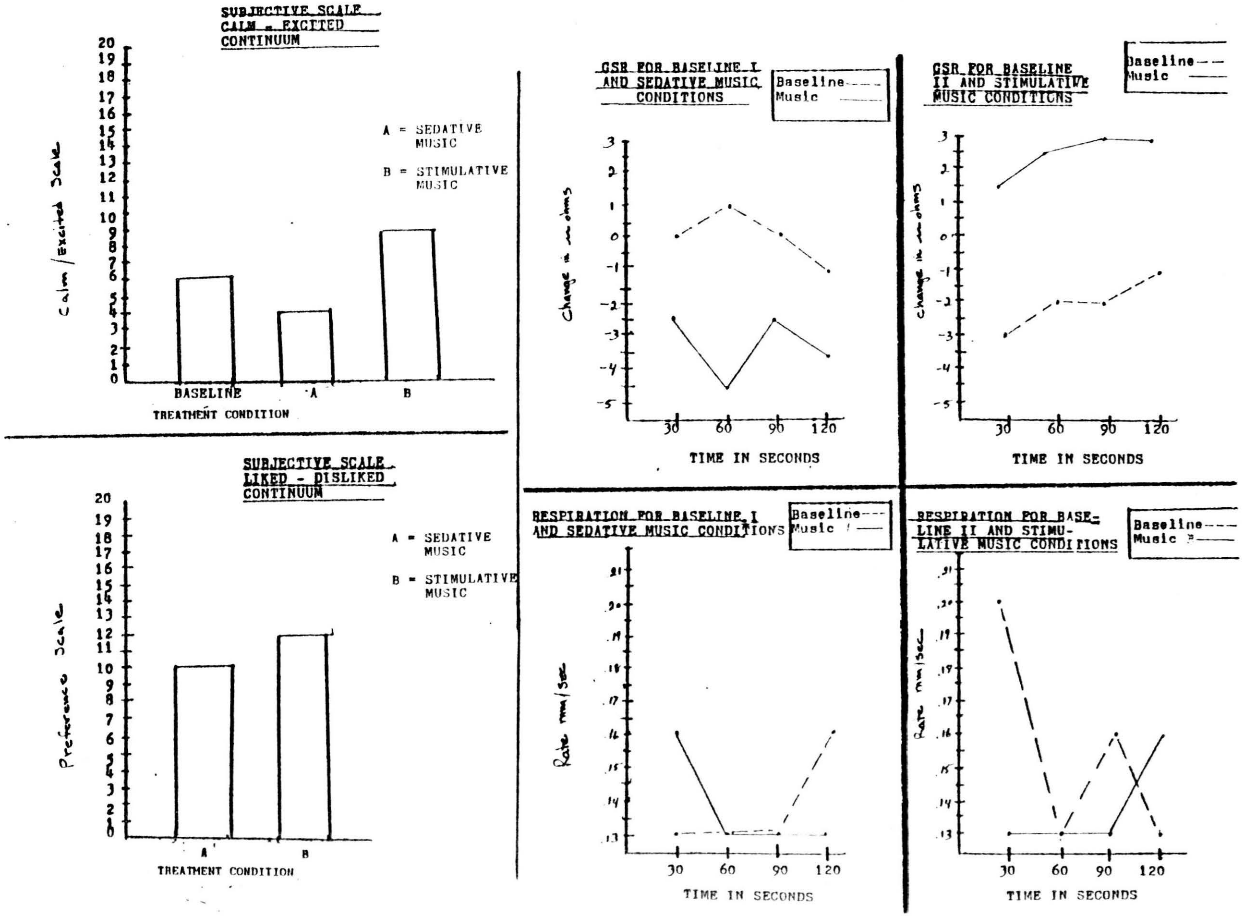

RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline - - -
Music ———
Rate mm/sec
TIME IN SECONDS


RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline - - -
Music ———
Rate mm/sec
TIME IN SECONDS

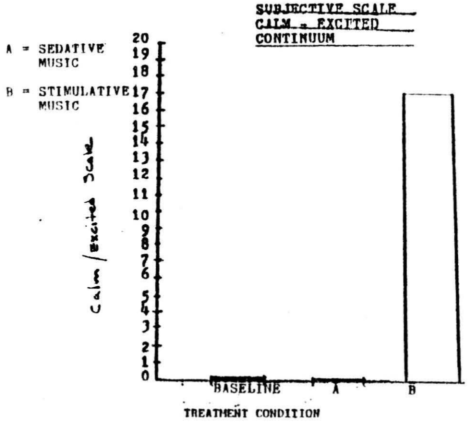
Subject 9

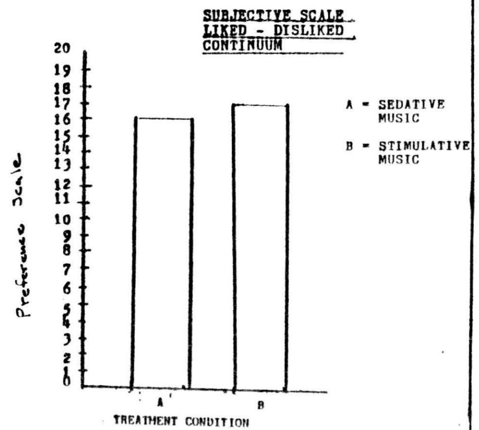

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
Calm / Excited Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
BASELINE
B
A
TREATMENT CONDITION
SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
Preference Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
B
A
TREATMENT CONDITION
GSR FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
GSR FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
RESPIRATION FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
RESPIRATION FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec

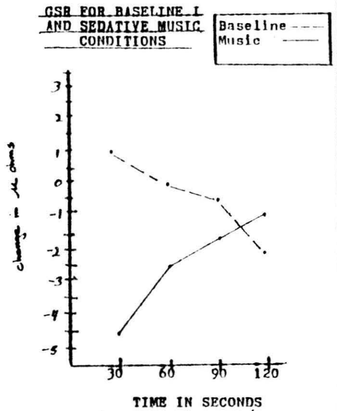
Subject 10

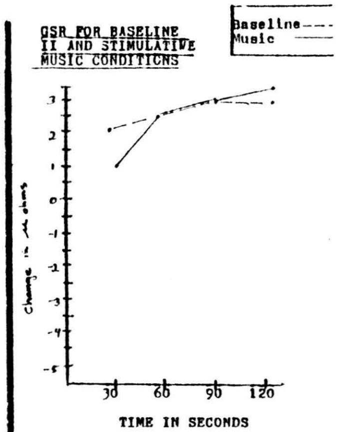

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
Calm / Excited Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
BASELINE
A
B
TREATMENT CONDITION
SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
Preference Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
TREATMENT CONDITION
GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
change in ohms
TIME IN SECONDS
GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
change in ohms
TIME IN SECONDS
RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS
RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

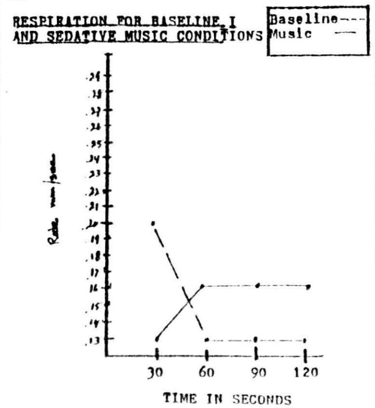
Subject 11

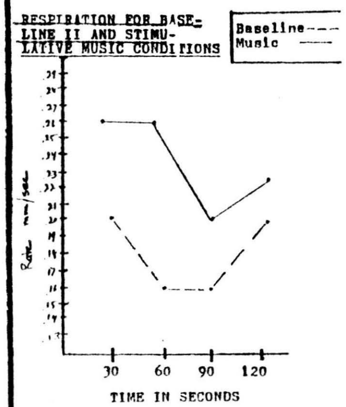

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm / Excited Scale
BASELINE
A
B
TREATMENT CONDITION


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
A
B
TREATMENT CONDITION

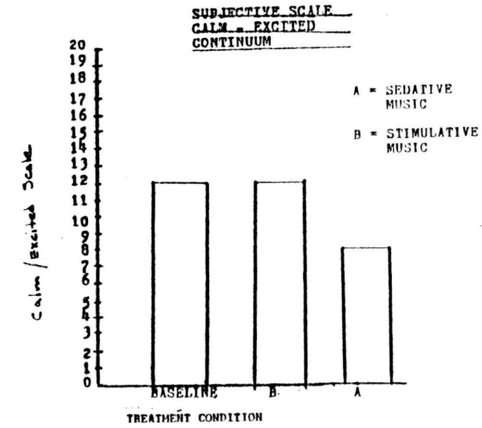

GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline ---
Music ——
30
60
90
120
TIME IN SECONDS

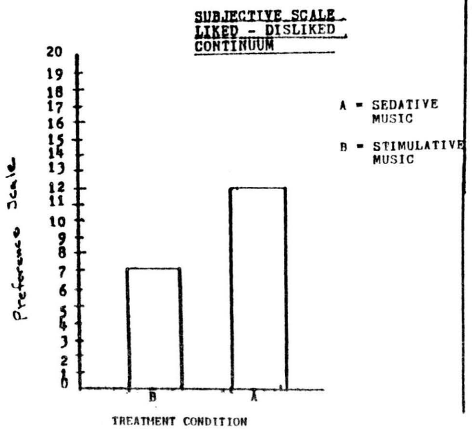

GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline ---
Music ——
30
60
90
120
TIME IN SECONDS

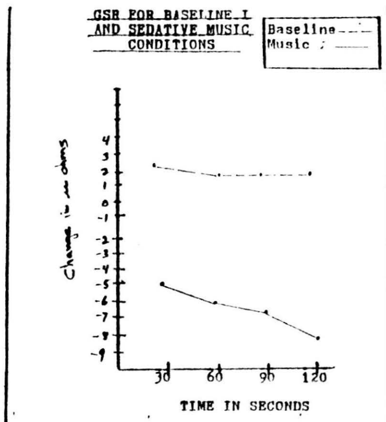

RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline ---
Music ——
30
60
90
120
TIME IN SECONDS

