CONTROL OF HEART RATE BY PROGRESSIVE RELAXATION

TECHNIQUES AND CEREBRAL ELECTROTHERAPY

THESIS

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MASTER OF ARTS

By

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This study presents the findings of an investigation of the effects of two different treatments, progressive relaxation and cerebral electrotherapy, on heart rate. With progressive relaxation, the subject relaxes by following instructions. With cerebral electrotherapy, relaxation is due to an external source of stimulation. Decreases in heart rate for subjects receiving progressive relaxation were compared with decreases for subjects receiving cerebral electrotherapy. A placebo group was used to evaluate the effects of both treatments independently.

While decreases in heart rate were observed for both treatments, only progressive relaxation produced decreases significantly greater than those of the placebo group. However, decreases in heart rate produced by progressive relaxation were not significantly greater than decreases produced by cerebral electrotherapy.
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CHAPTER I

INTRODUCTION

In 1958, a forty-four-year-old man entered a hospital with upper respiratory tract infection symptoms. The patient disclosed that in the past twenty years he had experienced six sessions of these symptoms. The unique characteristic of this patient was his claim that he could voluntarily cause cessation of his heart beat. According to him, during his sessions of respiratory difficulty, he had learned to relax so completely that his heart stopped beating. After waiting a few seconds, he took a deep breath, and normal heart functioning resumed. He was worried that his heart might stop beating during sleep and not resume normal functioning. McClure (26) verified the patient's assertions on several occasions by auscultating the heart and palpitating the radial pulse while the patient induced several seconds of cardiac arrest.

Instances of voluntary control of autonomic responses, not necessarily as dramatic as the above reported case, abound in the scientific literature. Instances of voluntary control of autonomic responses date back at least ninety-two years (37). Ogden and Shock (29), in 1939,
report on two subjects who were able to accelerate their pulse rates on command. These two subjects demonstrated true hyperventilation with excess elimination of carbon dioxide, true increase in metabolism with excess oxygen utilization, and circulation in excess of the metabolic requirement. In fifteen other instances of voluntary acceleration of pulse rate, these same phenomena were observed.

Documented cases such as those cited above appear to have been the first step in the scientific investigation of the voluntary control of autonomic responses. The next step, logically, was the replication of autonomic control in the laboratory. However, it has not been until recently that reports in the literature have focused on teaching individuals to control their autonomic responses. This delay is probably due to two main factors: first, sophisticated instrumentation has only recently become available; secondly, until recently most authorities agreed with Kimble (37) that operant conditioning of autonomic responses was not possible. This review intends to give evidence supporting the proposition that learned control of autonomic responses is possible. Also since this study deals with heart rate, some aspects of cardiovascular functioning will be discussed.
After years of controversy, the question of whether autonomic responses can be modified using operant conditioning rather than classical conditioning still exists. However, isolated instances of individuals who obtained control over some autonomic responses, coupled with reports by a number of investigators describing successful operant conditioning of autonomies, has made the case for learned self-control of autonomies appear stronger. Van Twyner and Kimmel (46) report successful operant conditioning of galvanic skin response. Operant conditioning of vasoconstriction was reported by Snyder and Noble (39). Shearn (40) and Ascough (1) report on the successful operant conditioning of heart rate. Ascough, using operant verbal reinforcement, obtained both increases and decreases in heart rate using instruction and exteroceptive feedback. Engel (12) believes that the failure of prior investigators to obtain significant results was due to a lack of adequate instrumentation.

The combination of operant conditioning procedures and instrumentation into methods designed to teach individuals how to control their autonomic responses falls under the general heading of biofeedback. In general, information about autonomic responses is transmitted from the subject to the apparatus by electrodes attached to the subject. This information is then transformed into
appropriate feedback so that the subject may monitor his heart rate, skin temperature, blood pressure, or whatever response may be in question. This feedback may be in the form of a tone, a light, or various forms of visual display.

Once the feedback reading becomes stable, the subject is instructed to modify the feedback in the desired direction. If, for example, an increase in the pitch of a tone signals increasing temperature, the subject might be instructed to make the pitch higher. For most adult humans, these instructions appear sufficient; if they are not sufficient, feedback may be augmented with reinforcers such as money, consumables, or social praise. In some cases, usually in research designs, the subject may be unaware of the autonomic response he is to control. In these cases, reinforcement contingent on the correct response is his only feedback. In practice, it is essential that a baseline period of no feedback be obtained so that comparisons of data under conditions of no feedback and during or after feedback can be made.

