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THE UNIVERSITY OF ALBERTA

Stress Management Using Music

by

Marilyn Allison

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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THE UNIVERSITY OF ALBERTA

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Stress Management Using Music submitted by Marilyn Allison in partial fulfillment of the requirements for the degree of Master of Education in Educational Psychology.

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Supervisor

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Date: Oct. 13, 1988

Dedication

To Agustin Garcia, my grandfather; to my family, friends and to all the other women and men whose love, trust and acceptance make this world a healthy and safe place.

Abstract

The purpose of this study was to evaluate the effect of relaxing music on EMG and finger temperature measures of tension reduction in a group of college students (N=40) who are not professional musicians and do not have a history of tension headaches, that is, a normal sample. Particularly, the purpose was to evaluate whether or not differences could be seen between and among four types of music that have been found, in the literature, to be relaxing, and a no music condition. There were four music conditions consisting of entrainment music (Mark Rider), Steven Halpern's music, Baroque (Pachelbel) music, jazz (Pat Metheny) music, and a no music condition. The tape-listening procedure consisted of these five music conditions presented in one of five different orders to randomly assigned subjects. Interspersed between the music conditions were five types of visual-spatial puzzles. The effects of the music on the relaxation response of each volunteer were measured by EMG and finger temperature readings. The primary statistical analysis used was a one-way ANOVA with repeated measures. Analyses of variance examining the mean and slope values of EMG and finger temperature revealed that there was no significant difference among the music conditions. The criterion for judging significance was an F-ratio at $p = .05$. Comparing the four music conditions with the no music condition using the Scheffe test also revealed no difference between the group of four music conditions and No Music. Post Hoc comparisons using between group t-tests indicated that the music by both Mark Rider and Pat Metheny was found to be significantly less relaxing ($p < .05$) than Steven Halpern's, or Pachelbel's music and the no music condition, using EMG mean as a measure. When Pat

Metheny's music was compared to the other music conditions using EMG slope as a measure of rate of relaxation, it was found that Pat Metheny's music relaxed people at a faster rate ($p<.05$) than the other music conditions. Using finger temperature mean as a measure of relaxation, Pat Metheny's music raised finger temperature to a higher level ($p<.05$) than any of the other music conditions. Implications for counselling and for further research were discussed.

Acknowledgements

I would like to express my appreciation to Dr. Don Sawatzky and Dr. Gerry Kysela, my Advisors, for their support, advice and encouragement; to Dr. Peggie Platt and Dr. Jack Goldberg for their careful editing, suggestions, and patience; to Dr. George Fitzsimmons, for his support, advice and use of the University of Alberta, Department of Educational Psychology, Biofeedback Laboratory; to Derek Berthiaume for support, advice and expertise with computer programming; to all the volunteers who generously gave their time; to the women of the Women's Workshop for their encouragement and empowerment; and to Lin Marie Clark for her patience, support and excellent work.

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CHAPTER I

INTRODUCTION

> The powers that can be communicated to earth by means of music are as yet scarcely suspected by the average individual.
>
> But the time is fast approaching when Man will select his music with the same intelligent care and knowledge he now uses to select his food. When that time comes, music will become a principle source of healing for many individual and social ills, and human evolution will be tremendously accelerated.
> (Corinne Heline, Esoteric Music of Richard Wagner).

Stress as a Part of Our Lives

In the industrialized first world, children and adults no longer tend to die of infectious diseases such as typhoid, cholera, measles, smallpox and tuberculosis at the tremendous rate we once did during the nineteenth century. We live long enough to experience the slow deterioration of our bodies. We witness the clogging of our arteries, the gradual weakening of the immune system until a tumor is finally allowed to take hold. In recent decades, medical science has come to an important insight: the diseases of aging we now experience, the rate at which they progress, can be influenced by how we live our lives, particularly, by how much stress we encounter (Sapolsky, 1988).

Anxiety and stress are widely recognized as having detrimental effects on human behavior and health. Medical advances have been made in understanding the physiology involved. Now it is known how the body constructively responds to a stressful event, how it gathers the energy to cope and how the same responses can cause harm when chronically prolonged, for instance, speeding the rate of cholesterol deposit in the bloodstream, or reducing the immune system's ability to screen for tumors.

Stress has become a growing social concern. An article in Newsweek (April 25, 1988) described several ways in which the current economic and business climate takes a toll on today's workers. Company mergers and takeovers, corporate and government restructuring, high-tech monitoring of worker performance, early retirement and demanding supervisors or bosses create an atmosphere where many workers claim their jobs cause them stress. There is a concern that not only the frequency in which we experience stress is increasing but that we may also experience more chronic, incessant stress now than, say, twenty-five years ago.

There is a growing list of ways in which stress can make us ill. Up to 75 per cent of all medical disorders have been directly attributed to stress (Hanser, 1985). Psychosocial stressors have been implicated in the development or progression of such medical problems as peptic ulcers, ulcerative colitis, skin disorders, female reproductive disfunction, headaches, depression, backache, insomnia, coronary artery disease, respiratory ailments and other life-threatening diseases such as cancer (Hanser, 1985; Whatmore and Kohli, 1974). Research has shown how a lifetime of chronic stress reactions can injure brain cells, aggravating the damage caused by strokes and seizures, and possibly accelerating the loss of mental functioning associated with aging (Sapolsky, 1988).

<u>Stress-Coping Models</u>

Since stress is so thoroughly a part of our lives, many individuals and mental health practitioners have developed and applied various models for coping with stress. There are two major categories of coping models: the instrumental and the palliative (Hanser, 1985). The instrumental model involves using direct action to change a problematic interaction. The purpose of most instrumental models is to change the environmental demands the person encounters, or to enhance the ability of the person to cope with the situation.

The palliative approach attempts to regulate the emotions associated with stress. The primary concern in this model is in managing tension and avoiding or minimizing distress. Examples of palliative stress-reduction techniques are: guided imagery, music, systemic or progressive muscle relaxation, hypnosis and biofeedback (Hanser, 1985). In actual practice, coping strategies combine instrumental and palliative techniques by focusing attention, regulating emotions and solving the immediate problem.

Stress Management Using Music

Through relaxation, music therapy can facilitate changes in emotion. Moreover, it can assist in instrumental strategies by using the music setting as a model for the environment where problems can be identified and solved, as in a psychotherapeutic counselling session (Devlin, 1986). Within the controlled environment of the music therapy situation, stress related behavior can be observed and changed. Here, emotional and behavioral aspects become an integrated coping strategy (Hanser, 1985). Hence, using music to relax our bodies can help prevent illnesses caused by prolonged or chronic stress reactions, even though we may have not yet shown overt manifestations of stress related problems. Also, in cases where we show symptoms of stress related difficulties, such as headaches, backaches, or insomnia, music enhanced relaxation can help us manage, avoid, or minimize the distress we experience as a result of these symptoms.

Knowing which type of music is an effective means of relaxation may be useful in stress management and pain reduction. A person who is aware of an increased stress level in his or her body could be prescribed the use of the most effective type of relaxation music at home or at work when they wish to reduce this level. Instead of using time consuming and costly methods of self-hypnosis, progressive relaxation, or biofeedback, a counsellor or physician may use music which effectively and conveniently relaxes the person.

Music as Healer

Although recorded music around us is often taken for granted, throughout the ages and around the world, music is acknowledged as having a certain magical quality which enchants and inspires us. The use of music in healing has a very long history. According to Achterberg (1985), music is one of the most ancient therapies. In Egypt, four thousand years ago, priest doctors used musical incantations to increase the fertility of women (Podolsky, 1939). In Greek antiquity, Pythagoras, a philosopher and mathematician, believed that if one participated in a daily routine of singing and music making, it would lead to good mental and physical health (Meincke, 1947). Young David, in a Biblical account, caused Saul's melancholy to disappear by strumming on his harp (Hughes, 1948). For thousands of years, Buddist and Hindu priests in India, China and Tibet used chants, melodic patterns and rhythms in a highly developed science of healing (New Age Journal, March/April, 1987). Johann Sebastian Bach wrote a series of harpsichord pieces for the Russian Envoy, Count Kayserling, who often suffered bouts of insomnia. He asked Bach to write some bright, yet calm music, so his musician, Johann Goldberg, could play these to the Count until he slept. The composition is known as the "Goldberg Variations" (Ostrander and Schroeder, 1979). Other examples of musical healing can be found in Hebrew, Arabian, Greek and Roman classical sources (Hughes, 1948), as well as in North American, Australian, Polynesian, and African Aboriginal cultures. Music has played an important part in human health and happiness throughout history, and it has retained its status as a pleasant healing agent even today.

A Question of Music - The Purpose of the Study

Music is magical. It gives us pleasure, plays with our emotions and heals us. We often face our music collection and wonder: what type of music will fit my mood? Which will change my mood to the one I want?

Exactly how music affects our brains and why it influences our bodies is still a matter of scientific debate. The most general question: 'How does music act on our bodies?, is the basic one this research study is helping to answer. Using only the category of 'relaxing music', the specific question of interest here is: 'Is one form of relaxing music more effective than another?' Or 'Does all relaxing music relax in the same way and to the same degree?' The answers to these specific questions will give us some clues as to what elements in music help us relax and heal.

General Overview of the Study

In Chapter I, the rationale for studying music as a means of stress reduction is discussed. Chapter II deals with the physiology of stress, relaxation and how music affects these states. Some issues about the research on the physiological effects of music are discussed and the hypotheses are stated. In Chapter III, the design and method of the experiment is detailed. Chapter IV reveals the results of the experiment and Chapter V discusses the implications of the results, the limitations of the study and suggestions for future research.

Definition of Terms

Anxiety: The affective response to a threat (Lazarus, 1966).

Altered state of consciousness: an inward directed mental state achieved through various practices including meditation, Yoga, deep relaxation, etc. (Achterberg, 1985).

Ludwig (1969) described the general characteristics of an altered state of consciousness as:

(1) a decrease in selective awareness, a suspension of criticism, or inward directed awareness,

(2) letting go or giving in to experience,

(3) changes in body image, such as feeling weightless or feeling disassociated, and experiences of oneness with the universe,

(4) a disrupted time sense,

(5) feelings of joy and ecstasy, feelings of profound insight, and feelings of rejuvenation, and

(6) the inability to communicate the nature of the experience to someone who has not undergone the same experience.

Attention: efforts consisting of action potential output from the occulomotor cortex. These efforts allow some signals coming into the organism to have greater influence on the nervous system than others. This output can be great enough to produce the turning of the eyes toward the source of stimulation or so slight as to produce a response "as if" to look in that direction (Whatmore and Kohli, 1974).

Baroque Music: Music of the period after the Renaissance, beginning about 1600 and ending with the death of J.S. Bach in 1750 (Buggert and Fowler, 1973).

Distress: Debilitating, excessive stress (Selye, 1974).

EMG: Electromyographic measurement of the stress response which assesses the effects of the stress response (or relaxation) on the striate muscle system (Everly and Rosenfeld, 1981).

Emotion: A state of the organism that includes such dimensions as affect, physiological changes, and motor-behavioral manifestations (Lazaruz, 1966).

Entrainment: Periodic events that are close in frequency tend to occur in phase with each other, hence minimizing total energy output (Rider and Eagle, 1986).

Eustress: Positive stress arousal which can be a motivating force to improve the quality of life (Selye, 1974).

General Adaption Syndrome: A theoretical framework developed by Hans Selye which structures the collective role of the endocrine response axes during chronic stress (Selye, 1974, 1977).

Homeostatic balance: The adaptive effort of the body's physiological systems to actively maintain a level of functioning, within the limits of tolerance of the systems, in the midst of ever changing conditions (Everly and Rosenfeld, 1981).

Jazz: Music thought to have originated around 1900 in which the musician is creating melodic variations based on harmonies of original material. These variations are created against a background of rhythmic syncopation (The Larousse Encyclopedia of Music, 1976).

Largo: Very slow pace of music, usually 40 to 60 beats per minute.

Melody: An arranged series of tones extracted from a particular scale. This series of tones can convey musical meaning. Most melodies make an impression within the framework of their pitch and rhythm, and their associations with tone color, dynamics and harmony (Buggert and Fowler, 1973).

Pentatonic scales: A five tone scale.

Psychophysiological disorder: Physical alterations in the body which are psychological in origin and if the alterations in the tissue system affected are significant enough and if the organ system affected is essential to life, the psychophysiological disorder may lead to death (Everly and Rosenfeld, 1981).

Psychosomatic disorder: Often confused with what was once termed hysterical neurosis, conversion type, which does not involve the destruction of tissue. Psychosomatic disorders are now called psychophysiological disorders to avoid confusion with conversion type reactions.

Relaxation: An awakened state of hypoaroused psychophysiological functioning, experienced within the total organism or within any bodily system (Everly and Rosenfeld, 1981).

Relaxation response: An overall reduction of the speed of the body's metabolism (Benson,1974).

Relaxing music: A type of music which is shown to produce one or more physiological responses characterized by the relaxation response.

Representation: Signal output from the cortex producing sensory images such as auditory images, visual images, proprioceptive images, tactile images, and pain images (Whatmore and Kohli, 1981).

Rhythm: The organization of sounds in time where a framework pattern is established with unit bars of so many beats (The Larousse Dictionary of Music, 1976).

Stress: The sum of all nonspecific changes (within an organism) caused by function or damage (Everly and Rosenfeld, 1981).

Syndrome: A group of symptoms and signs which appear together (Selye, 1974).

CHAPTER II

LITERATURE REVIEW

> So intimately woven are mind and body that it has been said that there can be no psychological event without a resulting somatic (bodily) event, and no somatic event without a psychological event. (Everly and Rosenfeld, 1981)

What Is Stress?

The term "stress" was first introduced into the health care literature by Hans Selye in 1926. Selye's definition for the concept of stress is "the nonspecific response of the body to any demand" (Selye, 1974). Selye (1974) argues that the stress response represents a set of nonspecific psychophysiological changes independent of the causing stimulus, whether the agent or situation is pleasant or unpleasant. He suggests that regardless of what specific action a stimulus produces in the body, the action demands a readjustment or adaption toward normalcy. For example, when we use our muscles either to jog or to shovel heavy snow, a great demand is placed on our musculature and cardiovascular systems. Muscles will need supplemental energy, hence, the heart beats more rapidly and strongly, blood pressure will rise which dilates the vessels and this results in an increased blood flow to the muscles. Once the work or jog is done, heart rate, blood pressure and blood flow return to normal. The essence of stress, according to Selye, is this adaption. In the example, both the increase and the decrease of heart rate, blood pressure and blood flow, regardless of the pleasantness or unpleasantness of the situation, is stress.

Hence, according to Selye (1974), stress is an identical biochemical reaction which occurs during pleasant and unpleasant events. It is a nonspecific psychophysiological response of the individual to adapt to a new environmental situation or internal event.

While many researchers accept Selye's definition, others have argued that the degree of specificity in the psychophysiological stress response may vary as a function of the stimulus and the individual's predisposition (Everly and Rosenfeld, 1981).

Lazarus (1966) argued that stress is not a response, a stimulus or an intervening variable, but an area of study. Lazarus noted that the phenomena of stress is most easily identified when there is a disturbance of biological and psychological functioning, brought about by threatening, damaging or demanding life situations such as natural disasters or imprisonment. Stress reactions occur under conditions that disrupt or endanger established personal and social values of those who are exposed to them. Hence, the stimulus conditions become identified as stressful situations. However, stress cannot be defined exclusively by a situation alone because the ability of any situation to produce stress reactions depends on the characteristics of the individual. Therefore, a definition of stress must include the important role of personality factors in producing stress reactions. Monat and Lazarus (1977) noted that in the literature, stress encompasses "any event in which environmental demands, internal demands or both tax or exceed the adaptive resources of the individual, social system or tissue system".

Stress can be examined from three points of view: the physiological, the psychological, and the social. Physiological stress deals with tissue and organ systems, psychological stress with the cognitive evaluation of a threat, and social stress with social units or systems. In ways that are not yet completely clear, these points of view are related. Stress can be further examined in terms of stimulus or response.

On the stimulus side, Lazarus (1966) discusses conditions that produce stress reactions. He noted that these stress conditions had common characteristics. Stressful situations were those where the individual's physical survival was uncertain, the maintenance of one's identity was unclear, there was little ability to control one's environment, and no opportunity to avoid pain and deprivation. He found that in situations of less severe threats or losses, the severity of the reaction was correspondingly reduced.

On the response side, Lazarus (1966) lists four main classes of stress reactions: affect, motor-behavioral reactions, changes in cognitive functioning, and physiological changes. Affects such as fear, anxiety, anger, depression and guilt represent the most important responses in this category. Motor behaviors such as tremor, increased muscle tension, speech disturbances, and particular facial expressions are also indicative of stress reactions. A third category of stress response represents changes in adequate cognitive functioning. Lazarus (1966) indicated that there is extensive literature on the effects of stress on perception, thought, judgment, problem solving, perceptual and motor skills and social — adaption. Lastly, a widely used class of stress indicators is physiological change, which includes reactions of the autonomous nervous system and of the adrenal glands which secrete various hormones under stress. With respect to the autonomous nervous system, some of the end-organ responses that have been studied as indicators of stress include: galvanic skin response (GSR), blood pressure, heart rate, respiration, skin temperature and electromyographic responses (EMG), to mention a few.