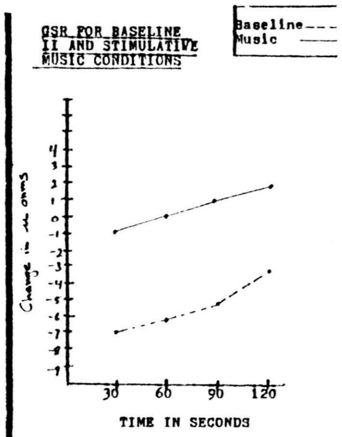

RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline ---
Music ——
30
60
90
120
TIME IN SECONDS

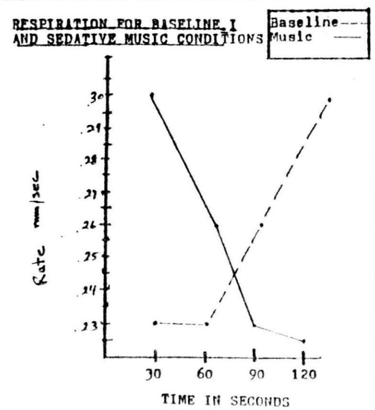
Subject 12

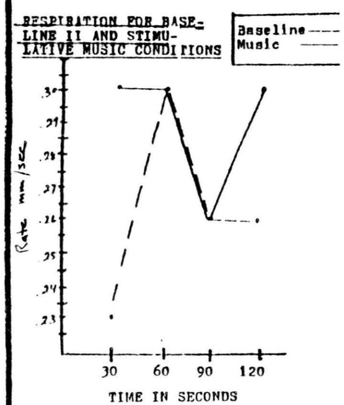

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm / Excited Scale
BASELINE
B
A
TREATMENT CONDITION


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
B
A
TREATMENT CONDITION

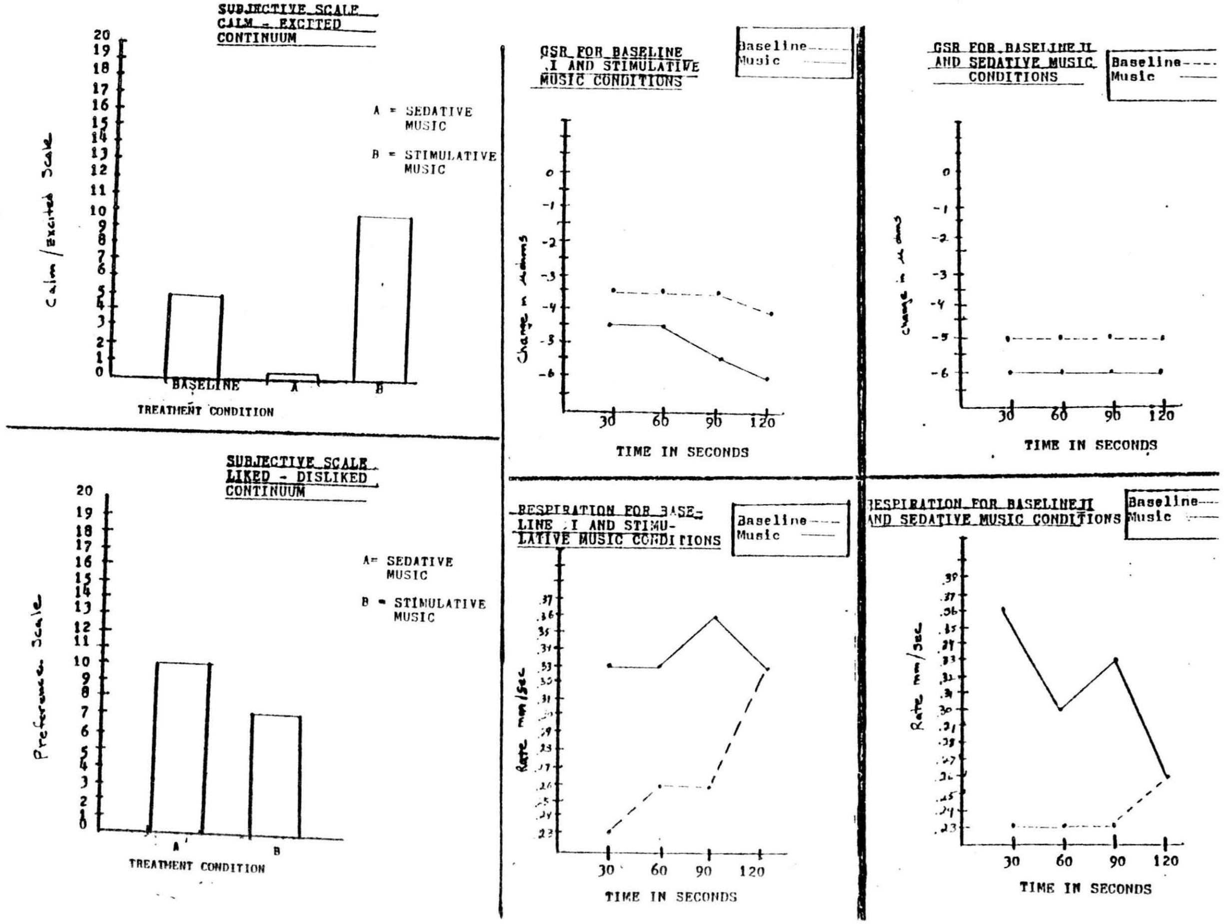

GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Change in ohms
30
60
90
120
TIME IN SECONDS


GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Change in ohms
30
60
90
120
TIME IN SECONDS

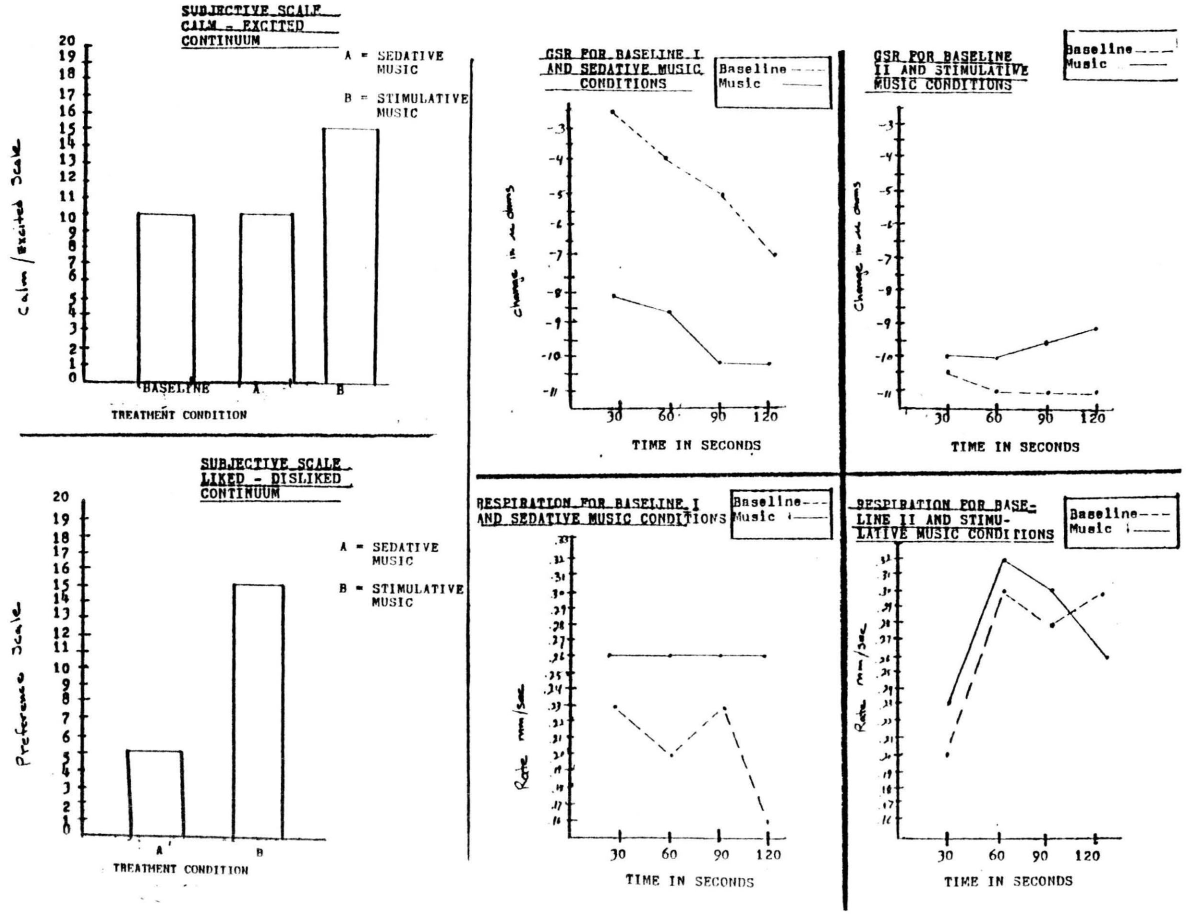

RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
30
60
90
120
TIME IN SECONDS


RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
30
60
90
120
TIME IN SECONDS