The term biofeedback is as general as the word pill. As a technique, it was given its name in 1969.

It refers to any technique using instrumentation to give a person immediate and continuing signals on changes in bodily functions that he is not normally conscious of (51).
Credit is usually given to Kamiya (51) for popularizing the term when he reported on the conscious control of brain waves. Since that time, research on biofeedback procedures has become more abundant. Clinical applications appear more feasible and popular. Much of the rising popularity may be due to media exposure in newspaper articles such as the Los Angeles Times (14).

With interest in the learned control of autonomic responses stimulated by at least ninety years of case reports of individuals who somehow learned to control various autonomic responses followed by successful training of individuals and groups in the laboratory in control of autonemics, the next step in the evolution of learned control of autonomic responses was the clinical application of these procedures to specific problems. Biofeedback procedures have been used to treat a wide variety of problems. Among them are anxieties, tension and migrain headaches, and cardiovascular irregularities. Wolpe (50) states that "the most characteristic and common feature of neuroticism is anxiety." Wolpe reached the conclusion that conditioned autonomic responses form the basis for anxiety. Still, it was not clear how the relationship between behavior and autonomic activity might be altered. Wolpe (49) and others have created conditioning techniques which rely heavily on progressive relaxation as developed
by Jacobsen (19). Wolpe's conditioning paradigm relies heavily, in theory, on changes in autonomic activity. However in practice, more often than not, subjective observations or self-report are the only methods used to observe change. Evidence exists, however, to support changes in autonomic activity due to the practice of progressive relaxation. As early as 1940, Jacobsen (20) reported changes in heart rate due to progressive relaxation practice. While these conditioning procedures do not rely heavily on instrumentation, they may well be an important step in the application of autonomic change to clinical problems.

An electromyograph is an instrument which measures electrical activity in the muscles. Using feedback from electromyographs, individuals have been taught to relax specific muscle groups. Electromyograph training has practical use in the treatment of tension and tension headaches (43). It may also be a useful indicator of relaxation in conditioning therapies such as Wolpe's.

Migraine headaches appear to be related to the dilation of one or both of the external cranial arteries. These headaches have been treated successfully using skin temperature conditioning. The target behavior is the warming of the hands since cool hands can be warmed only by decreasing the sympathetic outflow, thus relieving the
artery from engorgement by blood. Two thermistors are used. One is attached to the forehead and one to the index finger of the dominant hand. The criterion response is the warming of the hands above the temperature of the forehead.

But what about the application of biofeedback procedures to cardiovascular functioning? One problem with research in this area is the complexity of the cardiovascular system. The remainder of this review will hopefully cover a few interesting and relevant aspects of the cardiovascular system and its conditioning. Specifically some of the factors affecting heart rate and heart rate variability will be examined. In addition, the question of clinical applications of cardiovascular conditioning will be considered.

Some investigators have sought relationships between types of sensory input and heart rate. They define two conditions of attending for their subjects: those whose attention is focused in and those whose attention is focused out. A subject whose attention is focused out might be performing a task such as listening; those whose attention is focused in are performing a task such as making judgments. Spence and Lugo found that heart rate is higher when attention is focused in and lower when attention is focused out. Williams and Frankel (47) found heart rate to be higher for both schizophrenics
and normals during a word association test and during an interview as opposed to period of rest. These results imply a relationship between cortical activity and heart rate. Lacey and Lacey (23) imply that increases in baroceptor activity should be associated with cortical deactivation while decreases should produce the opposite results. Others such as Campos and Delphini (8) and Thompson and Botwinick (44) believe that efforts to use the intracardiac cycle method to relate baroceptor activity to sensory or motor activity will be of little use.

One method of study which might prove useful in determining the relationship between cortical activity and heart rate is the surgical removal of the cortex in the rat. However, as Thornton and Van Toller (45) suggest, surgical removal of the cortex presents problems. First, the occurrence of diachisis and, second, long post operative recovery periods may allow compensatory recovery to occur. Thornton and Van Toller used a procedure called Spreading Cortical Deactivation (SCD) to suppress cortical activity. They found that attempts at operant conditioning of heart rate in the functionally decorticate curarized rat failed while significant changes were obtained in the non-functionally decorticate curarized rat. These findings support the hypothesis that cortical activity is necessary in the operant conditioning of heart rate.
Associated with the issue of the necessity of cortical functioning is the mediation issue. Are the peripheral somata motor responses necessary for learned changes in autonomic responses, specifically heart rate? The data support a conclusion that mediation is not necessary (37). Swarts (37) has proposed a model which explains the specificity of learned autonomic changes. This model essentially allows for specificity of conditioning or generalized conditioning of heart rate and blood pressure. From this model, one might assume that it is possible to condition one autonomic response or a variety of autonomic responses at the same time.