In the literature, sometimes the response aspects of stress are emphasized, and at other times, the antecedents of the stress response, the stressors, are emphasized. Clearly though, the antecedents of stress can never be completely separated from the nature of the stress reaction. This produces a somewhat circular description of the stress phenomena, in that the stress stimulus is defined by the reaction and the stress reaction is defined by how it related to the stress stimulus (Lazarus, 1966). The difficulty with this circularity is that ultimately we want to be able to predict which conditions are necessary and sufficient to produce stress reactions, particularly when the stress reactions are less extreme and severe than those pointed out earlier. Most stress phenomena in everyday life do not occur during extreme situations such as concentration camps, floods, tornadoes and explosions.

As yet, there is no coherent theory of stress. Many issues remain unresolved and confusion about the definition of stress still exists. In the meantime we can look at the characteristics of stress situations and stress responses, and examine those which are of interest.

For the purpose of this study, we will discuss the response side of the stress phenomena, particularly at the physiological level but also at the psychological level. Of particular interest are the concepts, definitions and descriptions provided by Selye (1974, 1977). The key concepts and assumptions of stress reactions will be summarized in the following section.

Stress - Key Concepts and Assumptions

Selye defined stress as a reaction to some stimulus. The stress response consists of a psychophysiological reaction that involves complex mind/body interrelationships (Selye, 1974). The stimulus that triggers a stress response is called a stressor.

The cognitive interpretation or meaning an individual assigns to a stimulus determines whether or not a stimulus becomes a stressor. Also, a stimulus becomes a stressor if the stimulus affects the individual through some sensory or metabolic process which is in itself inherently stressful. For example, if a person interprets some stimulus as being challenging or aversive, then they will probably experience a stress response. Or, some stimuli are capable of causing a stress response simply by sufficient exposure to the stimuli. They affect the body via lower brain sensory mechanisms (as with extreme heat, cold or noise exceeding 85 decibels), digestive and metabolic mechanisms (as with caffeine, nicotine and amphetamines) and via strenuous motor activity (as in heavy exercise) (Everly and Rosenfeld, 1981).

In individuals who experience the chronic repetitions of the stress response, end-organ (the organ which shows the clinical signs of excessive stress) dysfunctions or pathologies may result. End-organ pathologies are called psychophysiological disorders. In psychophysiological disorders, there is no underlying anatomical or biochemical lesions producing the malfunction. There is no infection, enzyme deficiency, nutritional deficiency or foreign substance in tissue fluids (Whatmore and Kohli, 1974). Nevertheless, psychophysiological[1] disorders may still result in structural systems such as with peptic ulcers or arterial hypertension. Examples of psychophysiological disorders are allergy, bronchial asthma, hyperventilation, ulcerative colitis, eczema, acne, depression, anxiety and manic behavioral patterns.

It is important for the reader to understand that the end-organ effects or pathologies that result from excessive stress experiences are mistakenly thought of as the psychophysiological stress response itself. Stress is a process of psychophysiological arousal. The end-organ effects and pathologies appear because of chronic repetitions and/or intense instigations of the psychophysiological stress response.

Recall in the previous section, it was mentioned that stress arousal has both positive and negative aspects. Selye (1974) argued that stress arousal can be a motivating force which improves the quality of life. In his concept, positive stress is called "eustress" and excessive, deleterious stress is "distress". The relationship between stress and health and performance is shown in Figure 1. As stress increases, health and performance increase until a point of

1 I call psychophysiological disorders that have previously been called psychosomatic disorders and functional disorders.

maximal return, the optimal stress level, is reached. As stress continues to increase, it becomes destructive to the individual. An individual's optimal stress level, that is, the vertex of one's tolerance for stress arousal as a positive, productive force, seems to depend upon genetic, biological, acquired physiological and behavioral components.

Finally, as mentioned in Chapter I, excessive psychophysiological stress arousal is clinically treated in two ways: the instrumental and/or the palliative approaches. The instrumental approach helps the individual develop and implement strategies to avoid/minimize/modify exposure to stressors, thus the person's tendency to experience the stress response is reduced. The palliative approach helps the individual develop and use techniques and skills which reduce excessive psychophysiological reactions.

Figure 1 has been removed because of the unavailability of copyright permission. The figure represents a curve of health and performance in relation to stress arousal. The apex of the curve represents the optimal stress level. This figure was adapted from Everly and Rosenfeld, 1981, p. 7.

Other Stress Related Concepts

Many of the concepts that are now studied under the topic of stress were previously studied under the heading of emotion. Several stress response categories mentioned earlier, namely affective responses, physiological responses and motor behaviors, are all involved in the concept of emotion (Lazarus, 1966). The cognitive functioning category of stress responses can be viewed as what happens as a result of an emotional state, that is, how an emotional state can impair or enhance a cognitive process.To clarify, tension and anxiety are two concepts associated with stress and are sometimes confused as causing stress, when, in fact, they are responses to stressors,or the perception of a stressor. Tension, "the habitual or persistent reflex contraction of voluntary muscles" (Rinehart, 1980), is a motor response to a stressor. Anxiety, as Lazarus (1966) explained, is a response to a threat; that is, anxiety is an affective stress response, as is panic, depression and aggression.

A Description of the Psychophysiological Stress Response Mechanisms

Overview of the Human Nervous System

The nervous system is divided into two parts: the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS is further subdivided into the brain and spinal cord. The spinal cord is the only route in which impulses can travel from the brain to the rest of the body. The human brain consists of three functional levels: the neocortex, the limbic system, and reticular formation/brain stem.

The neocortex is the highest, most sophisticated level of the human brain. Its functions include the decoding and interpretation of sensory signals, communications, and gross control of muscle-skeletal behaviors. Also, the frontal lobe of the neocortex commands the imagination, logic, decision making, memory, problem solving, planning and apprehension (Everly and Rosenfeld, 1981). The limbic system is the second functional level of the brain and is important in the discussion of stress because it is the emotional (affective) control center of the brain. A complex system of neural structures make up the limbic system. This system consists of the hypothalamus, hypocampus, septum, cingulate gyrus, amygdala and the pituitary gland (the master endocrine gland). The reticular formation and brain stem comprise the lowest functional level of the brain. This level maintains the functions of bare existence such as heart beat, respiratory and vasomotor activity, and conducts impulses through the reticular formation and relay centers of the thalamus en route to the higher levels of the brain.

The PNS is made up of all the neurons in the body except those of the CNS. Two networks form the PNS: the somatic and the autonomic. The somatic network carries sensory and motor impulses to and from the CNS, that is it innervates sensory mechanisms and striate muscles.

The autonomic nervous system carries impulses involved in the regulation of the body's internal environment and the maintenance of homeostasis (balance). It consists of nerve pathways to the heart, the smooth muscles and the glands.

The sympathetic and the parasympathetic branches are two nerve subdivisions that make up the autonomic nervous system (ANS). The sympathetic branch of the ANS is involved in preparing the body for action. The effect of this nerve pathway is that of generalized arousal. The parasympathetic subdivision of the autonomic nervous system is involved in the restorative and relaxation functions of the body. Its basic effect is one of slowing the body and maintaining basic body requirements.

The Stress Response Process

The stress response is a process in reaction to an external psychosocial stimulus. Everly and Rosenfeld (1981) describe axes or central processes implicated in the stress response: the initiation of the stress response via CNS mechanisms, direct neural innervation of end-organs, the neuroendocrine axis, and the endocrine axes. The following is a summary of their description.

The initiation of the stress response

The sensory receptors of the peripheral nervous system must first receive neutral stimuli in order to evoke a stress response. They then send impulses along their sensory pathways of the body to the main ascending pathways of the CNS. The sensory pathways diverge from the main ascending pathways of the CNS to collateral nerves. Through these collateral nerves, perceived environmental events may be combined with emotional states stored in the hypothalamus and limbic system. The divergent pathways reunite with the main ascending pathways and arrive at the neocortex where the stimulus is interpreted. The emotional "gut reaction" we sometimes experience in response to psychosocial stimuli may be attributed to the collateral nerve pathways of the reticular formation.

The neocortical interpretation influenced by this emotional information is then sent to the limbic system again. Emotional arousal may result if the neocortic-limbic interpretation produces a perception of threat or challenge or is in anyway aversive. Thus, stress reactions to psychosocial stimuli do not result from the stimuli themselves but from the cognitive interpretation of the stimuli (Lazarus, 1966).

Direct neural innervation of end-organs

The sympathetic and parasympathetic nerve pathways of the autonomic nervous system affect end-organs quickly via direct neural connections. These are the most direct of all stress pathways and the activation of these autonomic nervous system axes occurs during emotional arousal. Once the neocortical-limbic interpretation of a threatening stimulus occurs, neural impulses descend to the posterior hypothalamus in the case of sympathetic activation, and to the anterior hypothalamus, in the case of parasympathetic activation. From the posterior hypothalamus, sympathetic neural pathways descend to the spinal cord, pass through the sympathetic chain of ganglia to innervate the end-organs. Similarly, the parasympathetic neural pathways descend from the interior hypothalamus through the spinal cord to innervate the end-organs.

Neural activation of the sympathetic system has a generalized arousal effect on the end-organs. Parasympathetic system activation results in inhibition, slowing or restorative effects on the end-organs.

In most people, emotional arousal activates one or more of the three major psychophysiological stress axes. The effects of autonomic nervous system action on end-organs are immediate during the stress response. Chronic effects of stress on the organism, due to the maintenance of high levels of stress arousal for a long time, involve the participation of neuroendocrine axis which mediates the "fight or flight" response.

The neuroendocrine axis

Walter Cannon researched the neuroendocrine process, one particular aspect of the autonomic nervous system's role in the stress response, which he termed the "fight or flight" response (Everly and Rosenfeld, 1981). Cannon also described a phenomenon which he called homeostasis, a concept which paralleled that of Hans Selye who wrote about the body's adaptive effort to stay in balance. Homeostasis, then, is the effort of the body's physiological systems to maintain a level of functioning despite ever changing conditions (Everly and Rosenfeld, 1981).

Cannon thought of the "fight or flight" response as a homeostatic, neuroendocrine response to a perceived threat where the body prepared itself for muscular activity in order to run or to fight.

Neural impulses comprising the "fight or flight" response originate in the dorsomedial-amygdalar complex of the brain, to the lateral and posterior hypothalamus, through the spinal cord to the adrenal medulla (Everly and Rosenfeld, 1981). Stimulation of the adrenal medulla produces a release of adrenalin and noradrenalin into the blood stream which, in effect, create an increase in a generalized adrenergic (adrenal medula) bodily activity (arousal). This effect is identical to direct sympathetic innervation except that it takes 20 or 30 seconds before onset of the activity and it increases the duration of the activity by ten times. Some examples of the effects of stimulating the adrenal medulla are increases in arterial blood pressure, cardiac output, muscle tension, and decreases in blood flow to the kidneys.

The effects of adrenal medullary stimulation last much longer than those of the neural ANS axes, but the most chronic of the stress mechanisms are regulated by the endocrine axes.

The endocrine axes

Three endocrine axes are implicated in the stress response: the adrenal cortical axis, the somatotropic axis, and the thyroid axis. In addition to being involved in the most chronic aspects of three stress response, these axes need to be stimulated much more intensely to activate them, but nonetheless they can be activated by numerous and diverse psychological effects. The endocrine axes are the final pathways to react to stress. This is due to its total reliance on the circulatory system for transportation.

The adrenal cortical axis, the somatotropic axis and the thyroid axis have pathways that originate in the limbic-hypothalamic system of the brain. The hypothalamus has secretory cells which secrete releasing factors (hormone chemicals) pertaining to each axis. The anterior pituitary has specific receptors into which these various releasing factors are accepted. The pituitary, in turn, releases hormones associated with the releasing factors of each axis. The activation of the adrenal cortical axis stimulates the pituitary to release adrenocorticotropic hormone (ACTH) which moderates the release of mineralocorticoid hormones. These hormones regulate electrolytes and blood pressure. ACTH also moderates the release of glucocorticoids, the effects of which, among others, are to increase fructose production and to potentially suppress the immune mechanisms. The somatotropic axis stimulates the release of the somatotropic hormone, a growth hormone, which seems to increase the concentration of free fatty acids in the blood. The thyroid axis stimulates the release of thyroxin, a hormone shown to increase general metabolism, heart rate, heart contractility, blood pressure and sensitivity of some tissue to catecholamines.

Selye (1974) has provided a framework called the "General Adaption Syndrome" to describe the function of the endocrine response axes during chronic stress. The General Adaption Syndrome (GAS) has three phases. The first phase is the alarm phase which represents a generalized shock to the body with the activation of the body's defence mechanisms. The endocrine system comes into play during this phase by activating the three endocrine axes, with primary emphasis on the adrenal cortical system. The second phase is the stage of resistance where the alarm phase processes are greatly reduced and the body's resistance becomes localized. The body attempts to maintain homeostasis while the stressor is present. If the stressor continues, eventually the adaptive mechanisms maintaining the stage of resistance are exhausted, at which point the body enters the stage of exhaustion. At this time, the body reactivates the alarm reaction where the endocrine axes again becomes highly active. Sometimes, during this stage, the actual survival of the individual may be in question.

Therefore, the stress response can be thought of in terms of a temporal sequence. The most immediate response to a stressful stimulus occurs through direct neural pathways to the end-organs. The neuroendocrine "fight or flight" axis represents the intermediate stress effects. Since the reaction time of this axis is reduced by its partial use of the circulatory system as a transport mechanism, its effects can range from intermediate to chronic, and at times may overlap with the endocrine axes. The last response system activated by a stressful stimulus is the endocrine axes, which relies totally on the circulatory system as a transport mechanism. Finally, the General Adaption Syndrome is a framework with which to understand the role of the endocrine response axes in the adaption of the individual to the existence of a chronic stressor. Figure 2 represents the sequence of responses and events involved in the activation of the stress response. Potentially, the activation of each of these axes, the neuroendocrine, the endocrine and the direct innervation of end-organs, could overlap with one another. The neuroendocrine and the endocrine axes are most commonly activated simultaneously.

Figure 2 has been removed because of the unavailability of copyright permission. The figure represents a sequence of reactivity to psychosocial stimuli. It represents the sequence of physiological reactions from the sensory pathways and brain stem to the neocortex and limbic system, to the sympathetic or parasympathetic innervation of the end-organs. This figure was adapted from Everly and Rosenfeld, 1981, p. 31.

Moreover, both of these axes have the potential to be chronically activated. However, all axes and all mechanisms cannot be responsive every time a person is confronted with a stressor. Not all stressors trigger the activation of all sympathetic and parasympathetic effects, for example. Thus an important question remains: what determines which stress response mechanism is activated by which stressor in which individuals? Some important clues will be presented in the next section which will help answer this question.

The links between stress, healing and music

The links between stress, healing and music involved mind/body integration. As was noted in the previous sections, the neocortex and the limbic system are involved in the cognitive and affective interpretation of a stimulus. An important aspect of the stress reaction is the interpretation of the stimulus as a threat to the individual.

The neocortex uses two functions in the interpretation and integration of a perception: attention and representation. Attention is comprised of signals from the neocortex which enable some stimulus signals to have greater influence on the individual's nervous system than others. Attention facilitates input signals. For example, attention directed to a given sound input enables that input to have greater influence on the individual than an auditory input to which the attention is not directed (Whatmore and Kohli, 1974). Attention can be directed to the external environment, the internal environment, to one's efforts to direct action potentials, or to one's representations (images). Music may help the acquisition of new information by focussing attention to the right thing or place at the right time (Jones, 1986).

Signals from the occulomotor cortex to the eyes constitutes the directing of attention. Signal output can be either great enough to produce the complete turning of the eyes toward the stimulus or so slight that it is only "as if" to look in that direction (Whatmore and Kohli, 1974). These signals are in the form of action potentials in the neuron pathways from the neocortex to the eyes. It is these action potentials which produce the input facilitating effect of attention, not the eye movements themselves, although eye movements may occur if the action potentials are great enough.

Whatmore and Kohli (1974) hypothesize that the signal input from the external and internal environment received by the eyes have greater influence on the individual than any other signal inputs. For example, when the eyes are either open or closed and the eye-directing cortical output is "as if" to look in the direction of a sound, the input from that sound takes precedence over any other sound. This is also the case for directing cortical output "as if" looking at one's own body or "as if" to look in the direction of a visual image or other sensory image, which is experienced as being in a specific part of the external or internal environment. The input from these images or representations take precedence over all other inputs. This is important in both stress and healing responses. Attention determines which stimulus input will take precedence over another. Music may focus attention to pleasant imagery or to memories that may have been repressed and brought up to consciousness in order to be restructured.

New sensory inputs, pleasant and unpleasant ones, activate pathways involved in the directing of attention. The more novel, pleasant or unpleasant a stimulus is the greater is its tendency to capture the attention (Whatmore and Kohli, 1974). Novel, pleasant and unpleasant stimuli effect attention-directing mechanisms via inborn or conditioned pathways. A conditioned directing of attention can occur to any signal input after adequate experience with that signal, for example, after sufficient number of pleasant, unpleasant or voluntary attention-directing experiences occurring one after the other.