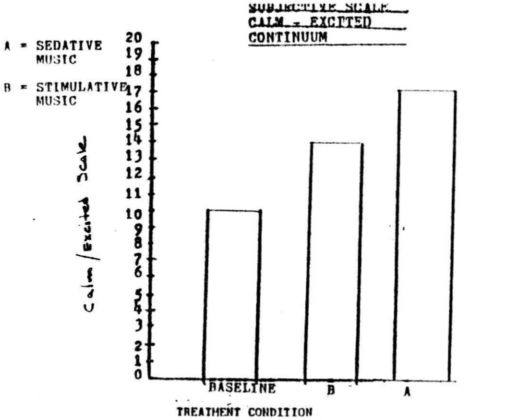
Subject 13

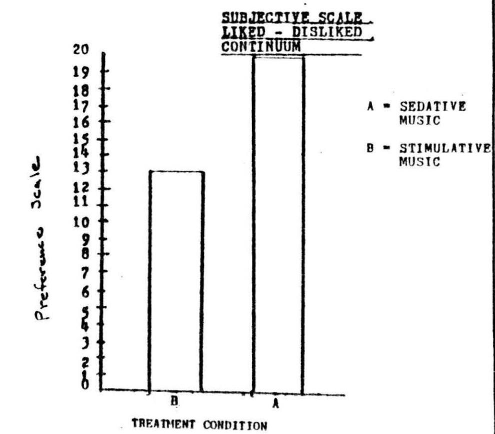

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
Calm / Excited Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
BASELINE
A
B
TREATMENT CONDITION
GSR FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Change in μ ohms
TIME IN SECONDS
GSR FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
Preference Scale
A= SEDATIVE MUSIC
B = STIMULATIVE MUSIC
TREATMENT CONDITION
RESPIRATION FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS
RESPIRATION FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

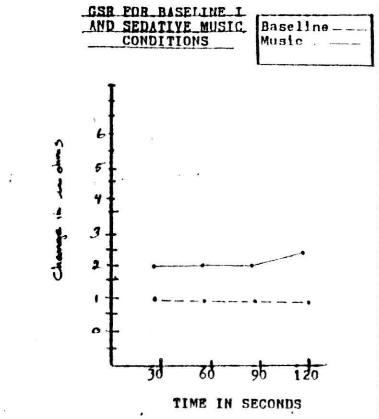
Subject 14

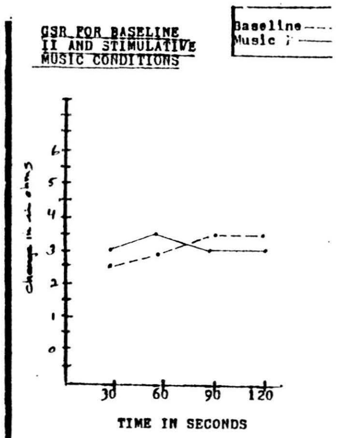

SUBJECTIVE SCALE CALM - EXCITED CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm/Excited Scale
BASELINE
A
B
TREATMENT CONDITION
GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Change in ohms
TIME IN SECONDS
GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
SUBJECTIVE SCALE LIKED - DISLIKED CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
A
B
TREATMENT CONDITION
RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS
RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

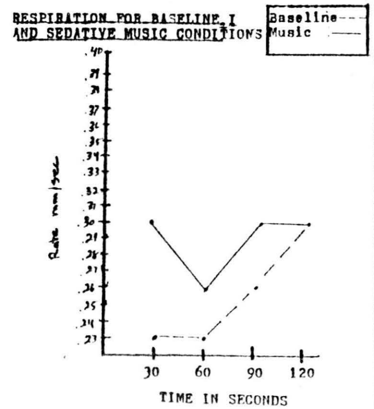
Subject 15

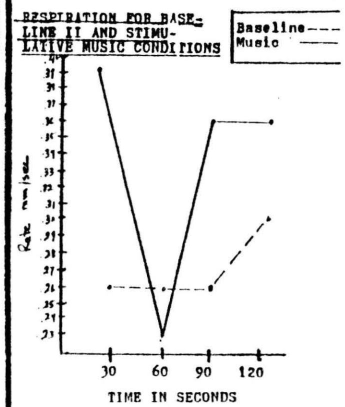

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm/Excited Scale
BASELINE
B
A
TREATMENT CONDITION


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
B
A
TREATMENT CONDITION

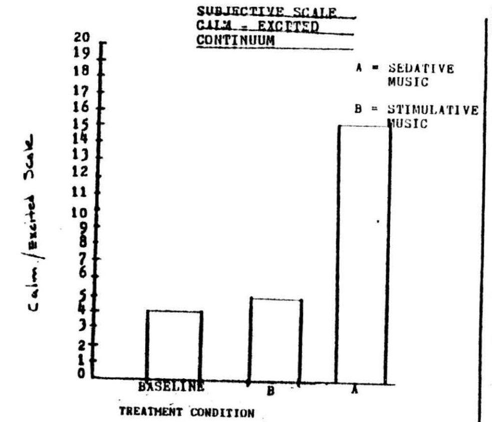

GSR FOR BASELINE I
AND SEDATIVE MUSIC
CONDITIONS
Baseline
Music
TIME IN SECONDS

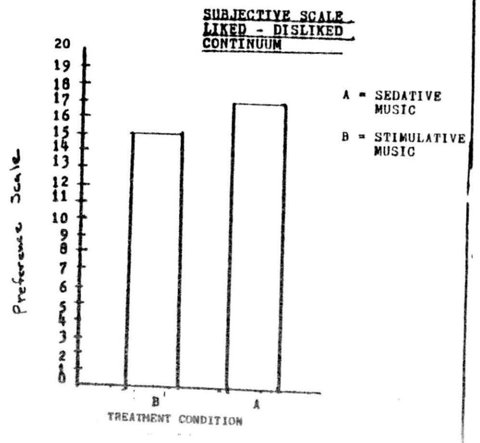

GSR FOR BASELINE
II AND STIMULATIVE
MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS

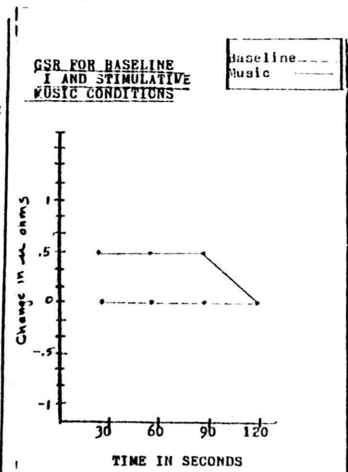

RESPIRATION FOR BASELINE I
AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS

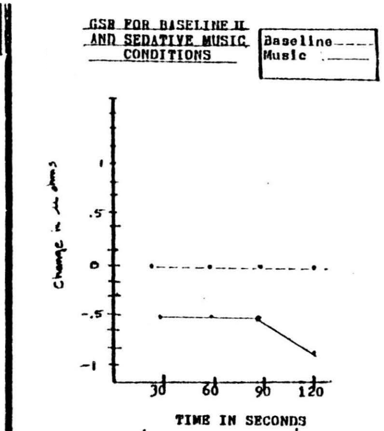

RESPIRATION FOR BASE-
LINE II AND STIMU-
LATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS

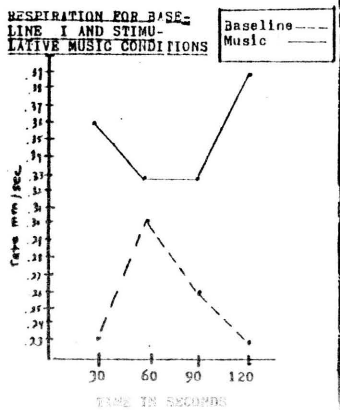
Subject 16

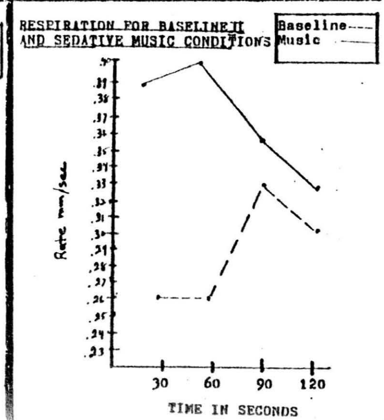

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm/Excited Scale
BASELINE
B
A
TREATMENT CONDITION


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
B
A
TREATMENT CONDITION

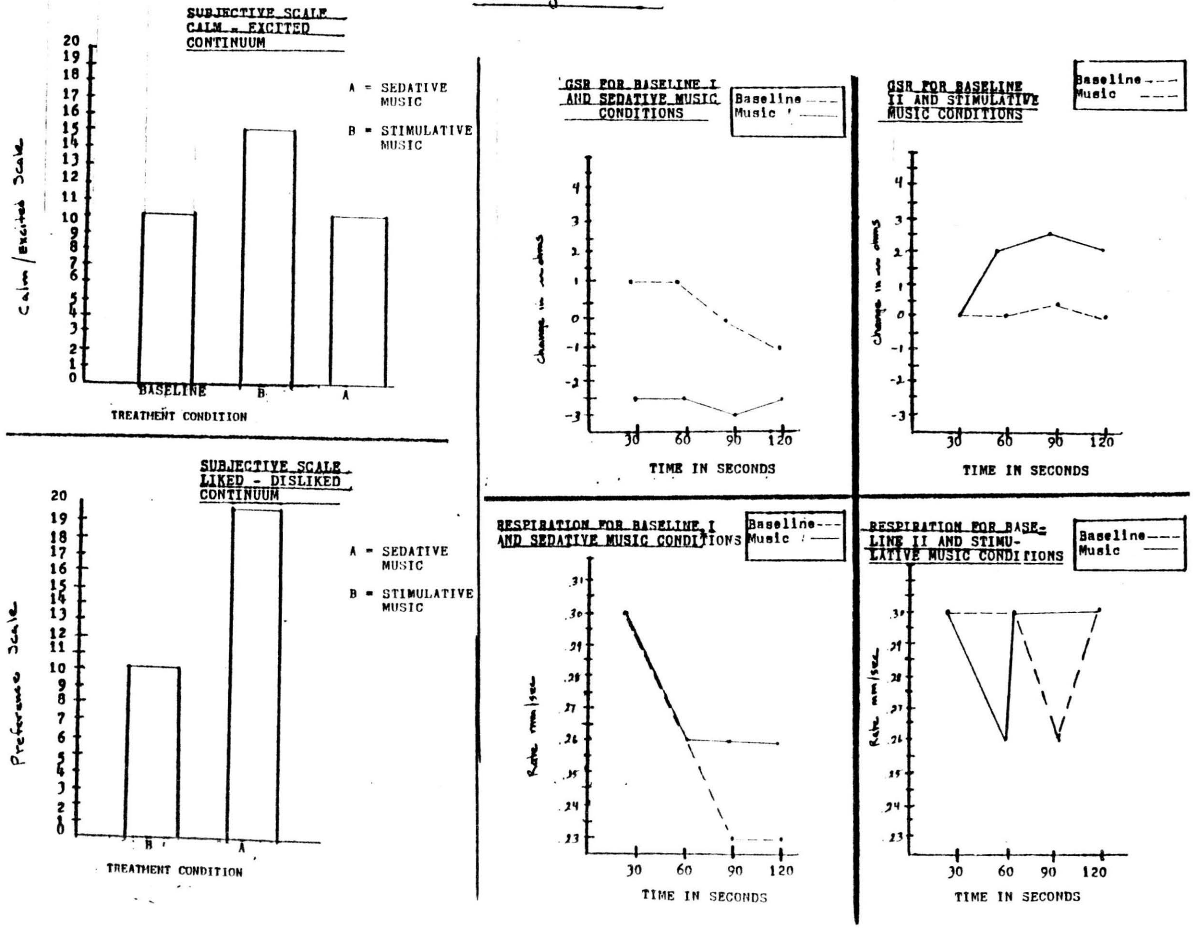

GSR FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Change in ohms
TIME IN SECONDS