According to Bond et al. (6) rhythmic heart rate variability (RHRV) reflects the normal mode of heart rate regulation. Its periodicity coincides with the respiratory cycle. Factors other than respiration may be relevant. One such set of factors is the stages of sleep. In their study, Bond et al. found that subjects showed maximal excursions of heart rate variability while awake. During stages 1 and 2, or light sleep, respiration was more regular but variability of heart rate was just as great as in the awake state. In stages 3 and 4, or deep sleep, the frequency and amplitude of RHRV were uniform and most closely associated with respiration. During rapid eye movement, (REM), the excursion and frequency of RHRV were
widely variable and less correlated with respiration than in stage 1. During REM, bursts of alpha coincided with increases in heart rate.

A wide variety of other factors has been reported to affect heart rate. Graham and Slaby (15) report greater acceleration in heart rate when subjects respond to white noise than when they respond to some other equally intense tone. Blevings (5) found that heart rate did not increase in rats with increasing hours of food deprivation. Ray and Strupp (33) found that internal locus of control subjects were better able to decrease heart rate. Ninety-five publications from 1863 to 1959 report that heart rate increases of from four to fifty beats per minute have been found during smoking. However, twelve publications from 1880 to 1955 report that no difference in the heart rate between smoking and nonsmoking has been observed. In a more recent study, Erwin (13) found no effect of smoking on heart rate. One reason for the discrepancy between this study and previous research is proposed by Erwin. Prior studies tended to measure basal heart rate at its lowest while Erwin measured heart rate while the subject was in a more casual atmosphere during the baseline and experimental stages.

Strofe and Morris (41) have reported on the relationship between heart rate and respiration in children.
Breathing depth but not breathing rate had a significant effect on heart rate. There was no difference between shallow and medium breathing, but deep breathing produced a significant change in heart rate. Both breathing rate and depth had an effect on heart rate variability; fast breathing and shallow breathing produced a more stable heart rate than slow breathing and deep breathing. Piggot et al. (32) compared heart rate and respiration in psychotic and normal children. They found respiration to be more shallow and faster in the psychotic children than in normal children. Notably there was no difference in heart rate. The psychotic children were also not able to sustain cardiac acceleration as respiratory depths increased.

Kakiga and Hayao (21) have investigated the effects of foreperiod interval on heart rate, alpha blocking, and reaction time. Foreperiod interval is defined as the length of time between a cue signaling ready and a cue signaling response. At a foreperiod interval of .6 seconds, the shortest reaction time and the greatest amount of alpha blocking occurred. No significant interval effects on heart rate were found. Klinger et al. (22) reported on the effects of different levels of mental activity on heart rate, REM, and alpha production. Low concentration produced more rapid eye movement than high concentration. Concentration blocked alpha while low level
mental activity produced high alpha. Concentration produced high heart rate while low level concentration produced low heart rates. However, Beaty et al. (2) found that conditioned changes in Electroencephalographic (EEG) are not mediated by shifts in heart rate or respiratory rates.

Thus, it appears that a wide variety of factors may be influencing heart rate at any given time. Much of the evidence is conflicting. The difficulty of studying heart rate changes is twofold: first, which variables should be controlled and, secondly, how they should be controlled.

Cross laboratory comparisons also prove difficult. Norman and Melville (28) point out that heart rate is a complex phenomenon that may not lend itself for cross laboratory comparisons. They point out that a variety of factors may influence heart rate. They list metabolic rate, exercise, nutrition, age, sex, physical posture, environmental temperature, and body temperature. According to Norman and Melville, the most important of these may be body posture. Smoking, types of mental activity, and respiration might be added to their list. Evidence of psychosis, especially in children, could be considered.

The next consideration is the feasibility of self-control of heart rate in clinical application. A necessary question is whether the effects of trained heart rate
slowing generalize to situations other than those in the immediate experimental conditions associated with the learned changes? Duhbar and Baer (9) trained subjects to slow their heart rate and found that the training generalized to situations such as electric shock, which normally produce heart rate acceleration. It appears that a degree of generalization to situations other than the training per se can be accomplished.