Therefore, attention determines which sensory input or stimulus will dominate in one's subjective experience at any given moment. The attention itself is not the subjective experience. Stressors are stimuli that are often perceived as being unpleasant or novel or both. Hence, stressors will dominate an individual's subjective experience. Music which is another pleasant and novel experience may be able to compete successfully and change the focus of an interpretation from threatening to non-threatening.

Representations are sensory images produced by signal output from the neocortex. Representations substitute for primary sensory experience (Whatmore and Kohli, 1974). They allow the individual to respond to objects and events that at the moment are not acting on the individual's sense organs. Several types of representing occur in individuals but auditory and visual forms are especially important. Auditory representing occurs when signal output in small amounts from the portions of the cortex controlling the speech muscles, particularly the tongue and throat, activate neurons which produce auditory images of sounds (Whatmore and Kohli, 1974). For example, when recalling a poem to ourselves, we produce signal output from the cortex as we do when reciting a poem aloud, except the signal intensity is much smaller. This signal output produces auditory images of words comprising the poem. Auditory representation often takes the form of inner speech, but representations of other sounds can be made, such as remembering a melody or a song.

Visual representations occur when small amounts of signal output from the part of the cortex controlling the eye muscles, activate neurons in the visual circuits which produce visual images of objects and events. For example, if we close our eyes and picture an event, we produce signal outputs from the cortex as we do when we look at an event with our eyes open, except that the output is much less (Whatmore and Kohli, 1974). Sensory images, like those described above, are similar, but not identical to the sensory experience produced by sense organ stimulation. The difference results from the different circuits used in the two processes. Representing provides signal outputs to circuits in the limbic system, which is involved in the integration of emotions. Music has been known to produce images or representations (Rider,

1985) and these images may interact with the limbic system to change the individual's emotions.

The right hemisphere of the neocortex has components which help in image storage and retrieval (Achterberg, 1985). It is the non-verbal sensory images or representations that are used in thought in this portion of the neocortex and that process information in a nonlinear holistic fashion. The right-side of the neocortex also processes emotional information and helps in making judgements. This side is active during stressful situations. Achterberg (1985) notes that images are predominant in emotionally charged situations, which stressful situations usually are, and images may determine which responses are given under which circumstances. Achterberg (1985) claims that there is a direct relationship between the right hemisphere and the autonomic nervous system, since they are both implicated in the integration of emotion. (The right hemisphere has a vast network of neural connections to the limbic system). The link, she suggests, lies in that the ANS more readily accepts messages which are in the form of representations (images) and that images are intimately connected with physiology. She claims that imagery is the medium of communication between the consciousness and the internal environment of the body. Pribram (1982) showed that music generates emotions and it is these emotions which give meaning to music. Music also generates images. The processing of images, emotion and music occurs in the right cerebral hemisphere.

Transduction and state dependent learning

How does imagery facilitate the communication between consciousness and the body's internal environment? Ernest Rossi (1986) explains this through the concept of information transduction in mind/body healing. Transduction is defined by Rossi (1986) as "the conversion or transformation of energy or information from one form to another". Rossi (1986) argues that the human body can be thought of as a web of interlocking information systems, such as the genetic, hormonal or immunological systems. The codes of these systems are each unique to its system. Information is transmitted between systems with the help of a converter or transducer which allows the code of one system, say genetic, to be translated into the code of another, say, hormonal system. Rossi cites evidence to suggest that it is the limbic-hypothalamic system which is the major mind-body transducer. Some of this evidence comes from Selye and the process he call the "General Adaption Syndrome" where mental and/or physical stresses are converted or transduced into psychophysiological problems by the hormones of the hypothalamic-pituitary-adrenal axis of the endocrine system.

Rossi (1986) explains further that the limbic-hypothalamic system converts mental experience into the physiological responses characteristic of emotions. Rossi (1986) cites work by Scharers and Harris who discovered the existence of secretory cells in the hypothalamus that worked as molecular information transducers. These cells converted the neural impulses that encoded "mind" or representations into the hormonal messenger molecules of the endocrine system regulating the body.

Rossi (1986) agrees with Everly and Rosenfeld (1981) when he explains that the neocortex organizes and expresses the "attention-getting" novel stimuli. The neocortex (frontal lobes) regulates the state of the body by synthesizing information about the outside world and about the internal state of the body and funnels this information through the limbic-hypothalamic system. The limbic-hypothalamic system then integrates this information with emotion. Regulation of the body state involves the construction of a body image in the frontal cortex and limbic system. This visual imagery is created with the help of the right hemisphere. The right hemisphere plays a predominant role in the holistic, metaphoric information transduction (conversion) which is characteristic of emotions and imagery. The right hemisphere's methods of information transduction are closely associated with the limbic-hypothalamic system and mind-body communication (Rossi, 1986). The right hemisphere has a primary role in the production of raw imagery, which tends to occur during dreaming, sleeping, muscle relaxation, free association, mind wandering, and is activated by music in the untrained listener who is enjoying music.

Experiences of the individual release hormones in the brain which modulate the strength of the memory of the experience. The limbic-hypothalamic system is involved in memory and learning and this system also interacts with hormones. The limbic-hypothalamic system is the area of the brain where information stored by many information systems is combined and integrated. Sensory-perceptual information from visual, auditory and the other sensory modalities, is available to the hypothalamus for it to convert (by hormones) the sensory information into the body's psychophysiological responses.

State-dependent memory and learning is described as: "what is learned and remembered is dependent on one's psychophysiological state at the time of the experience" (Rossi, 1986).

David Cheek (Rossi, 1986) studied severe stress, emotional trauma, and psychosomatic symptoms. Cheek proposed that severe stress caused an altered state, which he supposed was a state-dependent condition that brought up information previously conditioned by earlier similar stress. At such times, the individual may return in memory and physiological behavior to an earlier moment of great stress. This seems to suggest that experience is state-bound or state-dependent, that is, experience can be brought on by bringing about a particular level of arousal, or by presenting some symbol of its interpretation, such as an image, melody or taste. Therefore, music may be used to access memories with high emotional and stress content. Or, the psychophysiological state associated with relaxing music may be associated with pleasant images and emotions.

Benson (1976) described the relaxation response as having its healing source in the hypothalamic system, resulting in a generalized decrease in sympathetic nervous system activity. Music which elicits the relaxation response may reduce sympathetic nervous system activity. Therefore, learning new information or experiencing pleasant images during music listening, is a positive state dependent learning situation.

Hormones released during periods of stress modulate memory and learning in the limbic system. These hormones of the hypothalamic-pituitary-endocrine system are the same ones that Selye found to be the source of stress related psychosomatic problems. Selye's classical psychosomatic research are state-dependent memory and learning phenomena. The limbic-hypothalamic system processes, encodes and recalls a specific memory trace, and engages memory, learning and behavior with state dependent factors that encode psychosomatic problems (Rossi, 1986).

Mind and body are both aspects of one information system. Biology is a process of information transduction. Mind-body information transduction and state-dependent memory, learning and behavior mediated by the limbic-hypothalamic system, are the two fundamental processes of mind-body communication and healing.

The first stage of Selye's GAS, the alarm reaction is characterized by the activation of the sympathetic nervous system, which released the same hormones (epinephrine and norepinephrene, among others) which modulate the retention of memory. Therefore, learning and memory acquired during the alarm reaction tend to be state-dependent. Memories of the stress situation have become state-bound, that is, they are bound to the precise psychophysiological state evoked by the alarm reaction, together with its associated sensory-perceptual impressions. The psychosomatic response could be any part of the alarm reaction that was originally experienced, ie. anxiety, pain, headaches, ulcers, etc. The initial cause of the stress is gone, but the mind-body, having learned a new defensive psychosomatic mode of adaption, continues with the same maladaptive response. The psychosomatic mode of adaption was learned during a special (usually traumatic or threatening) state-dependent psychophysiological condition. It continues because it remains state-bound or locked into that special psychophysiological condition even after the patient apparently returns to his or her normal mode of functioning (Rossi, 1986). This mode of adaptation was learned usually during a highly emotional moment and situation.

Selye's research suggested that since different stressors generate the same physiological syndrome, everyone should manifest the same physiological dysfunctions whatever the source of stress. Each individual manifests different physiological patterns. The fact that the alarm response involves the state-dependent learning of an individual's unique form of adaption, provides a clue as to why different physiological patterns manifest themselves during stress responses for different individuals.

A palliative approach to coping with a stress response is closing the eyes and quieting down to facilitate the process of reviewing memories associated with the psychosomatic problem. Music can be used to focus attention, elicit images and memories which enhance a state of creative problem solving. Getting comfortable lowers the person's overall psychobiological level of arousal, initiates a shift in autonomic system dominance from sympathetic to parasympathetic. Closing the eyes enhances alpha wave generation in the brain which is associated with creative sensing, feeling and imagistic experience. This facilitates a shift from rational and linear left hemispheric processing toward holistic, creative right hemispheric processes which are closely associated with the limbic-hypothalamic information transduction system (Rossi, 1986).

Feeling states, thoughts and images actually cause chemicals to be released (hormones) and chemicals have a feedback effect of causing feeling states (Achterberg, 1985). Pressing the body to its physiological limits and inducing metabolic shifts is a way to induce an altered state and free the imagination. This can happen during stress or during healing. Methods of inducing an altered state include meditation and deep relaxation when concentrating on an object, word, idea or music. Relaxation evokes physical changes that reestablish homeostasis consistent with health (Achterberg, 1985).

The Relaxation Response

Many of the discussions about the relaxation response are given within the context of the stress response. The ergotropic response, usually associated with generalized arousal and the stress response, is the effect of neural activation of the end-organs via the sympathetic nervous system. The trophotropic response can be associated with the stress response in the form of inhibition, but it is usually associated with the parasympathetic nervous system's slowing and restorative functions (Everly and Rosenfeld, 1981). See Table 1 for a summary of the effects of the sympathetic and parasympathetic nervous system. The stress response, particularly the fight or flight aspect of the stress response, has been described as a state of internal imbalance in the two branches of the autonomic nervous system.

Table 1

The Effects of the Autonomous Nervous System

Autonomic Nervous System Branch	Effect
Sympathetic	Increased cardiac rate
	Increased blood pressure
	Sweat secretion
	Pupillary dilation
	Inhibition of gastro-intestinal motor function
	Desynchrony of EEG
	Increased skeletal muscle tone
	Elevation of certain hormones: adrenalin, noradrenalin, adrenal cortical steroids, thyroxin.
	Heightened emotional responsiveness
Parasympathetic	Reduced cardiac rate
	Reduced blood pressure
	Reduced sweat secretion
	Pupillary constriction
	Increased gastro-intestinal motor function
	Loss of skeletal muscle tone

That is, the stress response can be viewed as a state of dominance either in arousal or in inhibition (Nuerenberger, 1981). The relaxation response, then, reflects a state of balance or homeostasis, that is, a state in which physiological systems actively maintain a level of functioning, regardless of changing conditions. This concept is similar to that proposed by Selye, that is, stress is a state of imbalance.

The description of the relaxation response given by Benson, Beary and Carol (1974) assumes a state of increased arousal during the stress response (ergotropic response). Hence, to return to a state of balance, the trophotropic response (called the relaxation response) needs to be activated. The relaxation response, (Benson et al, 1974; Benson, 1976; Benson and Proctor, 1987) consists of an overall reduction of the speed of the body's metabolism, that is, a decrease in oxygen consumption, lowered heart rate, slower brain waves, increased skin resistance, decreased blood lactate levels and decreased muscle tonus. These changes are consistent with decreased sympathetic nervous system activity and increased parasympathetic nervous system activity.

Also associated with the relaxation response is a shift from the dominance of the brain's left-hemisphere, where analytic, linear, ego centered mode of thought is processed, to the dominance of right hemisphere neocortical activity, consisting of intuitive, creative, imaginal, holistic thought processing. It is thought that this relaxed state accompanied by right hemispheric dominance leads to an altered state of consciousness which allows restorative functions of the parasympathetic nervous system and other systems (immune system, for example) to take place. This hypometabolic or restful state can be elicited by many different relaxation techniques. Herbert Benson has identified four characteristics that are important in eliciting the relaxation response. The practice of the relaxation techniques Benson researched, such as Transcendental Meditation, Biofeedback, Sentic Cycles, Hypnosis, Autogenic Training, Zen Meditation and Yoga, have the following characteristics in common:

1. A mental device. The presence of a constant stimulus, such as a sound, word or phrase repeated silently or audibly, which allows for the shifting of thought from logical critical left hemisphere processes to imaginative, creative, intuitive right hemisphere processes.

2. A passive attitude. The disregard of distracting thoughts when they occur during the repetition of the constant stimulus.

3. Decreased muscle tonus. The individual practices the technique in a comfortable position to reduce some muscle tension.

4. Quiet environment. The techniques are practiced in a quiet environment, with eyes closed and with decreased environmental stimuli (Benson, 1976; Everly and Rosenfeld, 1981).

The practice of listening to music by the average person who simply enjoys listening to music has these characteristics in common. Benson (1976) notes that sentic cycles (a method of measuring emotion) devised by Manfred Clynes (1977) demonstrates the close relationship between emotional states and predictable physiological changes. Changes characteristic of the elicitation of the relaxation response have been recorded during the imagined emotional experiences of reverence, love and grief. Pribram (1982) suggested that structured variations in music generates emotions and that repetition in music is also important in the generation of emotion.

Thus, the state of relaxation may be defined as an awakened state of hypoaroused psychophysiological functioning, experienced throughout the individual or within any given bodily system (Everly and Rosenfeld, 1981). Relaxation techniques, such as neuromuscular relaxation, meditation, and some forms of biofeedback, produce a temporary trophotropic state. This trophotropic state, mediated by the parasympathetic nervous system, is a generalized state of decreased psychophysiological activity, described as an awakened state of hypometabolic functioning (Everly and Rosenfeld, 1981). Relaxation techniques appear to be conducive to health, because relaxation is the complete physiological opposite of the sympathetic stress response, and it appears to facilitate psychophysiological restoration within the body. Practicing relaxation techniques once or twice a day for several months tends to reduce limbic and hypothalamic activity which reduces the individual's predisposition to psychophysiological arousal during stressor situations.

Detailed descriptions are available for the processes involved in the stress response. The relaxation response is described within the context of the stress response and also within the context of healing using the imagination. Hence, when talking about relaxation and music, discussing the stress response cannot be escaped. Since it is known that the interpretations made by the neocortex when integrated with emotional information from the limbic system can produce the perception of a threat, it is assumed that the same mechanisms and processes are available to positive interpretations and images of healing. It seems that it is the cortex's attention to either a "threatening" or a "healing" representation which determines whether the bodily systems respond in a catabolic (breaking down) or an anabolic (building up) way.

Relaxation techniques can facilitate healing by reducing the activation of the sympathetic stress response and by allowing the imaginative, creative and intuitive right hemisphere to produce positive healthy representations. These positive healthy representations or imagery trigger the activity and acceleration of the immune system (Achterberg, 1985).

Music and Relaxation

In the previous section, we found that listening to music, simply the act of sitting and listening, has many of the characteristics of the relaxation response. Thus, taking the time to sit and listen can have a relaxing effect. But is it the active listening of music which is relaxing or the act of sitting comfortably? Does any type of music relax or must it be a certain type to relax an individual?

The research literature that deals with the psychological (verbal reports) and the physiological responses to music contains some confusion. This confusion arises partly as a result of the researchers precategorizing the music used in studies into either the sedative or the stimulative category. Taylor (1973) showed that music which had been precategorized as stimulative or sedative did not elicit in listeners the expected responses as measured by self-reports and galvanic skins responses (GSR). There may be three reasons for this result. As proposed by Taylor (1973), one reason may be that subjects were not always aware of the physically stimulative or physically sedative responses to musical stimuli, therefore, the GSR measures and self-report measures only agree 50 percent of the time. A second reason may be that the listener did not agree with the previously assigned stimulative and sedative categorizations of music, therefore, the subjects did not respond in accordance with the precategorization. Thirdly, using GSR as a measure of sedative or stimulative responses to musical stimuli may not be reliable.

Many of the studies employing GSR and heart rate as physiological measures of the effect of music on the listener report contradictory results. Zimny and Weidenfeller (1963) found no significant differences in heart rate for each of the exciting, neutral or calm pieces of music they chose. The GSR remained unchanged during the playing of neutral and calm music, but was indicative of arousal, to the playing of exciting music. Barger (1979) found that music, verbal suggestion, and music plus verbal suggestion were no more effective than silence in reducing heart rate after arousal. Peretti and Swensen (1974) found, contrary to the above studies, that presenting music was effective in reducing anxiety as measured by GSR. Landreth (1974) pointed out in her study that previous studies using heart rate, including the ones mentioned above, refer to total heart rate for a particular music selection. In her study, Landreth considered heart rate changes that occur within segments of music. She found that an elevated heart rate was produced by segments of music characterized by driving and insistent rhythm, mounting sequential interplay, and progressive dynamic intensity. A lowered heart rate was produced by musical segments with conspicuous changes in rhythm, texture, and dynamics. Landreth also pointed out that the summation of the accelerated and decelerated heart rates during a segment showed no apparent change in heart rate over the entire music selection.