GSR FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Change in ohms
TIME IN SECONDS

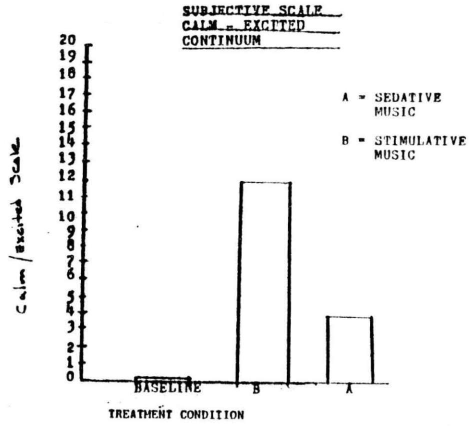

RESPIRATION FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
rate mm/sec
TIME IN SECONDS

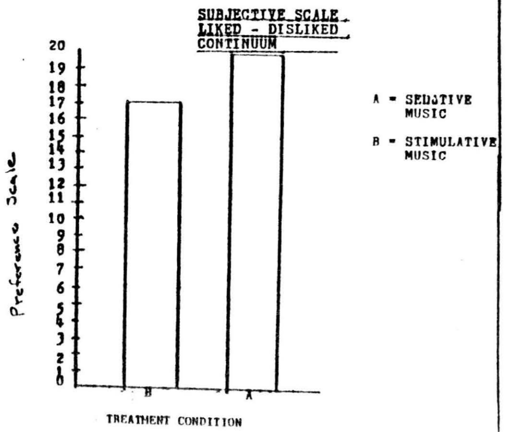

RESPIRATION FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

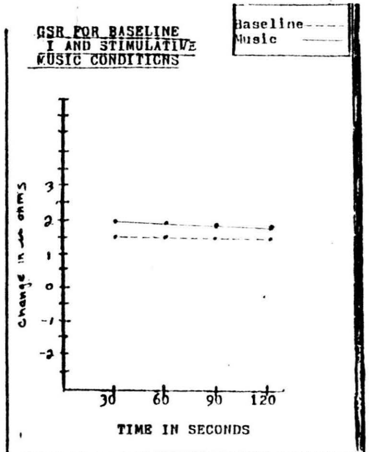
Subject 17

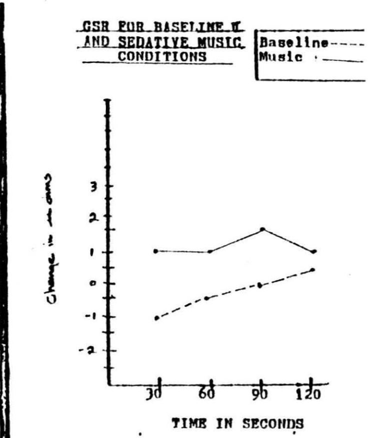

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm / Excited Scale
BASELINE
B
A
TREATMENT CONDITION
GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
change in mohms
TIME IN SECONDS
GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
B
A
TREATMENT CONDITION
RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS
RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

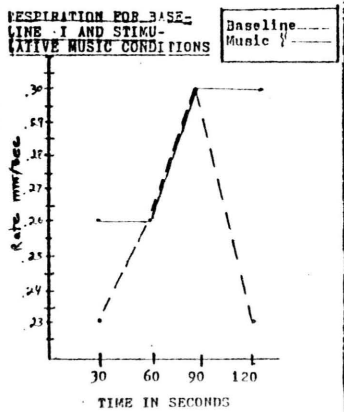
Subject 18

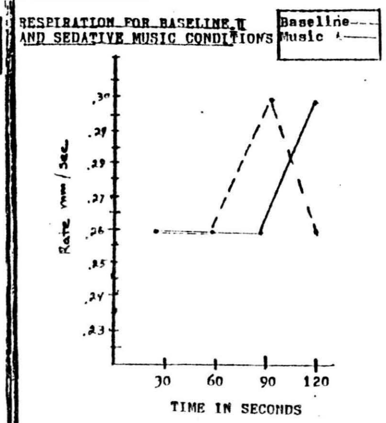

SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
Calm/Excited Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
BASELINE
B
A
TREATMENT CONDITION


SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
Preference Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
B
A
TREATMENT CONDITION