In considering clinical applications, it is important to point out that only tachyarrythmia is an exclusive problem of heart rate. Also clinical subjects are often on regimens of drugs such as digitalis. Other factors may influence susceptibility to operant training. Engel (4) has demonstrated that operant techniques can control premature ventricular beats. Engel considers the degree to which the heart is diseased, the ability of the patient to develop internal receptors, and motivational factors to be important predictors of the success of operant techniques on tachyarrythmias.

Lang and Hnatow (24) have shown that heart rate variability may be brought under control. Bleecker and Engel (4) have demonstrated that patients with arterial fibrillation can learn either to increase or decrease their ventricular rate when necessary. Since Bleecker and Engel's subjects were on stabilized regimens of digitalis,
these results imply that subjects under the influence of digitalis can learn to control their ventricular rate.

There appear to be not only clinical applications of conditioning to cardiac pathology related to the heart rate but also techniques to deal with blood pressure. Elder and Ruiz (10) successfully trained essential hypertensive patients to lower diastolic blood pressure by as much as 25 per cent in four days. Notably, no change occurred in systolic blood pressure.

While the above studies dealt with abnormal subjects, many studies do not. Blanchard (3) comments that although many studies have shown statistically significant results, only a few of them have dealt with abnormal subjects. Blanchard proceeds to define clinical significant results as a 20 per cent decrease from baseline. Engel (11) is critical of Blanchard's criterion for clinically significant results. Engel points out that "among all the tachyarrhythmias only one, sinus tachycardia, can be said to be exclusively a problem of heart rate." All of the other tachyarrhythmias are associated with abnormal sites of origin, pulse formation and when corrected the heart rate return to normal. Thus the only clinically significant result possible is in the sinus tachycardia, and a clinically significant result there is a lowering of the heart rate below one hundred beats per minute. Blanchard
may have been premature in his development of a clinically significant criterion. At the same time, he raises another important point, that other lines of investigation should be studied. Blanchard specifically mentions progressive relaxation as developed by Jacobsen, Yogi exercises, and other related forms of meditation. Blanchard feels that progressive relaxation procedures may be as effective as feedback procedures.

Paul (30) reported decreases in heart rate of eight beats per minute using progressive relaxation techniques. Paul and Timble (31) in 1970, using automated relaxation techniques, obtained decreases of four beats per minute. These results are consistent with earlier results by Jacobsen. They indicate that face-to-face techniques are more efficient than automated techniques. However, the difficulties with Cross study comparisons have been pointed out previously. Reddick et al. (34) found no difference between automated and face-to-face techniques.

Another line of investigation is the effect of cerebral electrotherapy on heart rate. Neurotherapy or cerebral electrotherapy (CET) is sometimes referred to as Electrosleep therapy. This term, derived from the Russian term "elektroson," is misleading since whether or not the
patient goes to sleep is irrelevant. Nor should electro-
shock therapy be mistaken for CET since the patient remains
conscious, experiencing only a mild tingling sensation.

The Russians have been working some twenty-five years
in this field. The American-made "Neurotone" differs
from Soviet instruments in two ways: first, alternating
current is used instead of direct current and, secondly,
electrodes are placed on the forehead rather than the eye-
lids. In practice, the Russians place emphasis on attain-
ing the sleeping state while American investigators do not.

Theoretically, CET achieves its effects through
stimulation of the hypothalmus. Recently it has been
hypothesized that CET's effectiveness is due to a process
in which normalization of the balance between the sympa-
thetic and para sympathetic nervous system occurs. CET
is reported to be an effective agent in the reduction of
chronic anxiety, depression, hypertension, insomnia, head-
aches, alcoholism, ulcers, bronchial asthma, and various
other somatic complaints.

Rosenthal (35) reports that the "best results are
probably seen when the anxiety is not clearly related to
an acute environmental stress but has persisted chronic-
cally." McKenzie et al. (27) also report good results
with chronically anxious patients. Cammer (7) reports a
notable lowering of blood pressure in hypertensive
patients. One of the most promising applications of CET may be its use with alcoholic patients. Hughs and King (18) of Charity Hospital in New Orleans report that when CET is used with patients experiencing delerium tremens, the tremens are halted in almost every case. Hughs and King also found that withdrawing alcoholics require smaller doses of tranquilizers and medication to aid sleeping when CET is applied.