Taken together, the results of the above studies, on the effect of music on GSR and heart rate are so far inconclusive. Research using electromyographic (EMG) responses in the study of the effects of music on physiology prove more promising.

The study done by Scartelli (1984) is an exemplary study on the physiological effects of music. He took into account both subjective and objective effects of music and used a wide variety of comparable conditions. Though his study is not definitive, it suggests that music classified by subjects as being sedative, does produce relaxation as measured by EMG responses.

In a study done to measure the effects of different types of music on pain relief, muscle relaxation and pain relief imagery, Rider (1985) found that entrainment music, in which the prevalent mood shifted from tension to relaxation, was the most effective condition in reducing pain and EMG levels.

Thus, the collective results of these studies suggest the music reduces muscle tension as measured by EMG responses, but it is still not clear if music influences GSR and heart rate responses in the direction indicating relaxation.

In one study using vasoconstriction, or finger temperature, to measure relaxation prior to and after the presentation of sedative music, sedative music was found to increase finger temperature, hence, increasing relaxation (Kibler and Rider, 1983). However, sedative music did not seem to produce a significantly higher increase in relaxation than either progressive muscle relaxation or progressive muscle relaxation plus music. Moreover, in a study comparing the effects of sedative and stimulative music using alpha rhythm as a measure of relaxation, Borling (1981) found that the sedative music group spent 26.81 percent more time producing alpha rhythms than the stimulative music group. However, a statistical analysis of the percentage difference between sedative and stimulative music revealed no significant difference in alpha production.

Overall, studies using EMG, finger temperature and alpha rhythms as measures of relaxation indicated that music produces relaxation in listeners. However, it has not been clearly established that sedative music produces greater relaxation than stimulative music.

Researchers have categorized music as either "stimulative" or "sedative" before having objective criteria on which to base this classification. Studies which have attempted to acquire objective criteria in order to classify music, such as those by Taylor (1973) and Logan and Roberts (1984), compare the effects of music on verbal responses of listeners and not on physiological responses. Taylor (1973) noted in his study the possibility that while listeners are aware of their musical preferences and may attribute relaxing qualities to those types of music, listeners may not be aware of their physiological responses to their preferred music. Preferred music may be psychologically relaxing as measured by verbal reports, but may not be physiologically relaxing, as measured by EMG, finger temperature, alpha rhythms, heart rate or GSR.

Researchers have repeatedly used Gaston's (1951) definition of stimulative and sedative music as a subjective categorization of music:

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

These descriptions offered by Gaston include differential properties of the music and also the anticipated effects on listeners, without having had these effects established objectively. When researchers have tried to control differences in the effect of music on listeners by categorizing music as either "stimulative" or "sedative", the observed responses were analyzed in direct relationship to the experimenter's categorization of the music (Taylor, 1973). Attempts to determine the effects of music on the listener were hampered by this classification of music based on purely subjective criteria.

Furthermore, Gaston's use of the word "sedative" to denote calming, soothing music seems inappropriate since "sedative" is also associated with such characteristics as being drugged, drowsy or lacking in alertness. Subsequently, Georgi Lozanov, a researcher in the area of superlearning or suggestology, observed that music can induce a relaxed state in the body and this music-induced relaxation left the mind alert and able to concentrate (Ostrander and Schroeder, 1979). Borling (1981) also found that music can enhance one's ability to focus attention. In recent literature, relaxing music and sedative music seem to be used interchangeably (Kibler and Rider, 1983; Rider, 1985; Rider, Floyd, and Kirkpatrick, 1985;

Scartelli, 1982; Scartelli, 1984). In other words, a clear description of sedative, relaxing, calming or soothing music has not been established.

Benson, Beary, and Carol (1974) identified a physiological state opposite to the flight or fight response associated with tension. They termed it the relaxation response. The major elements of the relaxation response are: decreases in oxygen consumption, carbon dioxide elimination, heart rate, and muscle tonus, with increases in skin resistance, skeletal muscle blood flow, alpha and theta wave intensity and increased coherence in alpha and theta brain wave frequencies between the left and right sides of the brain. Benson and Proctor (1987) claim that it is possible to alleviate illness and the uncomfortable effects of stress on the mind and body by eliciting the relaxation response on a regular basis.

Studies on music therapy and stress reduction imply that certain types of music produce or elicit physiological responses similar to those of the relaxation response described by Benson, Beary, and Carol (Kibler and Rider, 1983; Scartelli and Borling, 1986; Rider, 1985; Scartelli, 1982; Scartelli, 1984). Benson et. al. note that the relaxation response results in changes in the body which are distinct from physiological changes noted during quiet sitting or sleep. The effect of the relaxation response is a state of relaxed alertness and low-arousal (Benson, Beary, and Carol, 1974).

For this reason, music used in this study will be referred to as relaxation music or relaxing music, rather than sedative music. Relaxation music is that type of music which is shown to produce one or more physiological responses characterized by the relaxation response.

A number of contemporary composers have created music designed to reduce stress. Among them are Steven Halpern and Mark Rider.

Steven Halpern created twenty albums under the Anti-Frantic Alternative label. He designed music intended to provide a relaxing ambience using electric piano, grand piano and synthesizers. Halpern's composition "Spectrum Suite" is based on a series of pentatonic scales. Halpern and Savary (1985) claim that this music stimulates the production of alpha waves in the brain, which have been linked to the state of relaxation. These claims are based on research of GSR, EEG, and Kirlian photography (Bloom, 1987).

Mark Rider, a music therapist and researcher at Southern Methodist University, has composed music using synthesizers which he used in a study of spinal cord injury patients with chronic pain. He called this music entrainment music. The concept of entrainment is derived from the work by Christian Huygens, a seventeenth century physicist who observed the phase-locking of two pendula. When two adjacent, connected pendula were set in motion with unsynchronized but close periods, they would gradually become synchronized (Rider and Eagle, 1986). Rider and Eagle claim that this synchronization is similar to the sets of oscillators found in humans such as circadian (daily cycle) or ultradian (ninety minute cycle) rhythms. They suggest that light intensity, electromagnetic field, and social phenomena can synchronize or entrain the circadian rhythms of living organisms to non-circadian rhythms, if the oscillations of the entrainers are similar to those of the living organism.

Rhythmic entrainment can be explained by physical laws which suggest that the total energy output of a system tends to be minimized. That is, nature tends to be energy efficient by having periodic events that are close in frequency occur in phase with each other (Rider and Eagle, 1986). Brain studies reveal that the neural system tries to process information using minimum input. Music processing may be based on this principle, so that familiar music which matches our present mood may minimize the energy expended by the total physical system.

Rider and Eagle (1986) found that rhythmic and sedative elements of music which were matched to their clients rhythmic behavior increased relaxation (as measured by a decreasing brain wave frequency and muscle tonus) in cerebral palsy, autistic and profoundly retarded children. Rider (1985) found that the entrainment music he composed containing synthesized and acoustic guitar music which had a distinct mood shift from unpleasant to pleasant and a rhythmic shift from 7/8 meter to 4/4 meter, resulted in entrainment music being effective in lowering EMG. Hence, entrainment music, in which the mood of the music shifted from tension to relaxation, increased relaxation. Interestingly, Rider also found that entrainment music was the least preferred of the music types.

Rider (1985) also found that jazz music composed by Pat Metheny reduced EMG levels, although not as effectively as entrainment music. Pat Metheny has not composed music specifically to reduce stress nor does the composition "If I Could", which Rider used, contain any changes in mood. Like many other researchers in this area, Rider does not give a rationale for using this type of jazz music, other than it is thought to be "impressionistic" and soothing since it is highly repetitive in nature.

Proponents of superlearning, Ostrander and Schroeder (1979), claim that Baroque music with largo movements of sixty beats per minute relaxes the body and allows the mind to remain alert, hence allowing the mind to process information quickly and efficiently. They cite research by Lozanov which suggests that it is the particular pace of sixty beats per minute which is in itself an important element in inducing relaxation and increasing the speed of learning.

Given these different types of music which are claimed to reduce tension, do these types of music relax the body and bring into effect physiological responses present in the relaxation responses, such as a low EMG and increased finger temperature? How do these types of music compare to each other in terms of these physiological responses and how do they compare with a no music condition? Is one type of music more effective in reducing EMG and/or increasing finger temperature than the others?

Since there have been studies to suggest that all these types of music are relaxing, I would expect that all these types of music would reduce EMG levels and increase finger temperature. Moreover, having a consistent measure, such as EMG and finger temperature, would establish a common physiological bases on which to compare these types of music. By using reliable and consistent physiological measures with all these types of music and by using a physiological definition of relaxation, I will attempt to determine whether all these types of music are in fact relaxing and whether they can be ranked as to their effectiveness in producing two reactions which comprise the relaxation response.

<u>**Hypotheses**</u>

Two experimental hypotheses will be tested in this study: (a) differences will be seen between and among the different types of music, that is they will not all be equally relaxing and; (b) they will not be as relaxing as a no music condition, that is, differences will be seen between the different music selections and no music.

CHAPTER III

METHOD

Introduction

The aim of this study is to describe the physiological qualities of relaxing music, compare specific types of relaxing music with each other and with a no music condition, and draw statistically based conclusions.

Design

Summary

The study consists of a single-factor experiment with repeated measures, that is, a within-subject design. The dependent variable is a measure of relaxation which consists of electrical activity in the frontalis muscle recorded by electromyograph (EMG) and constriction or dilation of blood vessels measured by skin temperature. The independent variable is a music treatment condition with five levels (see legend in Table 3). These levels were counterbalanced in a latin square design (Table 3).

Subjects

Twenty-four females and sixteen male volunteers were obtained by word of mouth. Twenty-five volunteers were graduate and undergraduate students who were previous classmates of the experimenter at the University of Alberta (Table 2). Fifteen were recruited from various work places by friends who knew people interested in participating in an experiment using different types of music.

Table 2

Frequency Distribution of Sample Sex, Age, Education and Music Training

Description	Range	N
Sex	Female	24
	Male	16
Age in years	20-29	13
	30-39	15
	40-49	8
	50-65	4
Education (college or university participation in years)	1-2	12
	3-4	12
	4 or more	16
Formal music training in years	none	16
	1-2	7
	3-5	8
	5 or more	9

To minimize demand characteristics, the volunteers were told this was a study of the physiological responses to various kinds of music rather than revealing the focus to be on relaxation. The volunteers were debriefed as to the true nature of the study after their participation. Also, the volunteers were guaranteed anonymity and confidentiality.

Materials

Instrumentation

Frontalis muscle EMG and finger temperature levels were recorded on BioComp 2001 biofeedback polygraph, with a standard alloy shielded EMG surface electrode assembly. Two leads were used: one for the frontalis EMG measurement and another for the finger temperature measurement. The three EMG electrodes were attached to the forehead using double-sided adhesive discs. The finger temperature lead was attached using a velcro wrap around.

The BioComp 2001, consists of an Apple IIe computer with a master computer diskette containing a software program to record and display the measurements. One telemetric module is attached to the computer via a lead. Another telemetric module is attached via a lead to a sensory module into which the EMG and temperature electrode leads are attached. The sensory information is picked up by the electrodes and sent to the sensory module via the electrode leads.

The sensory information is converted in the sensory module from analog information to digital information which is sent to the attached telemetered module via a lead. This telemetered module sends the digitalized information via infrared light across the table to the second telemetered module attached to the computer. This infra red communication of information reduces the interference created by the electrical system in the building which has a frequency of 120 cycles per second.

Music

The music used in this study (Appendix A) consisted of 8 minutes and 24 seconds of recorded music for each music selection. Mark Rider's composition was 8 minutes, 24 seconds long. The rest of the music selections were shorter, therefore they were repeated for a total duration of 8 minutes, 24 seconds. The no music condition consisted of recorded tape hiss for the same duration as the music selections. Each of the music selections were taped sequentially, one after the other, on a tape with a 30 second pause in between each music selection, for a total recorded music time of 42 minutes per tape. Five tapes were recorded, each including all the music selections plus the no music condition. Each of the five tapes had a different order of presentation for the music conditions.

Setting

The treatment and data collection occurred at the University of Alberta Biofeedback Laboratory. The Laboratory contained a sink, a tall bookshelf, a wide filing cabinet, a narrow filing cabinet, two tri-lite lamps with bright and dim light selection, and one table containing a collection of stacked biofeedback instruments. Another table contained the Apple IIe computer, printer and BioComp 2001, modules and electrodes. In front of this table was placed a comfortable, padded, reclining arm chair and a wooden desk chair. The room was painted off-white, had a brown carpet on the floor and was moderately sound proof.

Audio Equipment

All the volunteers heard the tapes through Sony MDR-A20 headphones connected to a Sony Walkman WM-F65 portable cassette tape recorder. All the music was recorded on Fuji FR-11 Chromium Oxide,high bias, 90 minute tapes. Recording took place at the experimenter's home using standard [illegible] stereo equipment consisting of two tape recorders, a compact disc player and an amplifier.

<u>Procedure</u>

Each volunteer was scheduled for a two hour appointment. Appointments were booked throughout the day and evening. Each volunteer underwent a brief interview just before participation in the experiment. At this point, each person was asked if he or she was presently experiencing any physical discomfort which might contribute to a temporarily abnormal high tension reading. After determining that the person was free from discomfort, he or she was allowed to continue the experiment.

Each person was seated comfortably in a lounging chair in a dimly lit biofeedback lab. Once the subject was seated, the EMG electrodes were placed over the frontalis area and the temperature electrode was placed on the middle finger of the left hand. As a test to ensure proper EMG electrode placement, the person was asked to raise his or her eyebrows. If the electrodes were placed properly, the microvolt reading on the computer increased from about four to twenty-five or more microvolts.

In order to obtain personal data, the volunteers were asked to answer a questionnaire (Appendix B). The questionnaire consisted of questions regarding the criteria for participation, for example, medical history of tension or migraine headaches, and the number of years the person took music lessons. Additional questions which may have some bearing on their relaxation response were asked. For example, questions were asked about the volunteer's music listening habits; and on presently used methods of relaxation. Questions regarding their age, sex and education were also asked.

Once volunteers completed the questionnaire, they were randomly assigned to one of the five orders of presentation of the independent variable. A minimum of eight subjects was randomly assigned per order of presentation, that is, a total of forty subjects. An equal number of subjects was assigned to each order.

To minimize potential confounds introduced by the repeated measures design, it was necessary to counterbalance the order of presentation of the five levels of the independent variable (the music conditions) using a latin square design. By using a partial counterbalancing technique, five orders of presentation were selected such that each treatment level occurs in each position (that is, first to fifth) (Table 3).

Thus, each subject was presented with one order of presentation of the music treatment with five levels. For example, some subjects were randomly selected to be presented with the levels in Order 1 and would hear Mark Rider's (entrainment) music first and no music last. Other subjects who were randomly selected to be presented with the levels in Order 5 heard no music first and Metheny's music last (Table 3).

Furthermore, to minimize the possible cumulative relaxation effect that occurs over time when presenting uninterrupted music conditions one after another, five different visual-spatial puzzles were introduced to interrupt each level of music presented in each order. These puzzles were presented in five different orders, but for each selection of music the same puzzle corresponded to that selection (Appendix C). The relaxing effect of each level of music was interrupted by a puzzle which increases the person's arousal level. The puzzles use the visual-spatial regions and functions of the brain which are located on the right side of the brain. The right-side is involved in the processing of musical information. Thus, it is assumed that these puzzles will re-activate the region of the brain the music has relaxed. This minimizes the relaxation effect carried over from one level of music to the other and also minimizes the relaxing effect of sitting in a comfortable chair for a period of time.

Thus, for each music selection, EMG and finger temperature readings were monitored and recorded every fourteen seconds. Each music selection was 8 minutes, 24 seconds long. Mark Rider's composition was 8 minutes, 24 seconds long, hence, each of the music conditions needed to be the same length. After each music selection, recording of the readings was stopped, though they were still monitored. The volunteer was then given a puzzle to complete in his or her own time. The readings were monitored during this time to see if the state of relaxation was interrupted, that is, to see if the EMG readings increased and the temperature readings decreased. Once the volunteer finished the puzzle, the next music selection was turned on and the readings recorded. This sequence was repeated five times for a total recorded music time of 42 minutes. The total time for the completion of the experiment was between sixty and ninety minutes.

Upon conclusion of the experiment, volunteers were interviewed and debriefed. The volunteers were asked for a subjective report of the music and its effect on their ability to relax.

Data Analysis

The primary statistical analysis was a One-Way Analysis of Variance with Repeated Measures. Analyses of variance examining the mean and slope values of EMG and finger temperature revealed whether or not significant treatment effects exist. The criterion for judging significance was an F ratio at $p = .05$. In order to determine relative differences between music conditions, Scheffe tests and t-tests were used. A one-tailed t-test, with a .05 level of significance was established as the criterion of difference (Table 6).