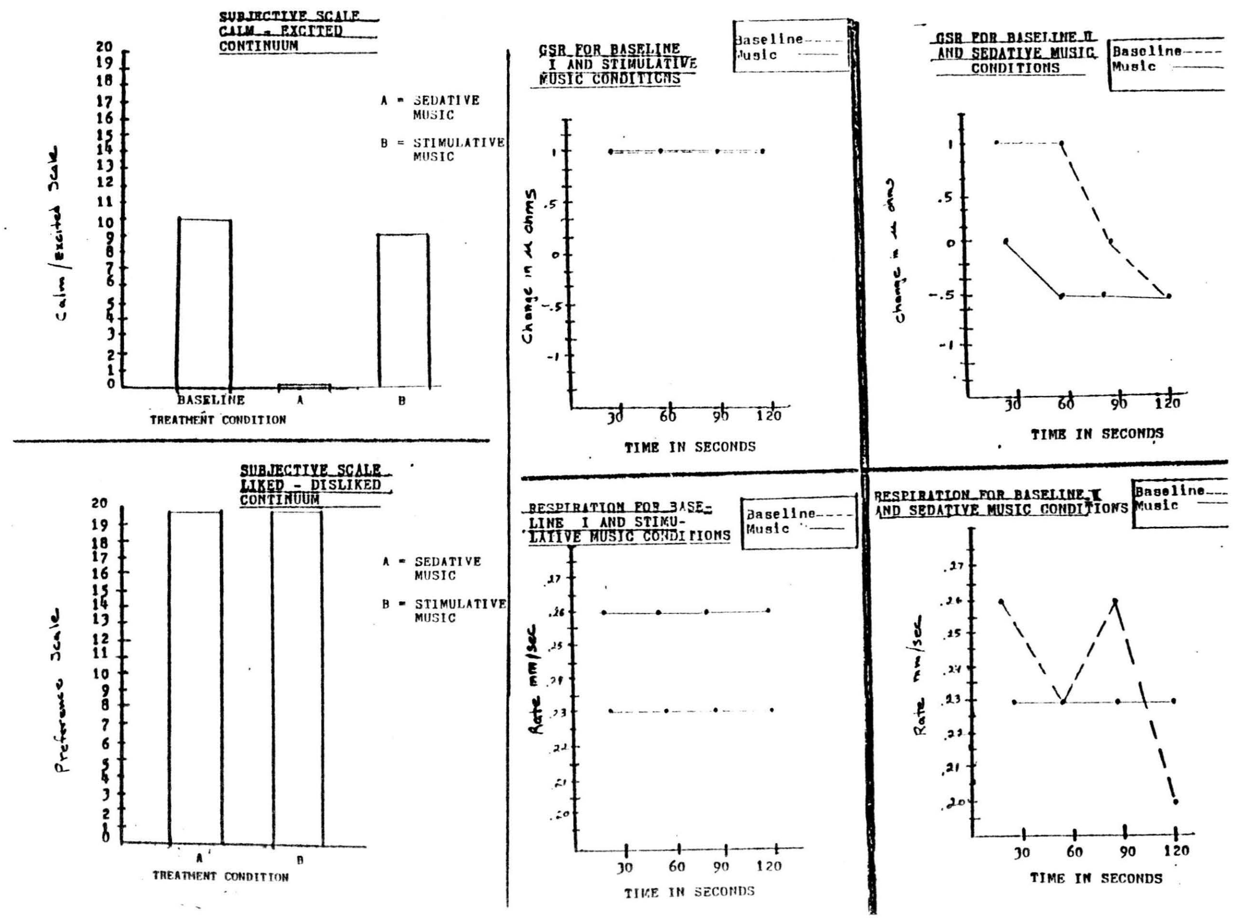

GSR FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS


GSR FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS

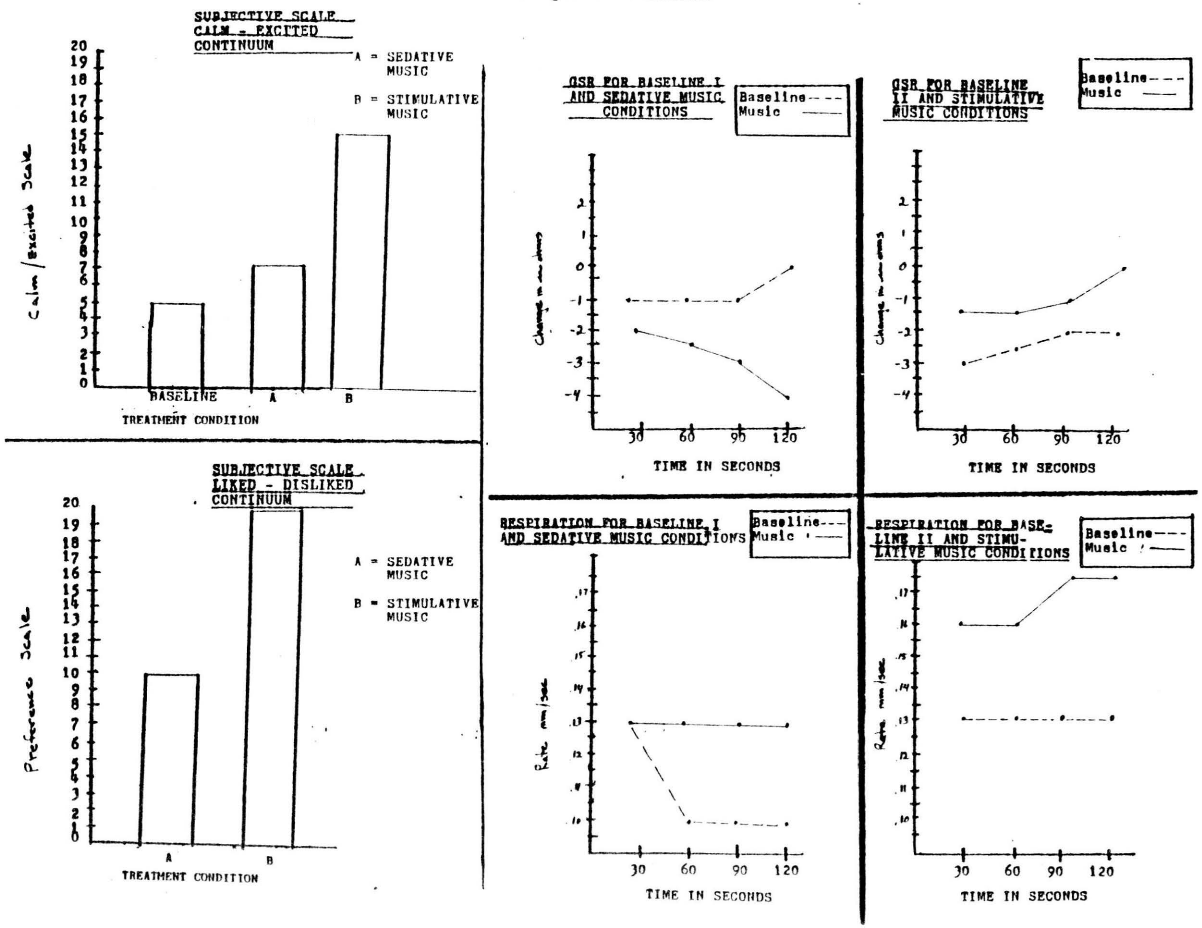

RESPIRATION FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS


RESPIRATION FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS

Subject 19


SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
Calm/Excited Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
BASELINE
A
B
TREATMENT CONDITION
GSR FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Change in M ohms
TIME IN SECONDS
GSR FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
TIME IN SECONDS
SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
Preference Scale
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
A
B
TREATMENT CONDITION
RESPIRATION FOR BASELINE I AND STIMULATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS
RESPIRATION FOR BASELINE II AND SEDATIVE MUSIC CONDITIONS
Baseline
Music
Rate mm/sec
TIME IN SECONDS

Subject 20


SUBJECTIVE SCALE
CALM - EXCITED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Calm / Excited Scale
BASELINE
A
B
TREATMENT CONDITION
GSR FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline - - -
Music ——
TIME IN SECONDS
GSR FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline - - -
Music ——
TIME IN SECONDS
SUBJECTIVE SCALE
LIKED - DISLIKED
CONTINUUM
A = SEDATIVE MUSIC
B = STIMULATIVE MUSIC
Preference Scale
A
B
TREATMENT CONDITION
RESPIRATION FOR BASELINE I AND SEDATIVE MUSIC CONDITIONS
Baseline - - -
Music ——
TIME IN SECONDS
RESPIRATION FOR BASELINE II AND STIMULATIVE MUSIC CONDITIONS
Baseline - - -
Music ——
TIME IN SECONDS

REFERENCES

Alexander, W. "An investigation on the effects of music on personality by way of figure drawings." American Journal of Abnormal Psychology, vol. 8, 1954, 126-132.

Anderson, L., Lubeetkin, B., Logan, D., and Alpert, M. "Comparison of relaxation methods for alcoholics: differential relaxation versus sensory awareness." Proceedings of the Eighty-first Annual Convention of the American Psychology Association, vol. 8, 1973, 391-392.

Altshuler, I. M. "The Past, Present and Future of music therapy." in E. Podolsky, ed. Music Therapy. New York: Philosophical Library, 1954.

Atherly, G. R. C., Gibbons, S. L., Powell, J. "Moderate accoustic stimuli: the interrelation of subjective importance and certain physiological changes." Ergonomics, vol. 13, 1970, 536-545.

Ayres, L. P. "The influence of music on speed in the six-day bicycle race." American Physical Education Review, vol. 16, 1918, 321-324.

Basmajian, J. V. Muscles Alive. Their Functions Revealed by Electromyography. 2nd ed. Baltimore: The Williams and Wilkins Co., 1967.

---------------- "Electromyography on muscular tone and relaxation." Canadian Medical Association Journal, vol. 77, 1957, 203-205.

Benson, H. The Relaxation Response. New York: Morrow, 1975.

Bernstein, D. A., and Bonkovec, T. D. Progressive Relaxation Training, A Manual for the Helping Professions. Champaign, Ill.: Research Press, 1973.

Biller, J. D., Olson, P. J., Breen, T. "The effect of 'Happy' versus 'Sad' music and participation on anxiety." Journal of Music Therapy, vol. 11, 1974, 68-73.

Bingham, W. V. "Studies in melody." Psychological Monographs, vol. 12, 1910.

Bonny, H., and Savary, L. Music and Your Mind. New York: Harper and Row, 1973.

Bourne, S. E. "An evaluation of the effects of induced tension on performance." Journal of Experimental Psycyology, vol. 49, 1955, 418-422.

Breger, I. "Affective response to meaningful sound stimuli." Perceptual and Motor Skills, vol. 30, 1970, 842-850.

Brenneis, N. C. "Mood diferential responses to music as reported by secondary music and non-music students from different socio-economic groups." Dissertation Abstracts International, vol. 31 (ii) 5837A-5838A, 1971, University Micofilms, Number 71-4307.

Brown, H. Brain and Behavior. New York: Oxford University Press, 1976.

Brown, Louis, "Music and the tension headache." in Podolsky ed., Music Therapy. New York: Philosophical Library, 1954.

Bruno, L. L., Hefferline, R. F., and Suslowitz, P. D. (Cross-modality matching of muscular tension to loudness." Perception and Psychophysics, vol. 10, 1971.

Budzynski, T. H. "Feedback-induced muscle relaxation: Application to tension headaches." Journal of Behavior Therapy and Experimental Psychiatry, vol. 1, 1970, 205-211.

----------------, Stoyva, J. M., Adler, M. "EMG bio-feedback and tension headache." Psychosomatic Medicine, vol. 6, 1973, 509-514.

Burns, J. M., Ascough, J. C. "A psychophysiological comparison of two approaches to relaxation and anxiety induction." Behavior Therapy, vol. 2, 1971, 170-176.

Campbell, I. G. "Basal emotional patterns expressible in music." The American Journal of Psychology, vol. 55, 1942, 1-17.

Chaney, D. S. "An electromyographic study of the relationship between relaxation ability and changes in the performance of motor and a mental skill under induced tension." Texas Woman's University Library, Denton, TX, 1970.

Cleary, A. Instrumentation for Psychology. New York: John Wiley and Sons, 1977.

Colbert, J. "The effects of musical stimulation on recall in high and low anxiety students." Doctoral dissertations, New York University Library, New York, 1959.

Coman, F. D. "Observations on the relation of the sympathetic nervous system to skeletal muscle tonus." Johns Hopkins Hospital Bulletin, vol. 38, 1926, 163-188.

Cratty, B. Movement Behavior and Motor Learning. Philadelphia: Lea and Febiger, 1964.

Cromwell, L., Weibell, F., Pfeiffer, E., Usselman, L. Biomedical Instrumentation and Measurements. Englewood Cliffs, New Jersey: Prentice Hall Inc., 1973.

Cuthbertson, D. P. L. "The influences of prolonged muscular rest on metabolism." Biochemical Journal, vol. 23, 1929, 1328-1345.

Daniels, L., Williams, M., Worthingham, C. Muscle Testing, Techniques of Manual Examination. Philadelphia, PA: W. B. Saunders, 1947.

Davies, R. C. "Modifications of the galvanic reflex by daily repetition of a stimulus." Journal of Experimental Psychology, vol. 17, 1934, 504-535.

Decker, Ruby, ed., Motor Integration: Springfield, ILL: Charles C. Thomas, 1962.

DeJong, M. A., Van Mourik, K. R., and Schellekens, H. S. "A physiological approach to aesthetic preference." Psychotherapy and Psychosomatics, vol. 22, 1973, 46-51.

Delagi, E., Perotto, A., Iazzetti, J., Morrison, D. Anatomic Guide for the Electromyograph: The Limbs. Springfield, ILL: Charles C. Thomas, 1975.

Dibner, A. S. "Ambiguity and anxiety." Journal of Abnormal and Social Psychology, vol. 56, 1958, 43-47.

Diserns, C. "Reactions to musical stimuli." Psychological Bulletin, vol. 20, 1923, 173-199.

Dixon, H. "Music and medicine considered from a physiological, pathological and therapeutic standpoint." The Lancet. 1899, 1815.