The above reports are simple reports from users of CET. Studies of CET utilizing research designs are not multitudinous. However, a few which bear on the question of physiological changes with CET do appear in the literature. One common finding is a decrease in gastric disturbance. In a study using the now famous executive monkeys, these same monkeys received therapeutic electric currents while engaged in the avoidance task. Wilson et al. (48) reported markedly reduced gastric secretion in executive monkeys receiving CET. Hanka et al. (16) have demonstrated similar results in studies using human subjects. In a study by Henderson et al. (17) decreases in Systolic/Diastolic blood pressure and pulse rate were found for subjects receiving cerebral electrotherapy.

Automated progressive relaxation and CET may not be considered biofeedback procedures per se. However, in the case of automated progressive relaxation, the subject
receives instructions to notice changes in his body such as hand warming, heaviness, etc. In that sense, the subject is not operating completely without information or feedback. Since biofeedback equipment is relatively expensive, its use in most cases is confined to the laboratory or the therapist's office. To the contrary, progressive relaxation may be practiced at home with minimal expense. Home practice allows the subject to practice often and in different environments, aiding generalization of the training. CET, however, in addition to having the same limitations of biofeedback, is confined by law to use by prescription from medical doctors.

Despite these limitations, CET may prove useful as a technique to control autonomic responses. Some individuals may not respond to verbal instruction as well as others. In these cases, CET may be the treatment of choice.

In stress-producing societies, the ability of mankind to control autonomic changes produced by stress may bear directly on his survival. In the past, stress-related disorders have been treated by removal from stress, removal of the stress, and/or medication. Conscious control of autonomic responses adds another alternative. Research bearing on the efficacy of various procedures' effects on specific autonomic responses is needed.
Purpose of the Study

The foregoing review of the literature and research points out the complexities involved in any discussion of ways to alter heart rate. With the difficulties of doing research in this area described, two methods now in clinical use for the treatment of anxiety have been described as potential tools for altering heart rate. Those are progressive relaxation and cerebral electrotherapy. Research tends to support the contention that these methods have a lowering effect on heart rate. The questions concerning the significance of results in studies dealing with heart rate have been discussed. In addition, the advantages and disadvantages from a logistical and legal point of view have been examined.

The purpose of the present study is to evaluate the effects of both progressive relaxation and cerebral electrotherapy and, if possible, differentiate effectiveness of the two in one quantitative dimension, namely heart rate. No assessment of clinical significance is intended.

Research Hypothesis

On the basis of previous research on heart rate conditioning and cardiovascular functioning in general, the following hypotheses were tested in this study:
1. Both automated progressive relaxation and CET will result in a significant lowering of heart rate.

2. Progressive relaxation produced decreases in heart rate will be significantly greater than decreases produced by CET.
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CHAPTER II

METHODS AND PROCEDURES

Source of Data

This study was conducted at a private hospital in Dallas, Texas. This hospital is an Inpatient-Outpatient Psychiatric facility which provides various forms of psychotherapeutic treatment. The subjects for this study came from the inpatient population.

Subjects

Participation in the study was voluntary. Because of the changing hospital population, subjects were selected from the present inpatient population. The only requirements for participation were that the patient not be receiving electroshock therapy, not be heavily sedated, not be judged brain damaged, and show no history of cardiac difficulty.

The subjects consisted of twelve males and three females between the ages of sixteen and fifty, with a mean age of twenty-six. The subjects had no prior information about the study. They were all told that this study was an investigation of relaxation and that their participation was purely voluntary. They were aware the results would
be published. They received no compensation in the form of privileges or money.

Experimental Design and Measures

The subjects were assigned to one of three groups (relaxation, CET, or placebo). There were five subjects in each group. Heart rate was recorded for each individual at the beginning and at ten-minute intervals for each session. Heart rate was measured with the Burdic EK/5 strip chart recorder. The first session was a pretreatment session; the next three sessions were treatment sessions, and the final session was a post-treatment.

Procedure

Upon entering the laboratory, the subjects were told to lie down. Electrodes from the electrocardiograph (EKG) were attached to their arms and legs. The subjects were told to relax and remain as comfortable as possible for the remainder of the thirty-minute session. They were told that the purpose of the electrodes was to measure some physiological responses.

Subjects in the Relaxation group were told that they would be listening to a thirty-minute tape of relaxation instructions and were asked to follow the instructions as best they could. Subjects in the Placebo and CET groups were told that they would be receiving a relaxation
treatment consisting of the application of a small amount of electric current to their forehead. Two electrodes were then placed on the frontalis and two on the mastoids. The current was increased until the subject reported an uncomfortable sensation. In the CET group the current was lowered until no uncomfortable sensation existed. In the Placebo group the current was turned completely off.

