THE BIOFEEDBACK TECHNIQUE AS A FACILLITATOR IN AUTOGENIC TRAINING

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PREFACE

The central inquiry this study addresses itself to is the comparative effects of relaxation, autogenic instructions and autogenic instructions accompanied by immediate and continuous feedback to the subject of what that subject's performance is like. The performance is one of changing the skin temperature on the "ball" of the left forefinger by means of verbal instructions only. A "one-way" analysis of variance is used to evaluate this data. Of secondary interest is the evaluation by a Lickert-type "scale" of eight subjective reactions during each experimental trial, and an attempt to relate verbal reports to the subjects' performances.

The author cannot help but be aware of the many people who cooperated in this study. Dr. Elmer Green and his gracious wife, Alyce Green, of the Menninger Foundation somehow found a great deal of time and even more enthusiasm in helping bring the experimental hypotheses into being as well as pointing out the way to obtain the instruments necessary. Mr. Rex Hartzell, also of Menninger's was the individual who designed the necessary Temperature Feedback Meter and was always available to help in my learning to use and calibrate it.

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cannot be overstated. With the support of Dr. Harris, it was possible to obtain Grant number 0101-6-629-2122 of the Kansas State Department of Mental Hygiene, which made it possible to obtain the funds necessary to provide the equipment required for the experiment.

Certainly the staff at Larned State Hospital, both those who were subjects and the supervisors who allowed their frequent absences to participate in the experiment, deserve a warm, appreciative "thank you," especially Mrs. Lorene Keeley who took so many details off my hands.

I would also like to thank my committee: Dr. Kenneth Sandvold has been my academic advisor throughout my attendance at Oklahoma State University and has been a major source of support, guidance and patience. He and my other committee members, Dr. Donald K. Fromme, Dr. Robert J. Weber, and Dr. David J. Weeks approved my proposal at a time when many others would have rejected it as being in, what was then, an unknown area. It is a commendation to their judgment that in less than three years since their approval the areas of biofeedback and voluntary autonomic control have seen several hundred related research publications.

To John Schoenherr, a very special acknowledgement. Thank you.

Finally, there is my wife, Myrna; without her love, courage and hard-working help there would be no occasion to write a preface to a doctoral dissertation.

Mrs. Adalou Penner typed and proofread the final manuscript.

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CHAPTER I

INTRODUCTION

In discussing the background of oriental practices that lead to seemingly paranormal control of the practioners over their bodily functions, a writer is confronted with many variations on a rather central theme. Possibly this is related to the large variety of subcultures found in China and India, but such speculation will be left to the orientalists' expertise. A second difficulty is the citations of the literature. When writing about western research and theory, the text can flow smoothly, even when the citations are inserted at the place where they are exactly relevant. Eastern thought, however, is curiously resistant to such citation, possibly because so much of it is traditional and often difficult to ascribe to a given individual. Therefore it was decided to give special acknowledgement to the several authors who provided much of the material that guides this discussion in the beginning. Such acknowledgement is given to James (1958), Jung (1958), Gard (1962) and Bagchi (1969).

To begin with, there seems to be a strong characteristic of unity in eastern tradition, in which there are seldom any demarcations between philosophy and religion. There appears to be a penchant for striving to attain a unity of thought with respect to ethics, cosmology, epistomology and spirituality. Although it is true, for example, that a few sects speak of philosophy as an apparently separate discipline,

e.g., Vendanta and Saskhya-Yoga, still there is the impression of a definitely unitarian outlook.

The unity of this outlook is based on the necessity that man discover self knowledge, the lack of which is the touchstone of all human misery. Perhaps it is in the manner of the eastern love for seemingly contradictory statements to state that the essence of self knowledge is an appreciation that the "self" is an illusion. Man, collectively and individually, is but a facet of existence yet participates in that existence intimately. God, as a separate personality supervising existence, is regarded as a myth (although some sects have set Buddha up as a god). Existence is "God" and man as a participator in existence, participates in "God." With no external diety to pray to for help, man must turn to the "God" within his own consciousness for aid. The folly of man is the excision of his own consciousness from the existence of which he is related, this blinds him to the bliss of discovering the "God" within himself.