Dreher, R. E. "The relationship between verbal reports and galvanic skin responses to music." Unpublished Doctoral Dissertation, Indiana University, 1947.

------------- "The measurement of muscular tension as a technique for the study of emotional tendencies." American Journal of Psychology, vol. 44, 1932, 146-162.

Dunbar, H. F. Emotions and Bodily Changes. New York: Columbia University Press, 1935.

Edwards, A. Experimental Design in Psychological Research. New York: Rinehart and Company, Inc., 1950.

Ellis, B. S., Brigham, G. "Effects of music on respiration and heart rates." In M. Schoen, ed., The Effects of Music. New York: Harcourt, Brace and World, Inc., 1927.

Epstein, L., Herson, M., Helpill, D. "Music feedback in the treatment of tension headache, an experimental case study." Journal of Behavior Therapy and Experimental Psychology, vol. 5, 1974, 59-63.

Farnsworth, P. R. The Social Psychology of Music. Iowa: Iowa State University Press, 1965.

Fine, S. E. "Processing and stereophonic presentation of physiological signals." IEEE Transactions on Bio-medical Engineering, Jan., 1971, 9-15.

Fisher, R. "Preferences of different age and socio-economic groups in unstructural musical situations." The Journal of Social Psychology, vol. 34, 1951, 265-273.

----------, and Greenberg, R. P. "Selective effects upon women of exciting and calm music." Perceptual and Motor Skills, vol. 34, 1972, 987-990.

French, J. D. "The reticular formation." Scientific American, 198, 1957.

Gamble, E. A., and Foster, J. C. "The effect of music on thoracic breathing." American Journal of Psychology, vol. 17, 1906, 406-414.

Gardner, E. Fundamentals of Neurology. Philadelphia: W. B. Saunders Co., 1968.

Gaston, E. T. "Dynamic music factors in mood changes." Music Educators Journal, vol. 37, 1951, 42-50.

------------- Music in Therapy. New York, Macmillan, 1968.

Gazzaniga, M., Blakemore, C., eds., Handbook of Psychobiology. New York: Academic Press, 1975.

Geddes, L. A., and Baker, L. E. Principles of Applied Biomedical Instrumentation. New York: John Wiley and Sons, 1968.

Gellhorn, E. "Patterns of muscular activity in man." Archives of Physical Medicine, vol. 28, 1947, 568-574.

Gentile, J. R., Roden, A. H., and Klein, R. D. "An analysis of variance model for the intrasubject replication design." Journal of Applied Behavior Analogue, vol. 5, 1972, 193-198.

Gibbons, S. G. "Physiological effects of noise." Doctoral Dissertation, University of Salford Library, Lancaster, MA, 1970.

Gilliand, A. R., and Moore, H. T. "Immediate and long-time effects of classical and popular phonograph selections." Journal of Applied Psychology, vol. 8, 1924, 309-323.

Gilman, H., and Parperte, F. "Music as a psychotherapeutic agent." Journal of Clinical Psychopathology, vol. 10, 1949, 286-303.

Girard, J. "Music therapy in the anxiety states." In E. Podolsky, ed., Music Therapy. New York: Philosophical Library, 1954.

Goodgold, J. Anatomical Correlations of Clinical Electromyography. Maryland: The Williams and Wilkins Co., 1974.

Graham, F. K., and Clifton, R. K. "Heart-rate change as a component of the orienting response." Psychological Bulletin, vol. 65, 1966, 305-320.

Green, E., Walters, E. D., Green, A., and Murphy G. "Feedback technique for deep relaxation." Psychophysiology, vol. 5, 1969, 371-377.

Greenberg, R., and Fisher, S. "Some differential effects of music on projective and structured psychological tests." Psychological Reports, vol. 28, 1971, 817-818.

Grim, P. "Anxiety change produced by self-induced muscle tension and by relaxation with respiration feedback." Behavior Therapy, vol. 2, 1971, 11-17.

Grossberg, J. M. "The physiological effectiveness of brief training in differential muscle relaxation." Grant RD-982p, Vocational Rehabilitation Administration, U.S. Department, HEW, 1965.

Grossman, S. P. A Textbook of Physiological Psychology. New York: Wiley International, 1967.

Grundlach, R. H. "Factors determining the characterization of musical phrases." American Journal of Psychology, vol. 47, 1935, 624-644.

Gunther, B. Sense Relaxation Below Your Mind. New York: Collier Books, 1968.

Gutheil, E., Wright, J., Parperte, F., Capurso, A., Fisichelli, V., Gilman, L. Music and Your Emotions. New York: Liveright Publishers Corp., 1952.

Hampton, P. "The emotional element in music." The Journal of Genetic Psychology, vol. 33, 1945, 237-250.

Hart, J., and Cogan, R. "Sex and emotional responses to classical music." Perceptual and Motor Skills, vol. 36, 1973, 1170.

Hassett, J. "Teaching yourself to relax." Psychology Today, vol. 12, 1978, 28-40.

Haverland, L. The Effects of Relaxation Training on Certain Aspects of Motor Skill. Urbana, Ill., 1953.

Henkin, R. E. "The prediction of behavior response patterns to music." Journal of Psychology, vol. 44, 1957, 111-127.

Henley, E. "Factors related to muscular tension." Archives of Psychology, vol. 183, 1935.

Herman, E. P. "Relaxing music for emotional fatigue." in E. Podolsky, ed., Music Therapy. New York: Philosophical Library, 1954.

Hevner, K. "The affective value of certain elements of musical form." Psychological Bulletin, vol. 31, 1934, 678.

Heyduk, R. G. "Experimental studies of elements of expression in music." American Journal of Psychology, vol. 48, 1936, 246-268.

-------------- "Expression in music, a discussion of experimental studies and theories." Psychological Review, vol. 42, 1935, 186-204.

-------------- "Rated preference for musical compositions as it relates to complexity and exposure frequency." Perception and Psychophysics, vol. 17, 1975, 84-91.

Hill, A. Muscular Movement in Man. New York: McGraw-Hill Book Co., Inc., 1927.

Hudson, W. O. "Music: A physiologic language." Journal of Music Therapy, vol. 10, 1973, 137-140.

Hume, W. F. "Electrodermal measures in behavioral research." Journal of Psychosomatic Research, vol. 9, 1966, 383-391.

Hunter, J. I. "The sympathetic innervation of striated muscles." British Medical Journal, vol. 1, 1925, 197-201, 251-256, 298-301, 350-353, 398-400.

Hyde, I. M. "The effects of music upon EEGs and blood pressure." In M. Schoen, ed., The Effects of Music. New York: Harcourt, Brace and World, Inc., 1927.

-----------, and Scalapino, W. "The influence of music upon electrocardiagram and blood pressure." American Journal of Physiology, vol. 46, 1918, 35-38.

Hyman, B. "The reciprocal inhibition of test anxiety by means of sedative music stimuli." Unpublished Master's Thesis, Florida State University, 1975.

Inman, V., Ralston, H. J., Saunders, C., Bertram, M., Feinstein, B., and Wright, E. "Relation of human electromyography to muscular tension." EEG and Clinical Neurology, vol. 4, 1952, 187-194.

Izard, C. E. Patterns of Emotion - A New Analysis of Anxiety and Depression. New York: Academic Press, 1972.

Jacob, R., Kraemer, H., Agras, S. "Relaxation therapy in the treatment of hypertension, a review." Archives of General Psychology, vol. 34, 1977.

Jacobson, E. Anxiety and Tension Control. Philadelphia: J. B. Lippincott, Co., 1964.

------------ Biology of Emotion. Springfield, Ill.: Charles C. Thomas, 1967.

------------ ed., Tension in Medicine. Springfield, Ill.: Charles C. Thomas, 1967.

------------ "Differential relaxation during reading, writing and other activities as tested by the knee-jerk." American Journal of Physiology, vol. 86, 1928, 693.

------------ "Electrical measurement concerning muscular contraction and cultivation of relaxation in man." American Journal of Psychology, vol. 107, 1933, 230-248.

------------ "Electrophysiology of mental activities." American Journal of Psychology, vol. 44, 1932, 677-694.

------------ Progressive Relaxation. Chicago: The University of Chicago Press, 1968.

------------ Modern Treatment of Tense Patients, Including the Neurotic and Depressed with Case Illustrations, Follow-ups and EMG Measurements. Springfield, Ill.: Charles C. Thomas, 1970.

------------ and Carlson, A. J. "The influence of relaxation upon the knee-jerk." American Journal of Physiology, vol. 73, 1925, 324-328.

Jellison, J. A. "The effects of music on autonomic stress responses and verbal reports." Unpublished doctoral dissertation, Florida State University, 1972.

Johnson, D. T., and Spielberger, D. "The effects of relaxation training and the passage of time on measures of state and trait anxiety." Journal of Clinical Psychology, vol. 24, 1968, 20-23.

Johnson, M. J. "The relation of music to physical education." National Educators Association, vol. 26, 1941, 373-379.

Jones, B. M., and Schlotter, B. E., eds. Proceedings of the Music Therapy Institute. Illinois: Macmurray College, 1957.

Kendall, H., Kendall, F., and Wadsworth, G. Muscles, Testing and Function. Baltimore: Williams and Wilkins Co., 1971.

Kleinsorge, H., and Klumbies, G. Techniques of Relaxation. Bristol: John Wright, 1964.

Knapp, B. Expression of Emotions in Man. New York: International University Press, 1963.

Knobloch, F., Postolka, M., and Synec, J. "Musical experience as interpersonal process." Psychiatry, vol. 27, 1964, 259-265.

Kohot, H., and Lerarie, S. "On the enjoyment of listening to music." Psychoanalytic Quarterly, vol. 19, 1950, 64-87.

Krugman, H. "Affective response to music as a function of familiarity." Journal of Abnormal and Social Psychology, vol. 38, 1968, 388-392.

Landreth, J. E., and Landreth, H. F. "Effects of music on physiological response." Journal of Research in Music Education, vol. 22, 1974, 4-12.