Table 3

Order of Music Treatment Presentation

Order	Music Condition				
1	Rider	Halpern	Pachelbel	Metheny	No Music
	A	B	C	D	E
2	Halpern	Pachelbel	Metheny	No Music	Rider
	B	C	D	E	A
3	Pachelbel	Metheny	No Music	Rider	Halpern
	C	D	E	A	B
4	Metheny	No Music	Rider	Halpern	Pachelbel
	D	E	A	B	C
5	No Music	Rider	Halpern	Pachelbel	Metheny
	E	A	B	C	D

Legend

Level	Music
A	Mark Rider entrainment music composition
B	Steven Halpern "Spectrum Suite"
C	Pachelbel "Canon in D major" (Baroque Period; 53 beats per minute)
D	Pat Metheny "If I Could"
E	No music

CHAPTER IV

RESULTS

The results of six analyses of variance with repeated measures and sixteen t-tests will be presented in this chapter, and the hypotheses, which were outlined in Chapter II will be addressed.

Hypothesis 1

Differences will be seen between the different types of relaxing music selections.

Table 4 represents the grand means and standard deviations for EMG and finger temperature measures for each of the music conditions. Table 5 shows the means and standard deviations for the EMG measure of relaxation for each order and Table 6 represents the means and standard deviations for finger temperature for each order. A graphic representation of this data (Tables 5 and 6) can be seen in scatterplots (Appendix D).

The F-value of 1.92 (Table 7), obtained through an Analysis of Variance with Repeated Measures among all the music conditions using EMG means as a measure of relaxation, is not significant ($p = .11$) and, therefore, the experimental hypothesis was not supported. In this study, these types of relaxing music, as a whole, were not significantly different from each other as measured by EMG means.

The F-value of 1.89 (Table 8), obtained through an Analysis of Variance with Repeated Measures among all the music conditions for finger temperature means, is not significant ($p = .11$), and therefore, the experimental hypothesis was not supported. Using finger temperature means as a measure of the resultant relaxation effect of the music conditions, this study found that most types of relaxing music were not significantly different from each other.

Table 4

EMG and Temperature Grand Means and Standard Deviations for Music Conditions

Measure	Music Condition				
	Rider	Halpern	Pachelbel	Metheny	No Music
EMG					
$\bar{x}$	6.45	4.98	5.21	6.17	4.99
s	4.98	2.60	3.20	3.55	2.51
Temperature					
$\bar{x}$	85.14	85.30	84.81	86.50	85.09
s	3.76	3.98	3.63	3.69	4.34

Table 5

EMG Means and Standard Deviations for Music Conditions by Position

Position	Music Condition				
	Rider	Halpern	Pachelbel	Metheny	No Music
First					
$\bar{x}$	6.61	6.92	7.51	8.72	6.17
s	3.84	3.86	5.45	6.03	3.58
Second					
$\bar{x}$	4.26	4.05	5.21	5.80	5.82
s	1.97	.86	2.08	2.75	2.92
Third					
$\bar{x}$	8.79	5.17	4.84	5.71	4.03
s	7.14	2.60	2.65	1.39	1.87
Fourth					
$\bar{x}$	5.21	4.57	3.55	6.08	5.30
s	1.80	2.07	1.69	3.48	1.64
Fifth					
$\bar{x}$	7.39	4.16	4.93	4.52	3.61
s	7.11	2.16	1.94	1.17	1.39

Table 6

Temperature Means and Standard Deviations for Music Conditions by Position

Position	Music Condition				
	Rider	Halpern	Pachelbel	Metheny	No Music
First					
$\bar{x}$	85.33	86.62	84.20	86.55	86.60
s	4.64	4.29	3.07	4.23	3.98
Second					
$\bar{x}$	84.93	86.25	83.80	86.77	85.87
s	3.38	3.86	3.96	3.79	4.50
Third					
$\bar{x}$	85.81	84.82	86.15	86.64	84.48
s	3.20	4.12	2.92	3.97	4.90
Fourth					
$\bar{x}$	84.87	84.96	84.08	86.32	85.39
s	4.21	2.65	4.84	3.70	3.87
Fifth					
$\bar{x}$	84.74	83.83	85.81	86.21	83.12
s	4.15	5.03	3.31	3.72	4.63

Table 7

Analysis of Variance with Repeated Measures of Effect of Music on EMG Mean

Source of Variance	Sum of Squares	df	Mean Square	F
Music	63.06	4	15.76	1.92
Error	1250.09	152	8.22	
Total	1610.19	194		

$F_{.05} = 2.62$
$F_{.10} = 2.01$

Table 8

Analysis of Variance with Repeated Measures of the Effect of Music on Finger Temperature Mean

Source of Variance	Sum of Squares	df	Mean Square	F
Music	69.25	4	17.31	1.89
Error	1357.02	148	9.17	
Total	2058.02	198		

$F_{.05} = 2.62$
$F_{.10} = 2.01$

A more sensitive measure of the effect of music on relaxation is the rate of relaxation. The rate of relaxation or slope was computed by characterizing the thirty-six EMG readings for each music selection per person as a straight line, obtaining the slope of that line and averaging the slopes across forty subjects for each music selection. Table 9 represents the grand means and the standard deviations for the slope of the line created by the EMG measures for all the subjects for each music selection. Table 10 shows the EMG slope means and standard deviations for each music selection when it was listened to in the first, second, third, fourth, or fifth position. A graphic representation of Table 10 can be seen in scatterplots in Appendix D.

Table 9

EMG Slope Grand Means and Standard Deviations for Music Conditions

Measure	Music Condition				
	Rider	Halpern	Pachelbel	Metheny	No Music
EMG					
$\bar{X}$	-.08	-.07	-.06	-.23	-.06
s	.21	.21	.42	.53	.30

Table 10

EMG Slope Means and Standard Deviations for Music Conditions by Position

Position	Music Condition				
	Rider	Halpern	Pachelbel	Metheny	No Music
First					
$\bar{X}$	-.27	-.21	-.43	-[illegible]	-.24
s	.27	.18	.78	.59	.48
Second					
$\bar{X}$	-.05	-.13	.02	-.00	-.11
s	.16	.23	.15	.26	.11
Third					
$\bar{X}$	.10	-.06	-.05	-.23	.00
s	.21	.17	.28	.65	.29
Fourth					
$\bar{X}$	.00	.02	.06	-.09	-.00
s	.19	.25	.17	.27	.32
Fifth					
$\bar{X}$	-.00	.04	.11	-.33	.03
s	.14	.15	.18	.72	.15

The F-value of 2.21 (Table 11) obtained through an Analysis of Variance with Repeated Measures among all the music conditions using EMG slope as a measure of rate of relaxation, is not significant (p=.07) and, therefore the experimental hypothesis was not supported. Thus,using EMG slope as a measure of the rate of relaxation, this study found that these types of relaxing music, as a whole, were not significantly different from each other.

Table 11

Analysis of Variance with Repeated Measures of the Effect of Music on EMG Slope

Source of Variance	Sum of Squares	df	Mean Square	F
Music	.78	4	.19	2.21
Error	13.44	152	.09	
Total	17.96	194		

$F_{.05} = 2.62$
$F_{.10} = 2.01$

Hypothesis 2

Differences will be seen between the various music selections and the no music condition.

Using the Scheffe test to compare the four music selection EMG means, using (-1) as a contrast for each piece of music, with the no music condition EMG means, using (-4) as a contrast, resulted in a contrast that was not significant. The Scheffe Test was used with the EMG slope measure and the finger temperature mean measure using the same contrasts (-1, -4) to compare the four music selections with the no music condition, and again, the contrasts were not significant. Therefore, comparing the four music conditions as a whole, with the no music condition did not show a difference between the music conditions and the no music condition.

The F-values of 1.92 (Table 7), 1.89 (Table 8), and 2.21 (Table 11)obtained by Analyses of Variance with Repeated Measures for EMG means, temperature means and EMG slopes respectively, among the music selections and no music,were not significant ($p=.11$, $p=.07$ and $p=.11$ respectively), and therefore, the experimental hypothesis was not supported.

The Effect of Order

In addition to the anticipated effects, order was found to have an effect in this study. The F-value of 5.41 (Table 12), obtained through an Analysis of Variance with Repeated Measures for EMG means, is significant ($p<.005$), and therefore, indicates that regardless of the music condition, EMG means progressively declined from first to fifth presentation.

Table 12

Analysis of Variance with Repeated Measures of the Order Effect on EMG Mean

Source of Variance	Sum of Squares	df	Mean Square	F
Order	142.56	4	35.64	5.41***
Error	1002.05	152	6.59	
Total	1553.56	194		

* $F_{.05} = 2.62$, $p<.05$
** $F_{.01} = 3.86$, $p<.01$
*** $F_{.005} = 4.49$, $p<.005$

The F-value of 5.84 (Table 13), obtained through an Analysis of Variance with Repeated Measures for EMG slope, is significant ($p<.005$) and therefore, indicates that the rate of relaxation, represented by EMG slope, was affected by the order, regardless of which music condition was presented.

The t_{obs} for EMG means(Table 14) of 2.72, 2.89, and 3.36 were significant ($p<.005$) and, the t_{obs} of 1.95 (Table 14) for EMG means between the first order and the second, third, fourth and fifth order respectively, were also significant ($p<.01$). This suggests, therefore, that as the music selections were progressively presented in time, habituation to the experimental situation took place, regardless of which music condition who presented.

Table 13

Analysis of Variance with Repeated Measures of the Order Effect on EMG Slope

Source of Variance	Sum of Squares	df	Mean Square	F
Order	1.98	4	.50	5.84***
Error	12.98	152	.09	
Total	21.90	194		

* $F_{.05} = 2.62$, $p<.05$
** $F_{.01} = 3.86$, $p<.01$
*** $F_{.005} = 4.49$, $p<.005$

The t_{obs} (Table 15) of 2.10, 2.27, 3.96 for EMG slope were significant ($p<.05$, $p<.025$, $p<.0005$ respectively). The t_{obs} of 2.89 (Table 15) for EMG slope was also significant ($p<.005$). This indicates, therefore, that the rate of relaxation that took place in the first order was significantly different from the rate of relaxation that took place subsequently. Hence, regardless of the music condition, the greatest change in EMG mean and slope occurred in the first order.

Table 14

The Effect of Order on EMG Mean: Between Condition t-Tests

Music Order	N	$\bar{x}$	df	t_{crit}	t_{obs}
First vs	39	6.86	76	2.65	2.72**
Second	39	4.87			
First vs	39	6.86	76	1.67	1.95*
Third	39	5.28			
First vs	39	6.86	76	2.65	2.89**
Fourth	39	4.76			
First vs	39	6.86	76	2.65	3.36**
Fifth	39	4.44			

* indicates significance ($p<.01$), one-tailed
** indicates significance ($p<.005$), one-tailed

Table 15

The Effect of Order on EMG Slope: Between Condition t-Test

Music Order	N	$\bar{x}$	df	t_{crit}	t_{obs}
First vs	39	-.28	76	2.00	2.10*
Second	39	-.05			
First vs	39	-.28	76	2.00	2.27*
Third	39	-.09			
First vs	39	-.28	76	3.44	3.96***
Fourth	39	.00			
First vs	39	-.28	76	2.65	2.89**
Fifth	39	-.03			

* indicates significance (p<.05), two-tailed
** indicates significance (p<.01), two-tailed
*** indicates significance (p<.001), two-tailed

Music Preferences

In this study, the volunteers were asked to rate how they liked each music selection presented. They rated their likes and dislikes on a seven point scale where a rating of seven was described as liking the music very much and a rating of one was described as disliking the music very much.

The F-value of 14.06 (Table 16), obtained through an Analysis of Variance with Repeated Measures among all the music selections for music preference, is significant ($p<.0001$). Therefore, the volunteers did show a preference for some music selections over others.

The t_{obs} of 4.71, 6.16, and 3.67 (Table 17) for music preference between Pachelbel and Rider, Halpern and Metheny were significant ($p<.001$), and also the t_{obs} of 2.12 between Metheny and Halpern for music preference was significant ($p<.05$). In this study, volunteers preferred the Pachelbel selection to any other music selection, and they preferred the Pat Metheny selection to the Steven Halpern selection.

Table 16

<u>Analysis of Variance with Repeated Measures of Music Preference</u>

Source of Variance	Sum of Squares	df	Mean Square	F
Music Selection	69.37	3	23.12	14.06*
Error	192.38	117	1.64	
Total	376.34	159		

$F_{.0001} = 6.79$, $p<.0001$

Table 17

Subject Preference for the Music Selections Presented: Between Selection t-Tests

Music Selection	N	$\bar{x}$	df	t_{crit}	t_{obs}
Pachelbel vs	40	6.33	78	3.44	4.71**
Rider	40	4.95			
Pachelbel vs	40	6.33	78	3.44	6.16**
Halpern	40	4.55			
Pachelbel vs	40	6.33	78	3.44	3.67**
Metheny	40	5.30			
Metheny vs	40	5.30	78	2.00	2.12*
Halpern	40	4.55			

* indicates significance ($p<.05$), two-tailed
** indicates significance ($p<.001$), two tailed

Post Hoc Comparisons

It was interesting to note that although the experimental hypotheses could not be supported at the p=.05 level, the results came close to significance for the EMG means (p=.11) and finger temperature (p=.11) mean measures, and very close to significance for the EMG slope (p=.07) measures. This would suggest, then, that further study of differences between these pieces of music was warranted.

When the data [illegible]ing the line graphs of finger temperature means, EMG means, and [illegible]pendix D), differences were found between Pat Metheny's music and the o[illegible] conditions. Therefore, Post Hoc comparisons were made between Pat Metheny's music and the other music conditions in order to explore these differences.

When Pat Metheny's music sample EMG means were compared to each of the other music conditions individually using a one-tailed t-test, some differences were found. The t_{obs} of 1.83 (Table 18) for EMG means between Metheny and Halpern was significant ($p<.05$), and the t_{obs} of 1.71 (Table 18) for EMG means between Metheny and Pachelbel was also significant ($p< .05$). Therefore, there was an observed difference between Pat Metheny's "If I Could" and both Steven Halpern's "Spectrum Suite" and Pachelbel's "Canon in D".

When Pat Metheny's music sample EMG slopes were compared with No Music using a one-tailed t-test, a difference was found. The t_{obs} of 1.91 (Table 19) for EMG slopes between Metheny and No Music was significant ($p<.05$). Therefore, there was an observed difference between Pat Metheny's "If I Could" and the no music condition.

Table 18

Differences in EMG Means between Music Conditions: Between Condition t-Tests

Music Condition	N	$\bar{x}$	df	t_{crit}	t_{obs}
Pat Metheny vs	39	5.87	76	1.67	1.83*
Steven Halpern	39	4.76			
Pat Metheny vs	39	5.87	76	1.67	1.71*
Pachelbel	39	4.84			
Pat Metheny vs	39	5.87	76	1.67	1.90*
No Music	39	4.75			
Mark Rider vs	39	6.00	76	1.67	1.68*
No Music	39	4.75			

* indicates significance ($p<.05$), one-tailed

Table 19

Difference in EMG Slope Between Music Conditions: Between Condition t-Tests

Music Condition	N	$\bar{X}$	df	t_{crit}	t_{obs}
Pat Metheny vs	39	-.19	76	1.67	1.91*
No Music	39	-.03			

*indicates significance ($p<.05$), one-tailed

Comparing each of the music sample finger temperature means individually with Pat Metheny's music using a one-tailed t-test, resulted in finding differences between some of the music conditions and Pat Metheny's music. The t_{obs} of 1.98, 1.67, 2.55, and 1.81 (Table 20) for finger temperature between Metheny and Rider, Halpern, Pachelbel, and No Music, respectively, were all significant ($p<.05$). Therefore, there was an observed difference between Pat Metheny's "If I Could" and all the other music conditions.

When Pat Metheny's music samples were compared with the no music condition on measures of EMG mean, EMG slope and finger temperature mean, some differences were observed.

The t_{obs} of 1.90 (Table 18) for EMG means between Metheny and No Music was significant ($p<.05$) and the t_{obs} of 1.91 (Table 19) for EMG slope between Metheny and No Music was significant ($p<.05$), as was the t_{obs} of 1.81 for finger temperature between Metheny and No Music (Table 20) ($p<.05$). Therefore, differences were observed between Pat Metheny's "If I Could" and the no music condition on measures of EMG mean, EMG slope and finger temperature mean.

Also, interestingly, a difference was observed between Mark Rider's entrainment music and the no music condition with respect to the measure of EMG mean when the graph of the effect of position on EMG means was examined. When Mark Rider's music was compared to the no music condition for the EMG means measure using a t-test, the t_{obs} of 1.68 (Table 18) was significant ($p<.05$).