The narrow, stony road to enlightenment is through various meditative exercises designed for the ultimate purpose of shedding "selfhood." The subject-object relationship that western man takes for granted is dissipated through meditative exercises. Instead of the manipulation of nature for man's satisfaction, man must revere nature and participate in it. Hesse (1951) in his small classic Siddhartha makes his hero go to extremes: "A heron flew over the bamboo road and Siddhartha took the heron into his soul, flew over forest and mountains, became a heron, ate fishes, suffered heron hunger, used heron language, died a heron's death" (Pp. 11-12). The meditator then proceeds to project himself into a dead jackal until its bones are picked and its

skeleton (hence Siddhartha) becomes dust.

The essential point is to convey to the reader the oriental sense of synthesis as contrasted to the western penchant for analysis, with opposites used as conceptual reference points. In such a system of synthesis, distinctions such as "voluntary" and "involuntary" have little relevance. When one pays very close attention to, and participates in existence, he attains power by giving it up (i.e., relinquishing his identity as separate from existence). The body is disciplined to moderation, pain is observed dispassionately, and the same process that enables the self to be submerged in existence enables the meditator to passively exert effort to control his body.

Before presenting some of the psychophysiological evidence of the bodily control some meditators seem able to exert, a tangential comment may be appropriate. Teilhard de Chardin (1960), one of the great, and certainly one of the most gifted mystics in the western world in over a century, was much concerned about the extent of the ego's submergence into existence. First, he distinguished between being in while not of the world, from divorcing oneself from the world altogether. The first, of which he approved, was in the spirit of Zen Buddhism, as contrasted to the second, reflected in the Yogic approach. Yoga tends to the extreme that disputes the Zen affirmation that a material reality exists, advising its adherents to withdraw from life's illusions completely and concentrate on saving oneself by losing oneself.

A second concern of de Chardin's (1960) was that no (western?) culture should wholly incorporate another (eastern?) culture's traditions, values and practices. Another culture might borrow and adopt, but the process must result in a selective meld rather than a massive conversion.

The typical view held by western man seems to be that he experiences what exists. The external world is reasonably well reflected by his subjective experiences. If there is even a casual analysis of the stimuli constantly bombarding us, then he must admit that he ignores most of his experience with some degree of deliberation. As Huxley (1954) states it: "To make biological survival possible, Mind at Large has to be funneled through the reducing valve of the brain and nervous system. What comes out the other end is a measley trickle of the kind of consciousness which will help us stay alive on the surface of this particular planet. To formulate and express the contents of this reduced awareness man has invented...languages. (This linguistic tradition)...confirms him in the belief that this reduced awareness is the only awareness..." (P. 37).

The literature in psychology contains a great deal of experimentation with, and demonstrations of such a "reducer valve." The Gestalt school has demonstrated the "unconscious inferences" people constantly make, e.g., Koffka (1935) and Wertheimer (1945). The perceptions are constantly distorted in ways that are often helpful in everyday life. These distortions are not only a function of the objects' physical characteristics such as brightness, color, shape and size, but of the emotional variables of the viewer. Hence frustration (Postman & Bruner, 1948), differential reward and punishment (Schafer & Murphy, 1943), and taboo words (Postman, Bruner & McGinnes, 1948) can all be occasions for the reducer valve to do its work. Interestingly enough, it is children who appear to use such a valve much less than adults (Beryl, 1926; Burzlaff, 1931). Thouless (1932) demonstrated that another exception is the professional artist who, among adults showed the least

distortions, i.e., the use of perceptual constancy. It should be mentioned however that Locke (1935, 1937) found no differences in such constancies of children, adults and monkeys.

Another aspect is that of habituation. Here again, a great deal has been written. As an experience is repeated time after time one tends to "tune it out" to some degree. One of the most common examples is that of driving a car; at first the experience is painfully conscious, but soon the accelerator, clutch, brake, etc. can be manipulated more or less smoothly without much attention. Pribram (1969) reports on the effects on a neighborhood when a noisy, late evening train was discontinued. People began reporting to the police that they heard strange noises (prowlers, burglars, etc.). It was then determined that most of the increase of police calls occurred around the time the now-discontinued train used to pass through. Furst (1971) experimented with habituation of viewing a picture. As the subjects repeatedly looked at the picture their eye movements became more and more stereotyped and bypassed areas that at first had received attention.