Langbein, M. "Use of voltmeter during neuromuscular relaxation practice." Dissertation, George Williams College, Downer's Grove, Ill., 1969.

Langbein, W. "A comparison of two approaches for teaching neuromuscular relaxation." Doctoral Dissertation, George Williams College, Downer's Grove, Ill., 1973.

Langer, S. K. Feeling and Form: A Theory of Art. London: Routledget and Kegan, 1953.

Lathrop, R. Introduction to Psychological Research, Logic, Design, Analysis. New York: Harper and Row, Pub., 1969.

Lazarus, R. S., and Opton, E. H. The Study of Psychological Stress, A Summary of Theoretical Formulations and Experimental Findings, in C. D. Spielberger, ed. Anxiety and Behavior. New York: Academic Press, 1966.

Levine, M. G. "Relaxation of spacticity by physiological techniques." Archives of Physical Medicine, vol. 35, 1954, 214.

Licht, S. ed. Electrodiagnosis and Electromyography. Connecticut: Elizabeth Licht, Pub., 1971.

Licht, S. Music in Medicine. Boston: New England Conservatory of Music, 1946.

Lidz, R. The Person. New York: Basic Books, 1968.

Lifton, W. M. "The development of a music reaction test to measure affective and aesthetic sensitivity." Journal of Research in Music Education, vol. 9, 1961, 157-165.

Lippold, O. C. Electromyography, in P. H. Venables and I. Martin, eds. A Manual of Psychophysiological Methods. New York: Wiley and Sons, 1967.

Lloyd, A. J. "Surface EMG during sustained isometric contractions." Journal of Applied Physiology, vol. 30, 1971, 713-719.

------------, Gottlieb, G., and Agarwal, G. "Dynamic relationship between isometric muscle tension and EMG in man." Journal of Applied Physiology, vol. 30, 1971, 345-351.

Lombard, W. P. "The variations of the normal knee-jerk and their relation to the activity of the CNS." American Journal of Psychology, vol. 1, 1887, 2-71.

Lomont, J. F. "The repression-sensitization dimension in relation to anxiety responses." Journal of Consulting Psychology, vol. 29, 1965, 84-86.

Lowe, J. "Excitatory response to music as a reciprocal inhibitor." Journal of Behavior Therapy and Experimental Psychology, vol. 3, 1973, 279-299.

Lundin, R. W. An Objective Psychology of Music. New York: The Ronald Press, 1967.

Lyons, M., and Lufkin, B. "Evaluation of tension control courses for college women." Research Quarterly, vol. 38, 1967, 663-670.

McDougall, R. "The relation of auditory rhythm and nervous discharge." Psychological Review, vol. 9, 1902, 460-480.

McElwain, J. M. "The effects of music stimuli and music chosen by subjects on the production of alpha brain-wave rhythms." Unpublished Master's Thesis, Florida State University, 1974.

McReynolds, P. Advances in Psychological Assessment. California: Science and Behavior Books, 1968.

MacDonaill, M. A., and Basmajian, J. V. Muscles and Movement. Baltimore: The Williams and Wilkins Co., 1969.

Madsen, C., Greer, D., and Madson, C. Research in Music Behavior. New York: Columbia University Teachers College Press, 1976.

Mandler, G., and Kremer, I. "Autonomic feedback, a correlational study." Journal of Personality, vol. 26, 1958, 388-399.

Malmo, R. B. "Anxiety and behavior arousal." Psychological Review, vol. 64, 1957, 276-287.

Martin, David W. Doing Psychology Experiments. Monterey, California: Brooks Cole Co., 1977.

Meyer, L. B. "Meaning in music and information theory." Journal of Aesthetics and Art Criticism, vol. 16, 1957, 16-19.

------------ Emotion and Meaning in Music.

Meyers, W. J., and Gullickson, G. R. "The evoked heart rate response: the influence of auditory stimulus repetition, pattern, reversal and autonomic arousal level." Psychophysiology, vol. 4, 1967, 56-66.

Miller, M. D. "Music and tension." The Psychoanalytic Review, vol. 2, 1967, 365-369.

Miller, W. How to Relax: Scientific Body Control. New York: A. S. Barnes and Co., 1944.

Minium, E. Statistical Reasoning in Psychology and Education. New York: John Wiley and Sons, Inc., 1970.

Misbach, L. E. "Effect of pitch of tone-stimuli upon body resistance and cardio-vascular phenomena." Journal of Experimental Psychology, vol. 15, 1932, 167-183.

Morey, R. "Upset in emotions." The Journal of Social Psychology, vol. 12, 1940, 333-356.

Mostofsky, D. ed. Behavior Control and Modification of Physiological Activity. Englewood Cliffs, New Jersey: Prentice Hall, 1976.

Mott, F. "The influence of song on mind and body." The Journal of Mental Science, vol. 67, 1921, 162-167.

Mull, H. K. "A study of humor in music." American Journal of Psychology, vol. 62, 1949, 560-566.

Niderer, J. A Factor Analytic Study of General Muscular Tension. Los Angeles: University of California, 1959.

Noy, P. "The psychodynamics meaning of music - point IV." Journal of Music Therapy, vol. 4, 1967, 81-94.

O'Gorman, J. H., Mangan, G. L., and Gowen, J. A. "Selective habituation of galvanic skin response component of the orientation reactions to an auditory stimulus." Psychophysiology, vol. 6, 1970, 716-721.

Ornstein, Robert, ed. The Nature of Human Consciousness - A Book of Readings. New York: The Viking Press, 1977.

Parente, J. A., and O'Malley, J. J. "Training in musical rhythm and field dependence of children." Perceptual and Motor Skills, vol. 40, 1975, 392-394.

Partridge, M. J. "Electromyographic demonstration of facilitation." Physical Therapy Review, vol. 34, 1954, 1-7.

Patrick, G. The Psychology of Relaxation. Boston: Houghton Mifflin Co., 1916.

Paul, G. L. "Physiological effects of relaxation training and hypnotic suggestion." Journal of Abnormal Psychology, vol. 74, 1969, 425-437.

----------- "Inhibition of physiological response to stressfull imagery by relaxation training and hypnotically suggested relaxation." Behavior Research and Therapy, vol. 7, 1969, 249-256.

Paul, G. L., and Shannon, D. T. "Treatment of anxiety through systematic desensitization in therapy groups." Journal of Abnormal Psychology, vol. 71, 1966, 124-135.

-----------, and Trimble, R. W. "Recorded versus live relaxation training and hypnotic suggestion: comparative effectiveness for reducing physiological arousal and inhibiting stress response." Behavior Therapy, vol. 1, 1970, 285-302.

Paul, W. "Muscle": Proceedings of the Symposium Held at the Faculty of Medicine, University of Alberta, 1964.

Payne, E. "Musical tests and personality." British Journal of Psychology, vol. 58, 1967, 133-138.

Peretti, P. O. "A study of student correlations between music and six paintings by Klee." Journal of Research in Music Education, vol. 20, 1972, 501-504.

-------------- "Changes in galvanic skin response as affected by musical selection." Journal of Psychology, vol. 89, 1975, 183-187.

--------------, and Swenson, K. "Effects of music on anxiety as determined by physiological skin responses." Journal of Research in Music Education, vol. 22, 1974, 278-283.

Perkins, C. "The effect of muscle relaxation and suggested therapeutic benefit on the reduction of anxiety." Unpublished Doctoral Dissertation. University of Illinois, Urbana, Illinois, 1966.

Phares, M. L. "Analysis of musical appreciation by means of the psychogalvanic reflex technique." Journal of Experimental Psychology, vol. 17, 1934, 119-140.

Pitts, F. "The biochemistry of anxiety." Scientific American, vol. 220, 1969, 69-75.

Plutchik, R. Foundations of Experimental Research. New York: Harper and Row Pub., 1968.

Podolsky, E., ed. Music Therapy. New York: Philosophical Library, 1954.

Podolsky, E. "Some astonishing effects of music on the body." Etude, vol. 38, 1919, 411.

------------ "The influence of music upon the human body." Illinois Medical Journal, vol. 42, 1922, 410.

------------ "How music exerts its favorable influence on the body." Medical Herald, vol. 49, 1930, 328.

------------ "Influence of musical stimuli on the body." Trained Nurse and Hospital Review, vol. 7, 613.

Pratt, C. Meaning of Music. New York: Johnson Reprint Corp., 1968.

Pritchard, E. A. "The electromyogram of voluntary movements in man." Brain, vol. 53, 1930, 344-375.

Prokasy, W., ed. Electrodermal Activity in Psychological Research. New York: Academic Press, 1973.

Prueter, B., and Mezzano, J. "Effects of background music upon initial counseling interaction." Journal of Music Therapy, vol. 10, 1973, 205-212.

Rachman, S. "The role of muscular relaxation in desensitization therapy." Behavior Research and Therapy, vol. 6, 1968, 159-166.

----------- Relaxation. New York: Teacher's College, Columbia University, 1943.

----------- Teach Yourself to Relax. Englewood Cliffs, New Jersey: Prentice Hall, 1957.

Rice, T. B. "Lessons in relaxation." Hygeia, vol. 9, 264-266. 1931.

Ries, H. "GSR and breathing amplitude related to emotional reactions to music." Psychonomic Science, vol. 14, 1969, 62.

Rigg, M. "An attempt to determine how accurately college students can interpret the intended meanings of musical compositions." Journal of Experimental Psychology, vol. 21, 1937, 223-229.

-------- "The effect of register and tonality upon musical mood." Journal of Musicology, vol. 2, 1940, 49-61.

-------- "The expression of meanings and emotions in music." Psychological Bulletin, vol. 37, 1942, 556.

Rimon, R., Sternbach, A., and Huhman, E. "Electromyographic findings in depressive patients." Journal of Psychosomatic Research, vol. 10, 1966, 159-170.

Robinson, D. W. "Concept of noise pollution." Aero Report, Number AC38, 1969.

--------------- "Is there a correlation between rhythmic response and emotional disturbance?" Journal of Music Therapy, vol. 7, 1970, 54.