Apparatus

The sessions were conducted in a 9 x 12 enclosed room normally used for EKG and EEG recordings by the hospital staff. The apparatus consisted of a Burdick EK/5 strip chart recorder, a Neurotone 101 CET device, and a Craig model 2603 portable cassette recorder.
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CHAPTER III

RESULTS

As stated in Chapter I, evidence indicates that a lowering of heart rate occurs as a result of automated relaxation training and also as a result of the application of CET. On this basis, it was hypothesized that the heart rate changes for both the relaxation and CET group would be significantly greater than those of the placebo group.

Initially, the mean heart rate changes between the initial ending baseline heart rate and the ending heart rate of the third experimental session for each group were computed. The difference between these were obtained and Fisher's t test for independent means was used to compute the significance. Mean difference scores for each group are shown in Table I. The difference between these means and the t scores obtained are shown in Table II. The relaxation group changes differed significantly from the placebo group: (t=2.63, P < .05). The CET group did not differ significantly from the placebo group: (t=.292, P > .05). Thus, these results do not support hypothesis 1 as stated in Chapter I. In addition, the hypothesis
that relaxation group changes would differ significantly from CET group changes was not supported: (t=1.39, P > .05).

**TABLE I**
**MEAN HEART RATE CHANGE**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean Change</th>
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<tbody>
<tr>
<td>Relaxation</td>
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</tr>
<tr>
<td>CET</td>
<td>.2</td>
</tr>
<tr>
<td>Placebo</td>
<td>-.6</td>
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**TABLE II**
**TEST OF SIGNIFICANCE BETWEEN GROUPS**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Difference Between Means</th>
<th>t</th>
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<tbody>
<tr>
<td>Relax-Placebo</td>
<td>7.2</td>
<td>2.63*</td>
</tr>
<tr>
<td>CET-Placebo</td>
<td>.8</td>
<td>.292</td>
</tr>
<tr>
<td>Relax-CET</td>
<td>6.4</td>
<td>1.39</td>
</tr>
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</table>

*P < .05

Figure I shows the average heart rate changes during each session for each group during the three experimental sessions. Figure 2 shows the average change in heart rate for each group at the end of each session. The decreases shown in Figure I show a decline in heart rate during each session. However, in Figure II only the relaxation group shows a steady decline with a return toward baseline in the final or post-treatment session.
Fig. 1--Average decrease in heart rate for each group during training sessions.
Fig. 2--Average change in heart rate over sessions for each group.
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CHAPTER IV
DISCUSSION AND CONCLUSIONS

The findings in the preceding chapter do not support hypotheses 1 and 2. In the first case, heart rate changes for the relaxation group differed significantly from heart rate changes of the placebo group while the CET group changes did not differ significantly from placebo group changes. In the second case, heart rate decreases for subjects in the relaxation group were not significantly greater than those of the CET group.

Whether one employs the criterion of either Blanchard or Engel, clinical significance was not obtained in these results. Blanchard's criterion of 20 per cent below baseline was not met. Since the subjects did not come from an abnormal group, Engel's criterion for clinically significant results cannot be used.

The fact that the variable of number of treatments was held constant may partially account for the lack of significant results. In the case of the relaxation group, it is possible that further training would have produced greater decreases in heart rate. It is difficult, if not impossible, to postulate the effect of increased number of sessions on the CET group.
In Chapter I, a number of variables affecting heart rate were outlined. Although as many of these variables as possible were held constant, some were not controlled. For subjects in the relaxation group, attention was focused out. Attention focused in or out may have varied in the CET group. No attempt was made to control external or internal locus of control.

While one type of placebo was used, it was specific only to CET. Had a placebo tape group been used listening to neutral verbal comments, the effects of progressive relaxation would be more convincing. However, the distinction between neutral and activating verbal comments is a difficult one to make. The more global view of treatment versus nontreatment was thus adopted. It is suggested that further studies deal with this difficulty.

Conclusions

The present study found that while progressive relaxation was effective in lowering heart rate, it did not significantly exceed the lowering obtained with CET. In addition, the CET treatment proved no more effective than a placebo treatment.

These results may be due to extraneous variables which were not controlled. These variables include respiration, focus of attention, movement, and locus of control.
to name a few. A more probable answer may be lack of sufficient treatment density, length, and/or frequency.

Further studies are needed to evaluate these factors, specifically treatment density, length, and frequency. Such studies, in addition to bolstering or lowering confidence in these procedures, would provide valuable guidelines for clinical usage.
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