One of the main goals of meditation is to at least temporily put these subject-object, task-orientating sets aside so that the individual might see the world and his relationship to it from a more insightful point of view. With this change in viewpoint, the setting aside of active effort, passive effort can be used to change the body as well as the mind to a sometimes startling degree. Although such demonstrations, e.g., Diekman (1969) Maupin (1969) and Green, Murphy, Green and Walters (private communication, 1967) dicate the extensive possibilities of self control of the human being, they are just that - demonstrations.

Just as impressive are the pathways that led westerners, by

experimental techniques, to discover that a funny thing happened on the way through logical positivism: western, subject-object, problem-solving ways could lead to the same discoveries.

As recently as 1969 Tart (1969) lamented that only twelve experimental articles on meditation could be found reported in the English language. Maupin (1969) complained that the standard dictionary of psychological terms (English & English, 1958) could only describe meditation as "serious thought." Suddenly there has been an explosion of newly-translated or newly-published articles. A reader, edited by Barber, DiCara, Kamiya, Miller, Shapiro and Stoyva (1971) contains seventy-five articles on such topics as instrumental conditioning of autonomic responses, biofeedback techniques and meditation. At about the same time Barber, et al (1971) published the first of what is planned to be an annual series of current research in these areas, incorporating hypnosis as well; the second annual edition some months later (Stoyva, Barber, DiCara, Kamiya, Miller and Shapiro, 1972) has continued the series. In all, these three publications contain 153 articles related to the above-mentioned subjects. Further, most certainly this list is incomplete. A much more selective approach could be used if the nature of the present paper were to test one theoretical approach against another, but this paper is confined to a lower conceptual level, being concerned with the empirical question of methodology. The selection must therefore be demographic at best.

There is a long Western tradition which has supported the notion that "reason" and "emotion" are naturally exclusive, and perhaps even antagonistic concepts. Plato seems to have established the precedent that this dichotomy is based on a biological distinction between

glandular and visceral responses which are "involuntary," and that skeletal responses which are "voluntary," and therefore related to the rational, controlled aspects of man's life. Miller (1969) describes the continuation of this dichotomy by Bichet, in which the neuroanatomist distinguishes the "great brain" and spinal cord from the ganglionic chains or "little brains" controlling visceral and emotional responses.

When modern behaviorism was developed, this dichotomy persisted. Skinner (1938) stipulated that instrumental conditioning was a function of the central nervous system and its skeletal responses, while classical conditioning was ascribed to the visceral and glandular responses of the autonomic nervous system. Until recently this separation has been a traditional assumption, although Hull (1929) indicated the difficulties with the assumption that emotion could be excluded in instrumental conditioning, at least with respect to avoidance learning. Mowrer (1947) appears to be the first to elaborate this point on a systematic basis, and later (Mowrer, 1960a), revised and extended his first paper to extend in detail to all human behavior, including cognition (Mowrer, 1960b). In the meanwhile Wynne and Solomon (1955) demonstrated that when a rat's sympathetic nervous system was rendered nonfunctional, learning still occurred, although not as quickly. Further, extinction was reported to be at least as difficult to obtain. The conclusion of these investigations was that the relationship between the central and autonomic nervous systems was quite complex and suggested that a variety of intervening variables, e.g., neurohormonal activity, had to be considered when behavior changes are explained.

In the Mowrer paradigm, i.e., Mowrer (1960a), the description of instrumental avoidance consists of the classical conditioning of the

conditioned stimulus (CS) to the emotion of fear, leading to the instrumental response of avoidance and the (emotional) positive reinforcement of "relief." Although the true conditioning paradigms are still kept separate, they are still presented as more intimately related--although not as much so as the Wynne and Solomon (1955) hypotheses would suggest.

More recently there have been a number of experiments suggesting that the previously-considered involuntary responses may be controlled by voluntary or instrumental conditioning. Examples are the conditioning of cardiovascular responses, such as Miller and Banreazzi (1968), Fields (1970), DiCara and Stone (1970), and Shapiro, Tursky and Schwartz (1971). Voluntary efforts to control changes in (autonomic) brain waves, as recorded by the electroencephalograph (EEG) are reported by Nolis and Kamiya (1970), Green, Green and Walters (1969), Black, Young and Bulenchek (1970), Luthe (1970) and Schultz and Luthe (1969).