Robinson, J., and Hirsch, P. "It's the sand that does it." Psychology Today, vol. 3, 1969, 42-45.

Rubin-Rabson, G. "The influence of age, intelligence and training on reactions to classical and modern music." Journal of General Psychology, vol. 22, 1940, 413-429.

Ruesch, I., and Finesinger, J. "The relationship between electromyographic measurements and subjective reports of muscular relaxation." Psychosomatic Medicine, vol. 5, 1935, 132-138.

Rummel, R. "EMG analysis of patterns used to reproduce muscular tension." Research Quarterly, vol. 45, 1974, 64-71.

Ryan, D. E. "Effects of stress on motor performance and learning." Research Quarterly, vol. 33, 1962, 111-116.

Savill, A. "Physical effects of music." Music and Letters, vol. 39, 1958, 16-28.

Schact, R. "The interaction of cognitive and physiological determinants of emotional state." in C. D. Spielberger, ed. Anxiety and Behavior. New York: Academic Press, 1966.

Schoen, M., ed. The Effects of Music. New York: Harcourt, Brace and World, Inc., 1927.

Schullian, D. M., and Schoen, M., eds. Music and Medicine. New York: Abelard-Schumann, Ltd., 1948.

Schultz, J., and Luthe, W. Autogenic Training: A Psychophysiologic Approach in Psychotherapy. New York: Grunet and Straton, 1959.

Sears, M. S. "A study of the vascular changes in the capillaries as affected by music." Unpublished Master's Thesis, University of Kansas, 1954.

Sears, W. W. "Postural responses to recorded music." Unpublished Master's Thesis, University of Kansas, 1951.

------------ "The effects of music on muscle tonus." Music Therapy. New York: Allen Press, 1957.

Shatin, L. "The influence of rhythmic drumbeat stimuli upon the pulse rate and general activity of long-term schizophrenics." Journal of Mental Science, vol. 103, 1957, 172.

---------- "Alteration of mood via music: A study of the vectoring effect." Journal of Psychology, vol. 75, 1970, 81-86.

Shaw, F. An Introduction to Relaxation Methods. New York: Dover Pub., 1953.

Shepard, J. F. "Organic changes and feeling." American Journal of Psychology, vol. 17, 1906, 521-584.

Shrift, D. "Galvanic skin responses to two contrasting types of music." Bulletin of National Association for Music Therapy, vol. 4, 1955, 5.

Siegel, S. Nonparametric Statistics. Boston: McGraw Hill, 1956.

Sipprelle, C. N. "Induced anxiety." Psychotherapy: Theory, Research and Practice, vol. 4, 1967, 36-40.

Skelly, C. G., and Haslervd, G. M. "Music and the general activity of apathetic schizophrenics." Journal of Abnormal Social Psychology, vol. 47, 1952, 188-192.

Slaughter, F. E. "The effect of musical stimuli on normal and abnormal subjects as indicated by pupillary reflexes." in M. Bing, ed. Music Therapy, Lawrence, Kansas: Allen Press, 1954.

Soglow, M. H. Relax Your Way to Health. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1958.

Sopchak, A. "Individual differences in response to different types of music in relation to sex, mood and other variables." Psychological Monographs, vol. 69, 1955, 396.

------------ "A relation between MMPI scores and musical projective." Journal of Clinical Psychology, vol. 13, 1957, 165.

Spielberger, C. State-Trait Anxiety Inventory. Palo Alto, California: Consulting Psychologists Press, Inc., 1970.

----------------, and Sarason, D. Stress and Anxiety. New York: John Wiley and Sons, 1975.

Stanton, H. E. "The effect of music on test anxiety." Australian Psychologist, vol. 8, 1973, 220-228.

Steinhaus, A., and Norris, J. "Teaching neuromuscular relaxation." Cooperative Research Project Number 1529, Washington: Office of Education, 1964.

Stephens, E. "The effect of music and relaxation on the anxiety level of alcoholics." Unpublished Master's Thesis, Florida State University, 1974.

Sternbach, R. A. Principles of Psychophysiology. New York: Academic Press, 1967.

Stetson, R. B. "A motor theory of rhythm and discrete sensation." Psychological Review, vol. 12, 1905, 250-270.

Stokes, J. H. "Recognition of tension." Journal of the American Medical Association, vol. 105, 1935, 1007-1013.

Stoudenmire, J. "A comparison of muscle relaxation training and music in the reduction of state and trait anxiety." Journal of Clinical Psychology, vol. 31, 1975, 490-492.

Stroud, J. B. "Apparatus for measuring muscular tension." Journal of Experimental Psychology, vol. 14, 1931, 184-185.

Sunderman, L. F. "A study of some physiological differences between musicians and nonmusicians, I-blood pressure." Journal of Social Psychology, vol. 23, 1946, 205-215.

Swale, V., and Thompson, J. H. "The effects of music upon the human blood pressure." The Lancet, vol. 1, 1929, 534-537.

Talbot, E. B., and Darlington, L. "Distraction by musical sounds; the effect of pitch upon attention." American Journal of Psychology, vol. 9, 1897, 332-343.

Tart, C. Altered States of Consciousness, Book of Readings. New York: Wiley and Sons, 1969.

Taylor, D. "Subjective responses to precategorized stimulative and sedative music." Journal of Music Therapy, vol. 10, 1973, 86-94.

Teyler, T., Roemer, R., Thompson, K., Thompson, R., Voss, F. "The role of sensory biofeedback in EMG response." In L. Geddes, Principles of Applied Biomedical Instrumentation. New York: John Wiley and Sons, 1968.

Tindall, G. M. "Rhythm for the restless." Personnel Journal, vol. 26, 1937, 120.

Todd, F. J., and Kelley, R. "The use of hypnosis to facilitate conditioned relaxation responses." Journal of Behavior Therapy and Experimental Psychiatry, vol. 4, 1970, 126.

Traxel, W., and Wrede, G. "Changes in physiological skin response as affected by musical selection." Journal of Experimental Psychology, vol. 16, 1959, 57-61.

Uherik, A., and Kurio, J. "Perception of musical stimuli and the bioelectric response of the skin." Psychologia and Patopsychologia Dietata, vol. 4, 1969, 299-306.

Underwood, B., and Shaughnessy, J. Experimentation in Psychology. New York: John Wiley and Sons, Inc., 1975.

Walker, C. Learn to Relax: Thirteen Ways to Reduce Tension. Englewood Cliffs, New Jersey: Prentice Hall, 1975.

Warthin, A. S. "Some physiological effects of music on hypnotized subjects." Medical News, vol. 65, 1894, 89-92.

Wascho, A. "The effects of music upon pulse rate, blood pressure and mental imagery." Unpublished Doctoral Dissertation, Temple University, 1933.

Watson, B. "The nature and measurement of musical meanings." Psychological Monographs, vol. 54, 1942, 244.

Webster, C. "Relaxation, music and cardiology: the physiological and psychological consequences of their interrelation." Australian Occupational Therapy Journal, vol. 20, 1973, 9-20.

Wechsler, D. "The measurement of emotional reaction: researches on the psychogalvanic reflex." Archives of Psychology, Number 76, 1925.

Wedin, C. "A multidimensional study of perceptual-emotional qualities in music." Scandinavian Journal of Psychology, vol. 13, 1972, 1-17.

Weidenfeller, E. W., and Zimny, G. H. "Effects of music upon GSR of depressives and schizophrenics." Journal of Social Psychology, vol. 64, 1962, 307-312.

Weinstein, J., Averill, J. R., Opton, E. M., and Lazarus, R. S. "Defensive style and discrepancy between self-report and physiological indices of stress." Journal of Personality and Social Psychology, vol. 10, 1968, 406-413.

Welch, B. Z. "Physiological effects of audible sound." Science, vol. 106, 1969, 533-534.

Weld, H. P. "An experimental study of musical enjoyment." American Journal of Psychology, vol. 23, 1912, 245-308.

Whitehead, A. N. Symbolism: Its Meaning and Effect. New York: Capricorn Books, 1969.

Wickramasekera, B. "EMG feedback training and tension headache, preliminary observations." American Journal of Clinical Hypnosis, vol. 15, 1972, 83-85.

Wilson, C., Aiken, L. "The effects of intensity levels upon physiological and subjective affective response to rock music." Journal of Music Therapy, vol. 14, 1977, 60-76.

Wilson, V. M. "Variations in gastric motility due to musical stimuli." Unpublished Master's Thesis, University of Kansas, 1957.

Winckel, F. Music, Sound and Sensation. New York: Dover Books, 1967.

Winold, A. "The effects of changes in harmonic tension on the GSR." Music Therapy Yearbook, vol. 10, 1958, 188-191.

Wooden, H. E. "The effects of sedative music and test measured anxiety level on the initial client-therapist relationship." Dissertation Abstracts, Number 1810,1972.

Wyn, R. "Mechanism of music as an emotional intensification stimulus." Dissertation Abstracts International, vol. 30, 1972, 7092A, University microfilms, Number 72-16, 546.

Yingling, R. A. "Classification of reaction patterns in listening to music." Journal of Research in Music Education, vol. 10, 1962, 105-120.

Zimmy, G. Method in Experimental Psychology. New York: The Ronald Press Co., 1961.

---------, and Weidenfeller, E. "Effects of music upon GSR of children." Child Development, vol. 33, 1962, 891-896.

--------- "Effects of music upon galvanic skin response and heart rate." American Journal of Psychology, vol. 76, 1963, 311-314.

--------- "Physiological effects of music." Proceedings of the National Association for Music Therapy, vol. 11, 1961, 183-190.

Zuckerman, M., and Lubin, B. Manual for the Multiple Affect Adjective Check List. San Diego, California: Educational and Industrial Testing Service, 1965.

--------------, and Spielberger, C. Emotions and Anxiety, New Concepts, Methods and Applications. New York: Lawrence Erlbaum Associates, Pub., 1976.