Table 20

Differences in Finger Temperature Means Between Music Conditions: Between Condition t-Tests

Music Condition	N	$\bar{x}$	df	t_{crit}	t_{obs}
Pat Metheny vs	38	87.02	72	1.67	1.98*
Mark Rider	38	85.63			
Pat Metheny vs	38	87.02	72	1.67	1.67*
Steven Halpern	38	85.81			
Pat Metheny vs	38	87.02	72	2.00	2.55**
Pachelbel	38	85.26			
Pat Metheny vs	38	87.02	72	1.67	1.81*
No Music	38	85.60			

* indicates significance ($p<.05$), one-tailed
** indicates significance ($p<.01$), one-tailed

CHAPTER V

DISCUSSION

Summary of Results

The purpose of this study was to give a description of relaxing music, to take examples of music that are claimed to be relaxing and compare them with each other and a no music condition to see if there were any differences between them , so they could be ranked with respect to their relaxing effectiveness. The following variables were controlled in the study: (a) the educational status of the volunteers, (b) the length and setting of the experimental situation, (c) the type of relaxing music and its presentation, (d) the order in which the relaxing music was presented to the volunteers, and (e) the amou[illegible]hemisphere arousal between pieces of music.

The data from this study, based on an N of 40, and resulting from a repeated measure of relaxation on volunteers from a specific university population listening to relaxing music, indicated, on the whole, that the pieces of relaxing music were not significantly different from each other or from the no music condition. When the music conditions were compared in pairs, some significant differences were found. The music by both Mark Rider and Pat Metheny were found to be significantly less relaxing than either Steven Halpern's, or Pachelbel's music and the no music condition, using EMG as a measure. Yet, when comparing the music in pairs using finger temperature mean as a measure of relaxation, Pat Metheny's music raised finger temperature mean to a higher level than any of the other music conditions. But, when the music selections were compared as a whole using temperature mean as a measure, no significant difference among them was found. Also, when the selections of music were compared as a whole using EMG slope as a measure of the rate of relaxation, no significant difference was found among the music selections or between the music selections and the no music condition. Again, when they were compared in pairs using the slope as a measure, Pat Metheny's music relaxed people at a faster rate than the other music condition.

It would seem then, that relaxing music could be described as that music which reduces muscle tension as measured by frontalis EMG and increases vasodilation as measured by finger temperature to the same extent as would sitting comfortably in a chair in a quiet room doing nothing.

Delimitations of the Study

Several factors limit the generalizability of the results of this study. First of all, the volunteers were highly educated, with all of the sample possessing a college or university education. The sample size was small (N=40) and was comprised mostly of females, thus, not being representative of the proportion of females and males in the population.

This study did not compare various types of music, such as loud, boisterous music, rock music, or other types of jazz and classical music. Comparing all types of music using consistent measures may give us a better definition of types of music which are not relaxing or that have other physiological effects.

Limitations of the Study

Other physiological measures such as EEG (electroencephalograph), corticosteroid levels, breathing rate, to name a few, were not used. However, it was felt that EMG and finger temperature measures were reliable, easy to use, and would give an accurate indication of relaxation on their own.

All the music conditions were presented in one sitting along with the no music condition. Although the order of presentation was controlled, perhaps the expectation of hearing music or having already heard music may have influenced the results of the study.

Theoretical Implications

This study did not support the earlier research of Rider (1985), who found that Rider's entrainment music and Pat Metheny's music were more relaxing than the other music selections he studied. This study did confirm his finding that entrainment was one of the least preferred of the music selections.

Whereas Rider (1985) used a selection [illegible]ssical compositions and music selected and brought to the experiment by the clients themselves, this study used music proven in the past to be relaxing using physiological measures. Not all the relaxing music tested here were tested in the past using the same physiological measures. To give some consistency to the literature on relaxing music, I chose to examine these pieces of music using the same measures. Rider (1985) was primarily interested in the effects of entrainment music on pain reduction, although he did examine the differences between pieces of music on an EMG measure of relaxation. His population consisted of people who were experiencing lower back pain. In this study, I was primarily interested in a non-clinical population, one that was not experiencing any particularly unusu[illegible] situation, that is, a population that would be considered to be experiencing normal, everyday stress responses. Much of the literature on the effects of music discuss music's effects on special populations, either clinical populations or musicians. It would seem likely that a population experiencing normal stress responses would be interested in an easy, effective relaxation method since they would have no seemingly pressing need or motivation to pursue other more time consuming methods of relaxation, hence, the choice of a normal population for this study.

Steven Halpern's (1985) claim that his "Spectrum Suite" composition was relaxing, was supported, as was the claim by Orstrander and Schroeder, (1979) that Baroque music (Pachelbel) was relaxing. Although these music selections are relaxing, they did not relax people anymore than did the no music condition. It would seem, then, that the relaxing music in this study did not have any greater relaxing effect on physiology than did the no music condition.

It is interesting, however, that Pat Metheny's composition "If I Could", which some people described as "sad", "having a longing feeling", and "reminding them of the feelings they experienced after making love", raised finger temperature significantly higher than all the other music conditions, including No Music. This may indicate that Pat Metheny's composition may be acting on a different physiological response system (ie. the cardiovascular system), and/or that the representations or images evoked by Pat Metheny's composition contribute to enhance physiological relaxation much more than the other music compositions. Then again, this result may indicate that the sample as a whole is more physiologically responsive to relaxing music by dilating peripheral blood vessels and capillaries, than by reducing action potential in the striate musculature.

Finally, it is clear from this study that music's effect on physiology is in a direction consistent with the relaxation response. But, it is still not clear whether or not relaxing music contributes physiologically any more than does simply sitting quietly in a comfortable chair.

Practical Implications

Both this study and that of Rider (1985) indicate that music may be used effectively as a means to promote muscle relaxation. In this study, the music by Steven Halpern and Johann Pachelbel are as relaxing as sitting quietly in a comfortable chair. Listening to music is a more appealing method of relaxation than simply sitting quietly. Music can become a positive focus of attention for a person. It also allows a person to shift emotions and facilitates imagery.

When a counsellor has a client who is experiencing a stress response, the counsellor may choose to prescribe Pachelbel's "Canon in D major" or Steven Halpern's "Spectrum Suite" as either preventive or curative measures. The client could use these pieces of music to relax during stressful situations. Taking five minutes from a hectic schedule to listen to a piece of music, and give the body a chance to regain its homeostatic balance, seems much more conceivable than asking a person to stop everything to sit quietly for five minutes. Relaxation may seem hard to accomplish sometimes, but with a relaxing piece of music, it need not be.

Most people in this study preferred Pachelbel's composition. Therefore, the music of choice for a counsellor to suggest would be this one. Steven Halpern's composition could be suggested as an alternative.

A counsellor may also choose to use relaxing music in counselling sessions to promote the client's ability to relax as counselling takes place. Furthermore, a counsellor may choose to use relaxing music during hypnotherapy. When the counsellor is guiding the client through a traumatic past event, relaxing music may be used at a time when the client's trauma is being reframed. The concept of state-dependent learning and memory suggests that the biochemical and hormonal state of the body is encoded along with memory traces during an emotional event. Relaxing music may be used to facilitate a relaxation response state during the time the client is re-experiencing the trauma and also during the reframing stage, thereby, encoding a relaxation response along with the memory. Encoding a relaxation response at this time may serve to correct the maladaptive physiological response pattern that was conditioned to the trauma.

Since Pat Metheny's composition was found to increase finger temperature, a counsellor may wish to use this music with migraine headache sufferers. The biofeedback treatment for migraine is to have the client increase their finger temperature. This biofeedback treatment may be facilitated by Pat Metheny's composition. Any treatment which involves facilitating a person's ability to vasodilate may be enhanced by accompanying it with Pat Metheny's "If I Could". Two other psychophysiological disorders that Metheny's composition may help to treat are Rayneau's disease and peripheral vascular disease, since these are disorders of the cardiovascular system.

The compositions by Halpern and Pachelbel also may be used in conjunction with various treatments such as biofeedback and systematic desensitization for disorders such as back pain, phobias, neck pain, tension or muscle headache, to name a few, where muscle relaxation is an important part of treatment.

Pachelbel's "Canon in D major" at 53 to 60 beats per minute can be used to relax people and facilitate the learning of languages using the Lozanov method. Apparently, Halpern's "Spectrum Suite" is not as effective for learning as Pachelbel (Ostrander and Schroeder, 1979).

Therefore, music that evokes physiological responses resembling those of the relaxation response may be used to facilitate the various treatments of stress related disorders. Listening to relaxing music is a pleasant, appealing method of allowing the body to re-establish a homeostatic balance during times when stress responses are triggered. Modern technology allows people to obtain inexpensive, portable tape recorders that can be used essentially anywhere. Taking a few minutes to listen to Pachelbel's "Canon in D major" is an accessible and easily learned method of relaxation. Using music during various treatments of psychophysiological disorders is easy to implement. Research literature suggests that using music in combination with other treatments such as EMG biofeedback, enhances the effectiveness of the treatment (Scartelli, 1986).

Suggestions for Further Research

Several modifications to the design of the current study would provide additional areas of research and improve its applicability to the general population.

In future studies of this nature, a more proportional representation of females and males in the general population might be used. Further, the volunteer sample might be drawn from various work places, such as from offices or from various trades, rather than from the usual university pool.

An electromyographic study placing the polygraph electrodes on the trapezeus muscles or on the lower back muscles may give more accurate measures of relaxation. Such a study might also explore the effects of music on the right and left hemispheres using the electroencephalograph. Also, other measures of the relaxation response could be used, and the use of more measures would provide information on where music has its greatest effect on the body.

A greater number of pieces of music and a wider variety of musical styles could be explored. A definition of stimulative music may be developed using physiological measures. This physiological definition would make comparison of musical styles and types much easier.

In future research of this kind, the experimenter may want to compare fewer pieces of music, use more measures, increase the time between music selections and increase the duration of the musical piece. Doing this may reduce the cumulative effects of listening to several pieces of music at the same sitting and reduce the confounding effects of one piece of music on the other.

Sometimes the stress response is triggered by the de-synchronization of the bodies ultradian and circadian rhythms. An interesting study could examine the effects of music on these rhythms. Perhaps using music to relax during airplane travel reduces the amount of discomfort felt due to sudden time changes. Also, for those people who work in shifts, music at work during the night may help them rest more effectively when off the job, hence allow them to be more effective on the job.

A phenomenological study, either alone or as a complement to the usual statistical procedures, would be an invaluable contribution to the pool of information about music. For example, a personal and detailed account of emotions and images experienced; the sudden recall of forgotten memories; the type and rate of stress related material intruding in to the music listening; exploration of descriptions of kinesthetic, visual, auditory, tactile, pain and proprioceptive representations, these explorations may give us information on how music affects the interpretive and integrative processes of the neocortex and limbic system.

It is possible that being in a state of relaxation while intently listening to relaxing music may closely resemble an altered state of consciousness. This could be explored in a study which compared a known method of producing an altered state of consciousness, such as meditation, with music. Perhaps in exploring these phenomena we would better understand the holistic, healing qualities of music.

The mind may consider music to be a highly novel class of stimuli. Music, as novel stimuli, may provide a way for the mind and body to focus attention away from a threatening situation to one that is physiologically balancing and healing. Research addressing the effect of music on the mechanisms of attention may provide information on how and why music helps people learn.

Thus, it is becoming clear, though the study of music and other relaxing methods which seem to affect us through imagery, that the mind and body are not separate units or entities. The mind affects the body, in illness and in health, and the body affects the mind.

> But sweet music can minister to minds diseased
> Pluck from the memory a rooted sorrow
> Raze out the written troubles of the brain
> And with its sweet oblivious antidote
> Cleanses the full bosom of all perilous stuff
> Which weighs upon the heart.
> (William Shakespeare, cited in Licht, 1946 ,p.9)

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APPENDIX A

Music List

<u>Halpern, S.</u>
_______ Keynote C: Red
_______ Keynote D: Orange
_______ Keynote E: Yellow
<u>Spectrum Suite</u>
Steven Halpern - Gramavision (18-7770-1)

<u>Metheny, P.</u>
_______ If I Could
<u>First Circle</u>
Pat Metheny Group - ECM (25008-2)

<u>Pachelbel, J.</u>
_______ Canon in D Major
<u>Fasch Trumpet Concerto in D Major, Pachelbel Canon in D Major</u>
Jean-Francois Paillard, Jean-Francois Paillard Chamber Orchestra - Musical Heritage Society (MHS 1060)

<u>Rider, M.</u>
_______ Entrainment music.
<u>Personal Cassette Recording</u>
Mark Rider, Meadows School of the Arts, Southern Methodist University, Dallas, Texas 75275.

APPENDIX B

Questionnaire

The following questionnaire was used to obtain personal data. The questionnaire was put together in booklet form. These questions were answered after the leads with the electrodes were placed on the finger and the forehead.

This is not a test!

This is a study of physiological responses to music.

I will be using measures of muscle activity and temperature change.

Inside is a :

1. questionnaire

2. set of puzzles

3. set of questions

Please do not open booklet until asked to do so.

Code: RHPMS

The following information is confidential. It will only be read by the experimenter, and will be used as information to correlate with the physiological measures.

1. Age: Sex: M F Occupation:

2. What is your education level?

a. High School

b. 1-2 years college or university

c. 3-4 years college or university

d. more than 4 years college or university

3. Are you experiencing any physical discomfort at this time (eg. headache, stomach upset, sore muscles)? Yes No

If yes, please describe:

4. Do you have a history of any of the following:

a. headaches	How long?	How often?
b. stomach problems	How long?	How often?
c. skin problems	How long?	How often?
d. ulcers	How long?	How often?
e. sleep problems	How long?	How often?

5. Are you using any medication? Yes No

a. Prescription

b. Non-prescription

6. Have you received any instruction in relaxation techniques? Yes No If yes, what kind?

7. Have you had any formal music training? Yes No

If yes, please circle one of the following:

a. music appreciation course

b. 1-2 years instruction

c. 3-5 years

d. more than 5 years

8. How much music do you listen to during an average day?

a. 1-4 hours

b. 5-8 hours

c. more than 8 hours

d. hardly any music at all

9. When do you usually listen to music? (circle more than one)

a. morning

b. afternoon

c. evening

d. while studying

e. before bedtime

f. when relaxing

g. when working

h. when exercising

10. What type(s) of music do you prefer? (circle more than one)

a. jazz

b. country

c. pop

d. classical

e. rock

f. all

11. What kind of music do you listen to?

a. loud, boisterous

b. calm, soft

c. fast beat

d. slow beat

e. all

12. Do you consider music:

a. very emotional

b. somewhat emotional

c. not at all emotional

13. What happens to you inside your mind when you listen to music?

a. I daydream

b. I have pictures running through my mind

c. I listen closely to the changes in the sounds

d. I follow the melody line

e. I feel all kinds of sensations in my body

Please describe your own experience:

14. I listen to mostly:

a. radio

b. T. V.

c. tapes

d. records

e. compact discs

15. Name a composer/singer/musician you listen to regularly:

16. I would say that music is _________ in my life.

a. not important

b. somewhat important

c. very important

APPENDIX C

Visual-Spatial Puzzles

Attached to the questionnaire were five pages of puzzles. Each page contained three or four puzzles which were answered before a particular piece of music. So, before listening to Rider's composition, every person would answer the same three puzzles. Hence, for every order of music presentation, there was also an order of visual-spatial puzzle presentation. After the experiment was completed, those people who were interested, received a complete set of puzzles with answers. The puzzles were obtained from Eysenck (1978), pp. 22-126.

After listening to two pieces of music, the volunteers were asked to rate their enjoyment of the pieces of music on a seven point scale.

The visual-spatial puzzles from this section have been removed because of the unavailability of copyright permission. Th puzzles consisted of drawings used to test one's own I. Q. These visual-spatial puzzles were taken from Eysenck, 1978, p. 122-126.

RE PAGES 96 + 97

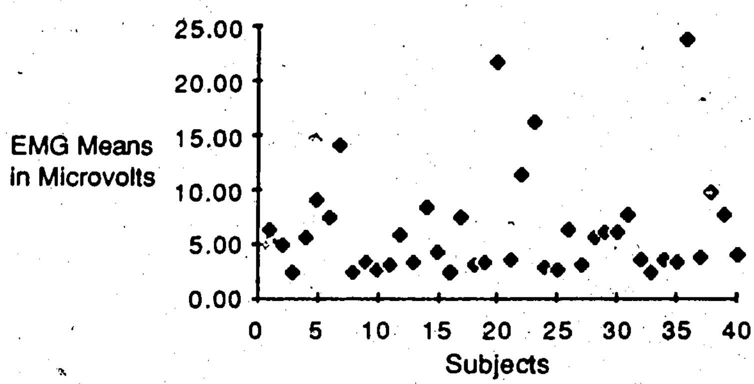
APPENDIX D

Graphs

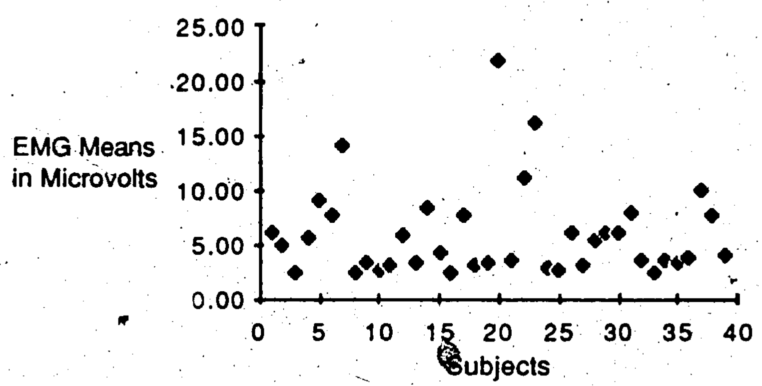
The following is a set of thirty scatterplots which are visual representations of the tables outlining the EMG means, temperature means, and EMG slopes used in the statistical analysis. The set of scatterplots for 40 subjects represents the actual data collected. The set of scatterplots with 39 or 38 subjects represents the deletion of one or two outliers from each music condition in the statistical analysis.