Miller (1969) raises the question of whether autonomic responses are controlled directly by conscious effort or are initiated by skeletal muscles which in turn activate autonomic responses. In at least some autonomic changes this would seem to be the case. In certain Yogic exercises for example, breath control is a major method for eliciting visceral changes as well as altered states of consciousness, although there are reports that on preliminery analysis, the changes in EEG activities have shown there is no relationship to respiration, cardiac rate or eye movements (Kamiya, 1969). Clearly, even a superficial acquaintance with the striate muscle system leads one to appreciate the extreme difficulty in monitoring that whole striate system

to assure that there is no relationship. Perhaps the explanation will prove to be closer to the Wynn and Solomon (1955) hypotheses of intervening variables which make the neurological roles of the previously dichotomized systems relative.

An area of particular clinical promise for stress-ridden clutures such as the United States is the modification of cardiovascular responses. Schwartz, Shapiro and Tursky (1971) report that heart rate and blood pressure can be modified at the same time. Rewards (feedback and money) resulted in slight increases in both functions and substantial decreases in those functions. Possibly there are two feedback variables at work here--the visual (slides) and subjective experiences. Another finding, possibly of more theoretical interest, is an experiment by DiCara and Miller (1969). Previously they had demonstrated that when the central nervous system had been rendered inoperant by curare (Miller & Banuazini, 1968; Miller & DiCara, 1967) rats could, with some difficulty, learn autonomic responses by means of instrumental conditioning. It has also been shown, however, that not only is there positive transfer from the curarized state to the non-curarized state (DiCara & Miller, 1969), but from the non-curarized state to the curarized state (Pappas, DiCara & Miller, 1970). These results would suggest that, per Wynn and Solomon (1955), there are indeed mediators between the autonomic and central nervous systems.

Ranging further afield, Kamiya (1968, 1971) has shown that the alpha waves can be modified by operant conditioning--a finding that in a short time has become commonplace. Miller and DiCara (1968) have controlled urine flow and Frezza and Holland (1971) have operantly conditioned salivation in humans.

Autogenic Training

Autogenic Training (AT) is a technique developed by Johannes Schultz, who is currently Professor of Neuropsychiatry in Berlin, West Germany. It is based on a psychophysiological approach to disorders ranging from primarily organic causes to those presently regarded as primarily functional, including psychoses (Schultz & Luthe, 1959).

The background for the development of the technique is noted in internal medicine, psychiatry, neurology, hypnosis and oriental approaches to meditation (Luthe, 1969). The latter influence is reported by Green, Green and Walters (1969) to have been "imported" from the orient by military physicians who had served in India. These witnesses reported that the seemingly amazing feats of "fakirs" appeared to be genuine, yet apparently in some medical circles were regarded as more than a curiosity. Luthe explains that Schultz was influenced by the work of Oskar Vogt in the 1890s, who was conducting research on sleep and autohypnosis at the Berlin Institute. Impressed with his patients' reports of being able to reduce stress and its symptoms, Vogt entitled these self-induced exercises "prophylactic rest-autohypnosis," (Prophylaktische Ruhe-Autohypnosen).

Luthe (1969) procedes to explain that Schultz was studying the phenomena of hallucinations in normal subjects and his results seemed to be meaningfully related to Vogt's data. In particular, his work with hypnosis seems to have convinced him of the importance of the feelings of heaviness and warmth. His intention was to further Vogt's work by attempting to help his subjects induce autohypnosis, using as suggestions these commonly-reported experiences of persons under

externally-induced hypnosis. The first systematic presentation of his method, Das Autogene Training, was published in 1932. Luthe (1969) reports that since then about one thousand publications have appeared on the subject but that only about one percent have been written by English speaking authors.

This apparent lack of interest in AT in English-speaking countries seems to be substantiated by mitigation by the appearance in America of a six volume set on AT, variously written by Schultz and Luthe (1969), Luthe and Schultz (1969a, 1969b) and Luthe (1970). Together they appear to represent the complete body of AT methodology, case reports and research findings. Over two thousand citations are presented, although the great majority refer to non-English publications.