The last three line graphs represent trends in the EMG means, temperature means, and EMG slopes for the music conditions by position.

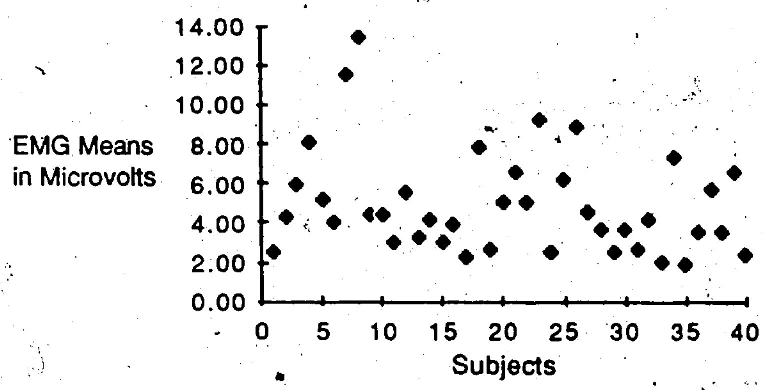
EMG Means for Rider's Music for 40 subjects



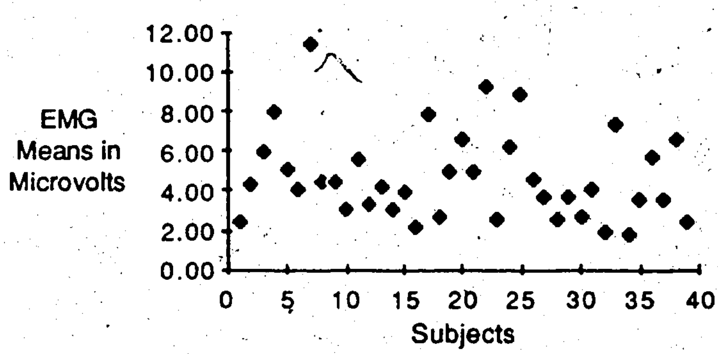
EMG Means For Rider's Music for 39 Subjects



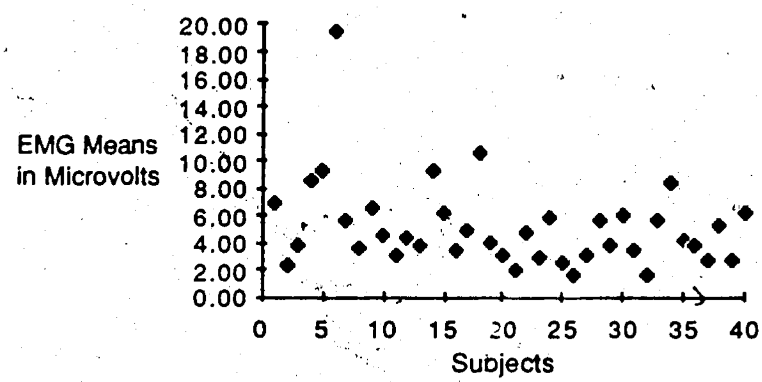
EMG Means for Halpern's music for 40 Subjects



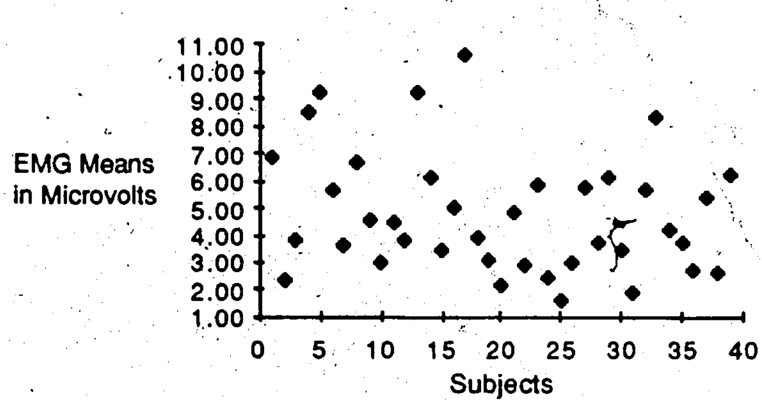
EMG Means for Halpern's music for 39 Subjects



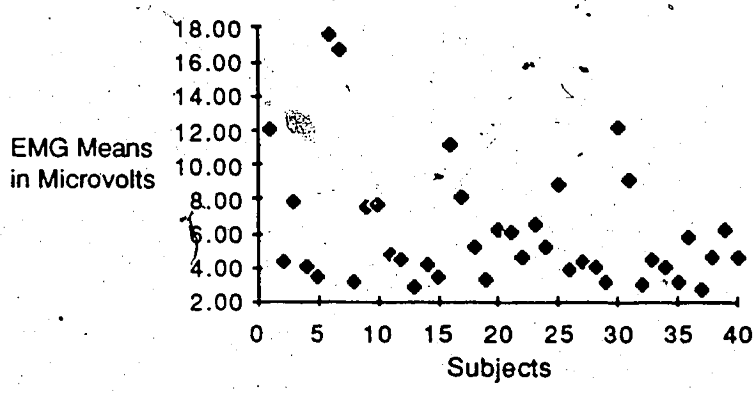
EMG Means for Pachelbel's music for 40 Subjects



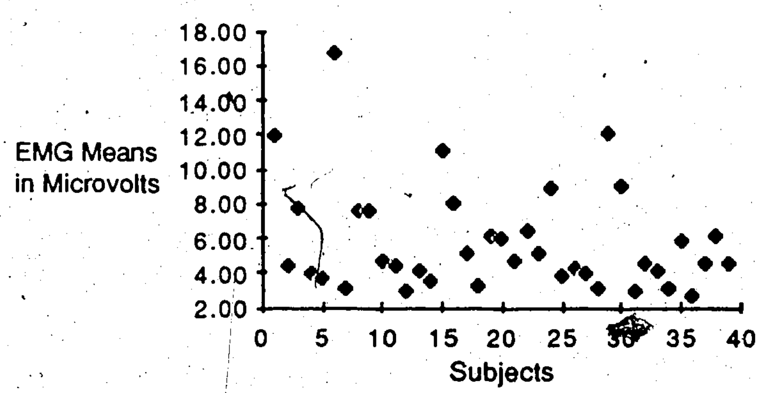
EMG Means for Pachelbel's music for 39 Subjects



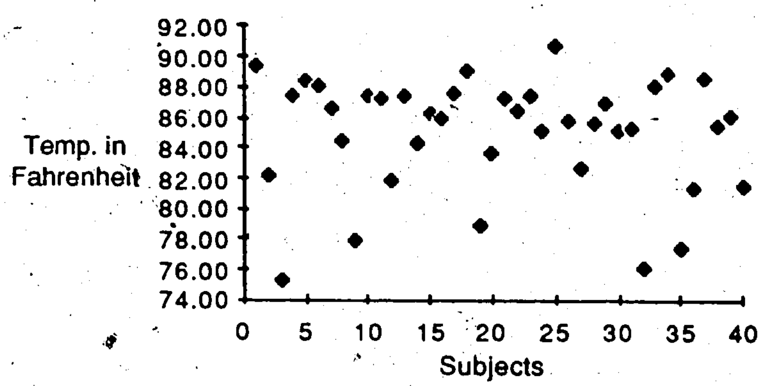
EMG Means for Metheny's music for 40 Subjects



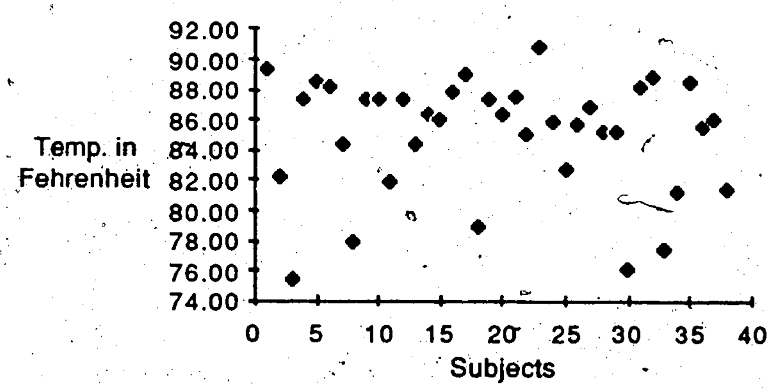
EMG Means for Metheny's music for 39 Subjects



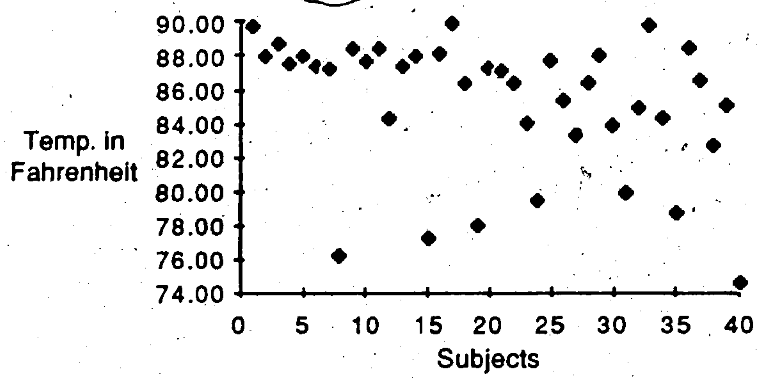
Temperature Means for Rider' Music for 40 Subjects



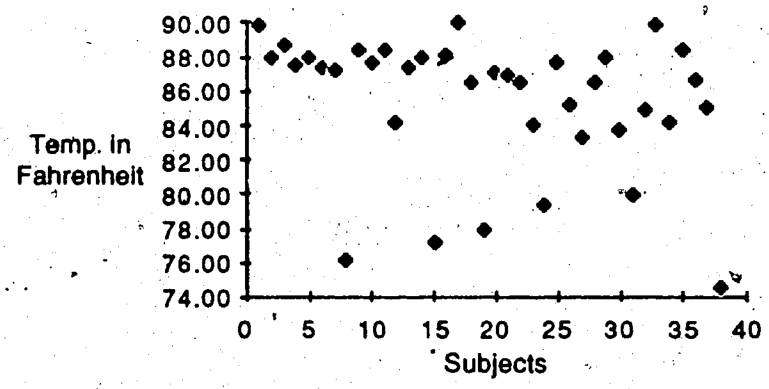
Temperature Means for Rider's Music for 38 Subjects



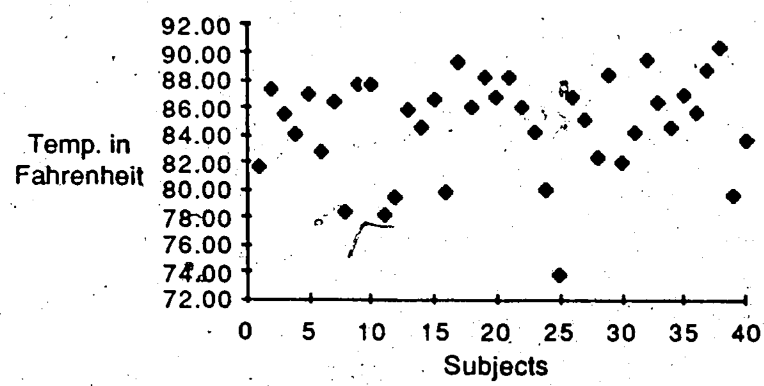
Temperature Means for Halpern's Music
for 40 Subjects



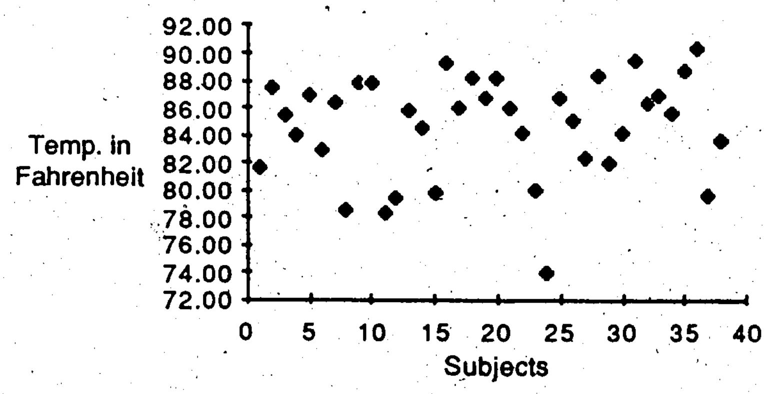
Temperature Means for Halpern's Music
for 38 Subjects



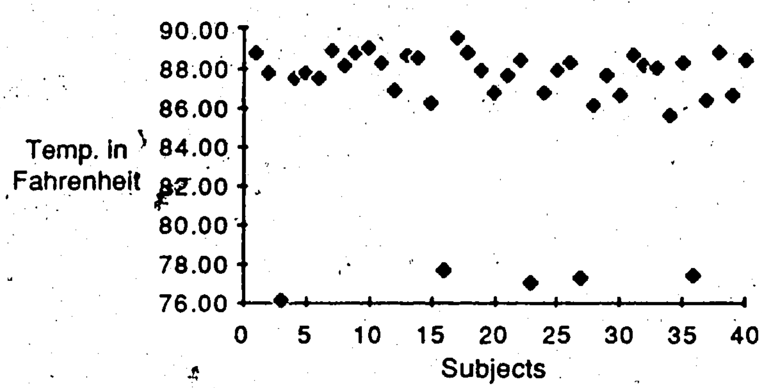
Temperature Means for Pachelbel's Music for 40 Subjects



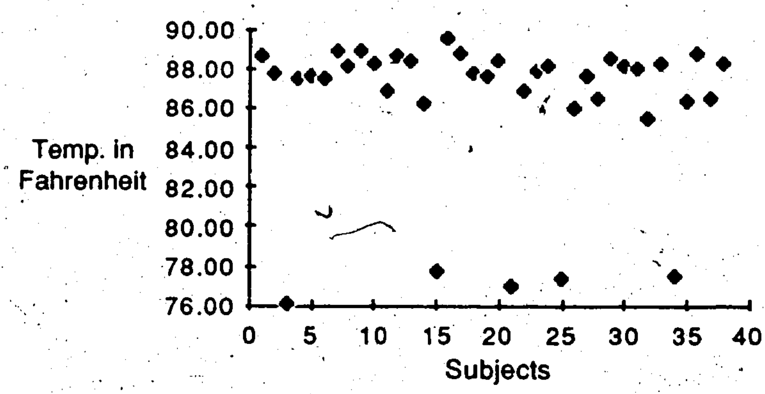
Temperature Means for Pachelbel's Music for 38 Subjects



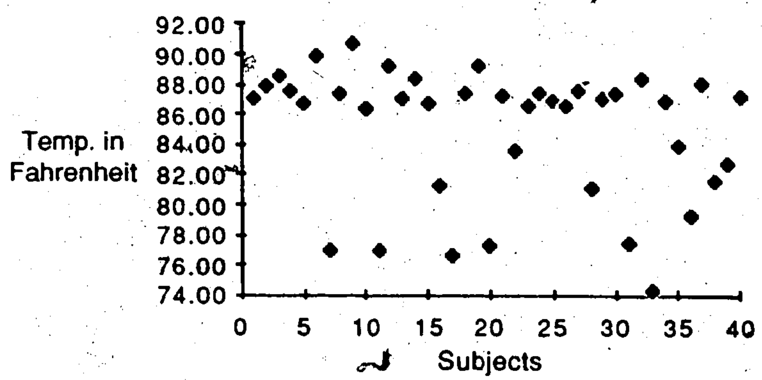
Temperature Means for Metheny's Music
for 40 Subjects



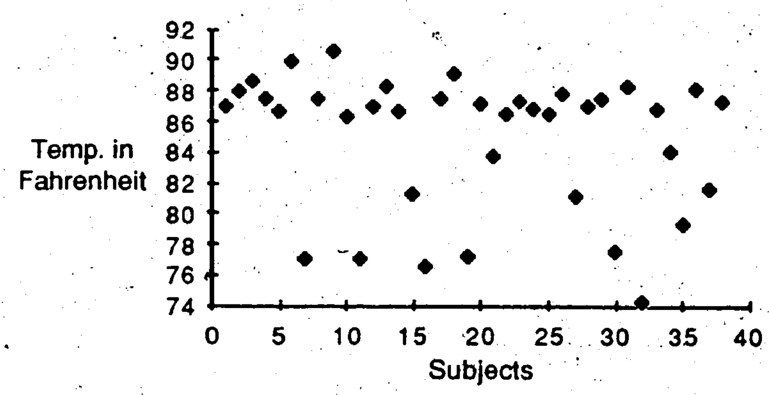
Temperature Means for Metheny's Music
for 38 Subjects



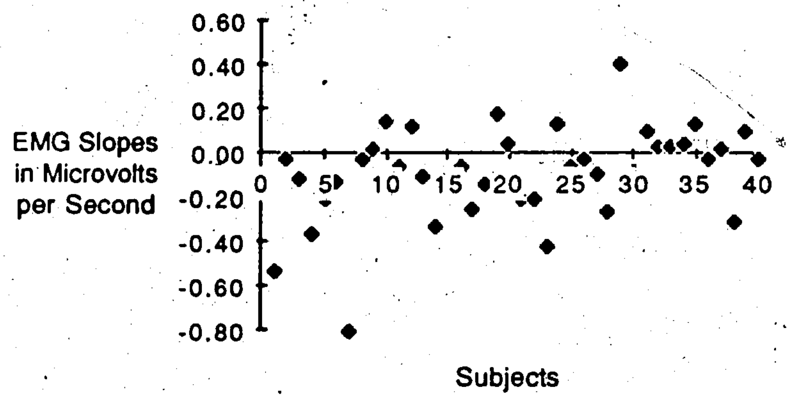
Temperature Means for No Music for 40 Subjects



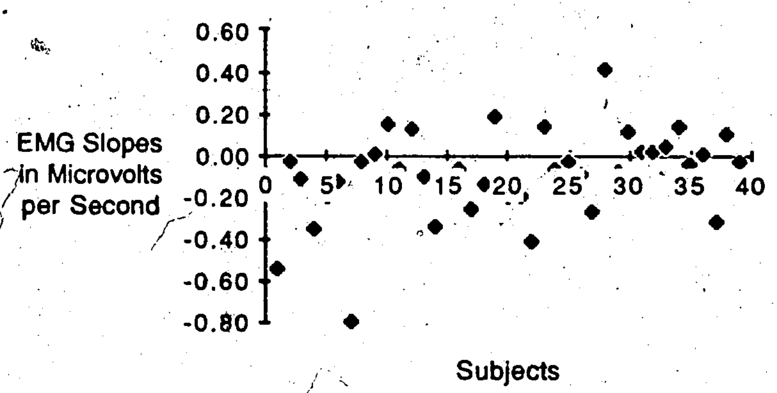
Temperature Means for Halpern's Music for 38 Subjects



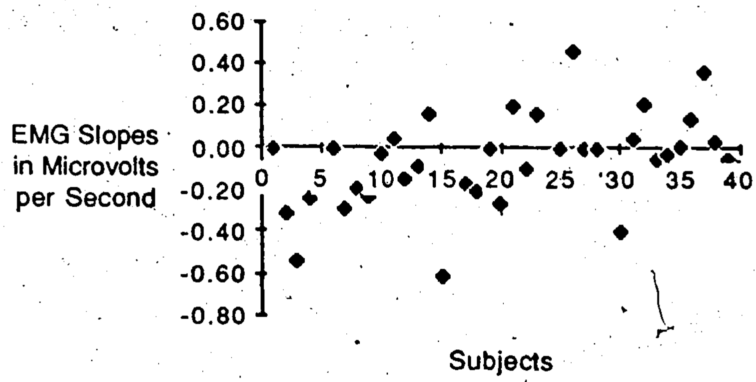
EMG Slopes for Rider's Music for 40 Subjects



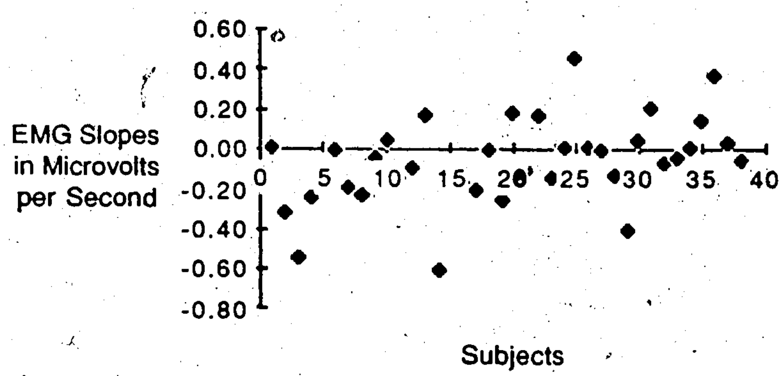
EMG Slopes for Rider's Music for 39 Subjects



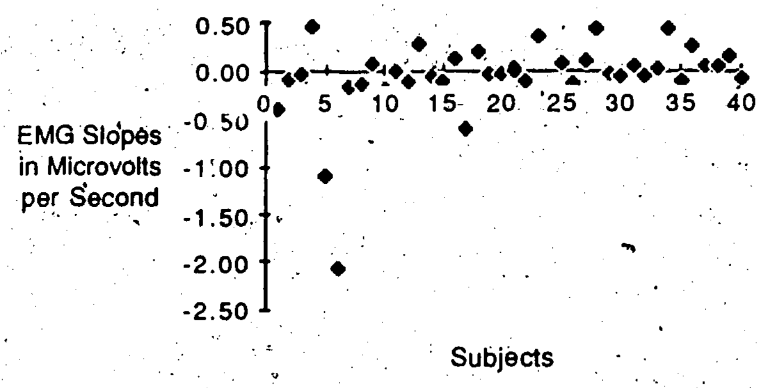
EMG Slopes for Halpern's Music for 40 Subjects



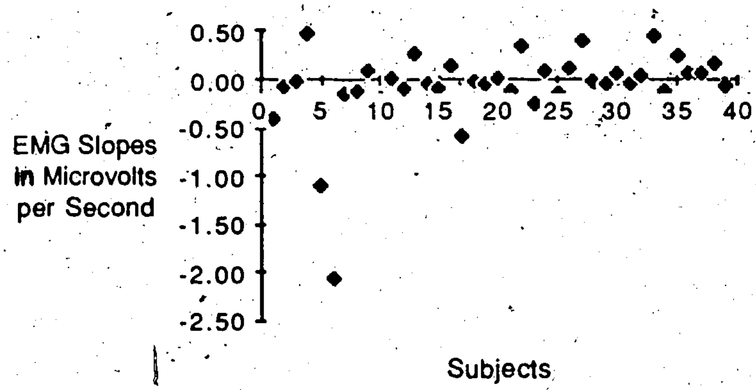
EMG Slopes for Halpern's Music for 39 Subjects

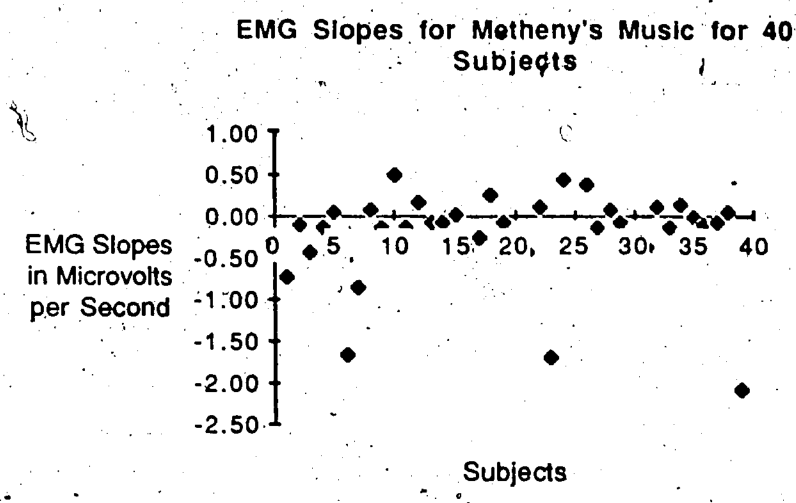


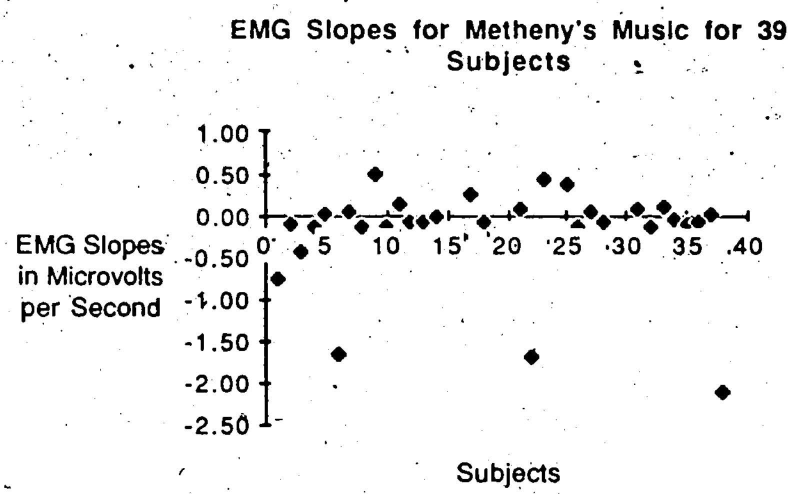
EMG Slopes for Pachelbel's Music for 40 Subjects



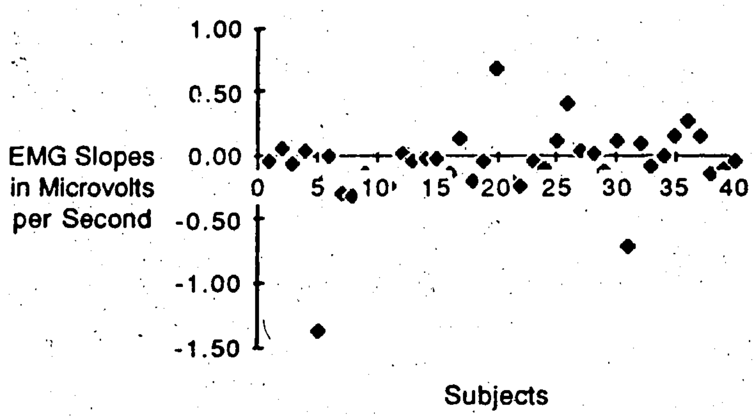
EMG Slopes for Pachelbel's Music for 39 Subjects



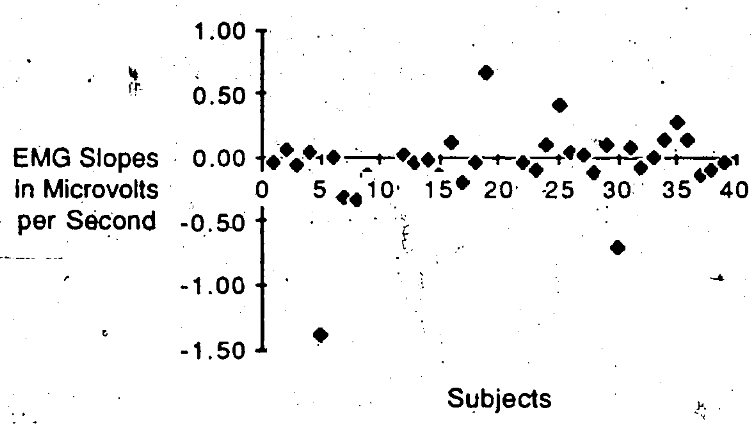

EMG Slopes for Metheny's Music for 40 Subjects
EMG Slopes in Microvolts per Second
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
0
5
10
15
20
25
30
35
40
Subjects


EMG Slopes for Metheny's Music for 39 Subjects
EMG Slopes in Microvolts per Second
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
0
5
10
15
20
25
30
35
40
Subjects

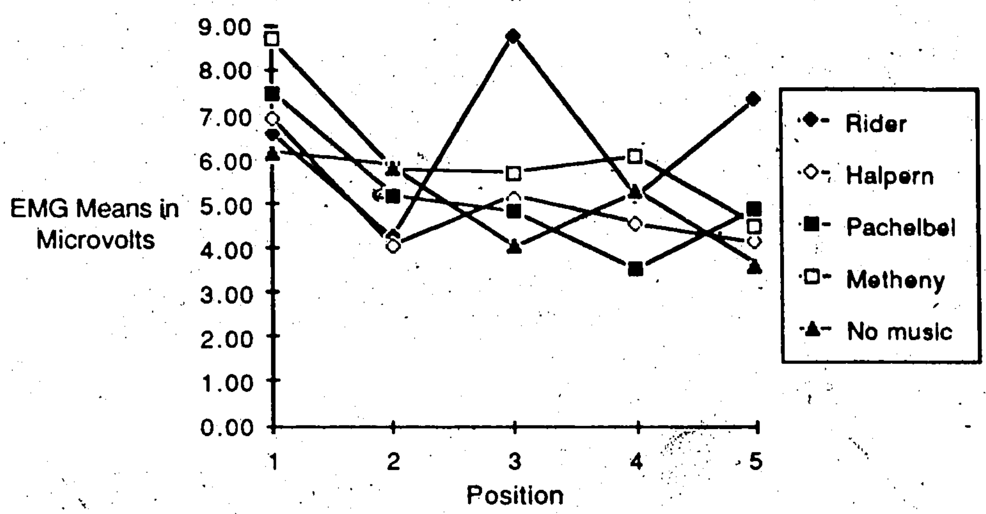
EMG Slopes for No Music for 40 Subjects



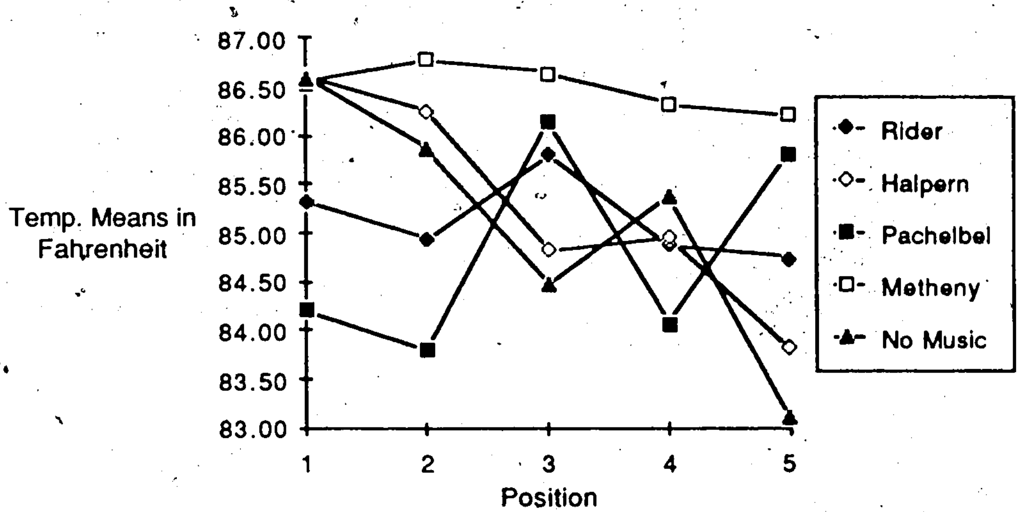
EMG Slopes for No Music for 39 Subjects

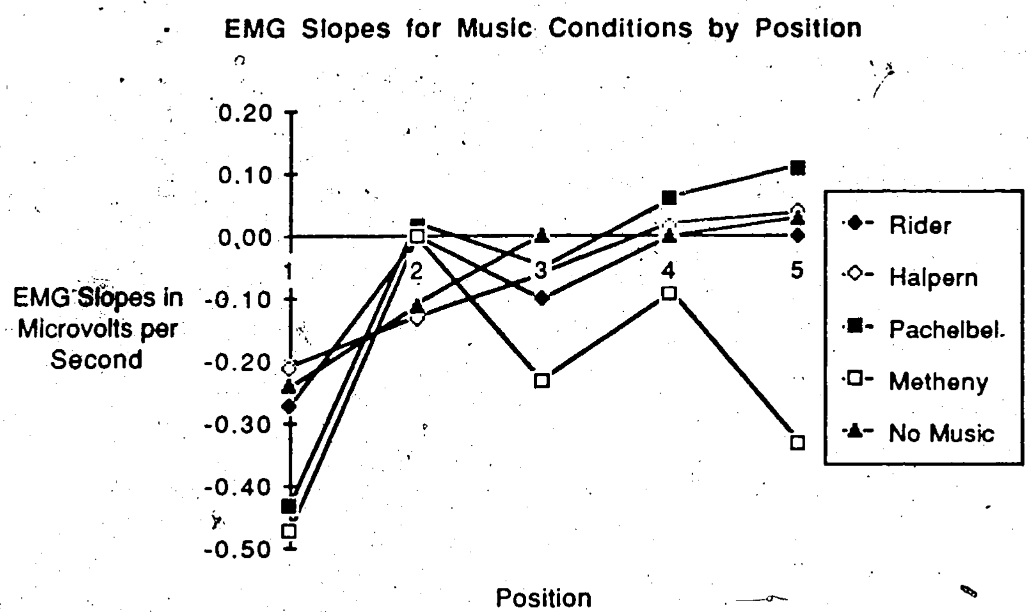


EMG Means for Music Conditions by Position



Temperature Means for Music Conditions by Position




EMG Slopes for Music Conditions by Position
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
EMG Slopes in Microvolts per Second
1
2
3
4
5
Position
Rider
Halpern
Pachelbel
Metheny
No Music