The first volume describes the six "standard excercises" as they are called. The subject or patient is placed in a sitting or reclining position or in a reclining chair and, after explaining what is expected, is given the first excercise to repeat to himself. It is explained that he is to close his eyes and use a passive effort, i.e., he is to observe his own body responding to the instructions. He is also warned that there may be temporary negative feelings and/or images but he is not to become particularly concerned about them.

The first exercise is that the body feels heavy, and the beginner starts out with sessions of 30-40 seconds. After this exercise is mastered, the second one may be introduced, that the body is warm. As the sessions continue the rest of the exercises may be added. In order these are: cardiac regulation (with the hand placed over the heart for feedback), respiration regulation, abdominal warmth, and, finally, cooling of the forehead.

Before any training is begun, the trainer is abjurred to take a careful history of the patient's medical and emotional background. Based on that history, certain exercises may be deleted entirely or dropped if the patient shows unfavorable reactions. For example, in a cardiac patient afraid of dying, the cardiac regulation was stopped when the patient showed high anxiety; obviously the heart's reaction was in the opposite of the direction required to a dangerous extent.

An examination of the table of contents of the second volume (Luthe & Schultz, 1969a) gives some overview of the disorders that AT has treated. Under the heading of "Disorders of the Gastrointestinal Tract" are listed gastritis, peptic ulcer, bilary disorders and anorexia nervora, to name just some. Under "Disorders of the Cardiovascular System and Vasomotor Disturbances" are such pathologies as auricular fibrillation, heart block, angina pectoris, myocardial infarction and even hemophillia.

The other major area in which AT is applied is psychotherapy (Schultz & Luthe, 1969; Luthe & Schultz, 1969b). The standard exercises are used first. The patients' disorders range from character disorders and psychosomatic complaints to various neuroses to psychotic diagnoses such as schizophrenia and manic-depressive behavior. The reader can hardly restrain from skepticism over the range of mankind's maladies that AT claims to help or cure, but the case documentation seems impressive both in its meticulous reporting and its reports of partial or complete failure.

The exposition of AT, especially in the area of psychotherapy is vague about how AT was developed while explicit about how it is done. The prevailing theme throughout is that while the dynamics of the

technique's success are very unclear, there is a basic faith in the (brain-directed) organism to heal itself if pathological restraints are removed. The main reservation is that some patients can cope with fewer restraints than others, and it is the therapists' responsibility to identify the limits. The pathological restraints are broken down by virtue of the hypnogogic-like stimuli that accompany the exercises and the spontaneous emission of emotional and gross motoric reactions that accompany those stimuli. Again, there are no hypothetical constructs to explain the subsequent therapeutic benefits--only extensive anatomical, neurological and psychological measures contrasting the pre- and post- therapeutic states of many patients. When there is speculation on why there are therapeutic changes, the discussion centers on the conceptual levels of "brain-directed" discharges of tension, and "...corticodiencephalic interrelations which enables natural forces to regain their otherwise restricted capacity for brain-directed, trophotropically orientated self-regulatory (autogenic) normalization" (Luthe, 1970, P. 125).

The Biofeedback Technique

The concept of biofeedback is derived from the principle of cybernetics that a system can be self-regulatory if information about its performance is continually monitored and relayed back to it. A thermostat, for example, can continually regulate heat by virtue of a temperature sensor; when the heat drops below a specified level the sensor relays this information to a relay that activates the heat source which produces heat until the sensor once again provides the relay system with the required input--this time that the required temperature has

been reached and the heat source is to be turned off. There is a tremendous variety of such systems ranging from the relatively simple thermostat to elaborate guiding systems for airplanes and rockets.

In the biological world there is a variety of such systems; e.g., in the maintenance of the glucose level in the body. Most of the time, however, these systems operate either without the organism being conscious of them or at least unable to identify the reason for the awareness of change. If emotion is heightened, for example, the adrenal level might rise and the organism become aware that there are changes in its body, but the nature of the changes might not be understood.

Although a feedback system may be of a biological nature, the term "biofeedback" is usually understood to have a more specific meaning. This more specific meaning is, first, that there is an awareness on the organism's part that change(s) in its body are directly related to perceivable stimuli, internal or external, natural or artificial. Second, such stimuli must have the potential for allowing the organism to learn how to monitor them so that the organismic process they represent can be modified. Examples of natural stimuli are the pulse or, as Schultz and Luthe (1969) describe, the heartbeat. Although even humans are not ordinarily aware of each stimulus, most people are aware that these stimuli are related to the degree of activity or stress in the cardiovascular system and can easily be taught to attend to such cues. An example of artificial stimuli is the use of sound to inform a subject whether his electroencephalographic activity is of the desired nature and/or amplitude (Kamiya, 1968; 1971). The variety and sophistication of such techniques seems to be limited only by the technological boundaries of scientific instrumentation.

In addition to the electroencephalograph, there are monitors for heart rate (DiCara & Stone, 1970), electrodermal activity (Crider, Shapiro & Tursky, 1968), salivation (Miller & Carmona, 1967), muscle tension level (Green, Walters, Green & Murphy, (1969), and many more. It is the artificial type of biofeedback, i.e., a dial indicating changes in finger temperature, that will be used in the present experiment.

Temperature

In this study the dependent variable will be the temperature on the "ball" of the left forefinger. Before proceding, however, it would seem appropriate to give some physiological description of what is taking place as that temperature changes.

Under the almost complete direction of the sympathetic nervous system the arterioles dilate and constrict, thereby regulating the amount of blood that is available to the venous plexes--a network of small blood vessels near the skin surfaces of the feet, ears and hands (Guyton, 1966). When the sympathetic system is stimulated the arterioles constrict; when sympathetic centers of the posterior hypothalumus are excited, vasoconstriction is enhanced, but when these centers are inhibited vasoconstriction decreases. Futher, it is the fingers and toes that are reported (Plutchik, 1956) to be the most sensitive indicators of temperature change. Consistent with the autogenic instructions to be used, Mittleman and Wolff (1939) report a decrease in forehead temperature as finger temperatures increase.

Another factor to be considered is the effect of the menstrual cycle, since the experiment is using female subjects only. Although

Rothman and Felsher (1946) report that capillary size fluctuates with the menstrual cycle, Plutchik (1956) reports that capillary size is not particularly related to blood flow. Although Hardy, Milhorst and DuBois (1941) state that women are more susceptible to temperature changes than men when the environmental temperature changes, there were only two women and four men used in the study. The literature seems curiously sparse on sexual differences in temperature.

Finally, when the dependent variable is one of temperature change, the "floor" and "ceiling" of that variable must be considered. Although it would seem reasonable that the higher the initial value, the less the change that is to be expected (formalized by Wilder, 1957), Hord, Johnson and Lubin (1964) found this not to be true for skin temperature. This implicit discrepancy is possibly due to the range of initial values Hord and his associates sampled. Extreme differences in initial values would probably show that a "floor" and "ceiling" do in fact exist. For the purposes of this experiment, however, it is assumed that no subjects will show radically different initial temperature values, so the finding that smaller differences in those values does not substantially influence temperature change seems adequately reassuring.

Although the experimental design used in this study could have been a more straight-forward use of each subject acting as her own control, the design was changed to provide for a control group experiencing relaxation instructions only, because relaxation only might result in an increase of skin temperature (Mittleman & Wolff, 1939). It seemed more straight-forward, therefore, to design the experiment as a one-way analysis of variance, comparing the means of three groups than to

partial out some "error variance" (by use of an analysis of covariance or an analysis of variance with each subject as his own control), which might result in supporting a hypothesis which is not true.

Hypotheses

The hypotheses that will be tested are: Subjects receiving autogenic instructions aided by a biofeedback technique will be better able to increase their finger temperature than subjects who receive autogenic instructions but no biofeedback on their performance. Subjects receiving only relaxation instructions will not be able to increase their finger temperature as well as either of the groups receiving autogenic instructions.

CHAPTER II

METHOD

Subjects

The experiment provided for 30 Ss to be randomly assigned to three groups of 10 Ss each. The recruiting pool consisted of 41 potential Ss, one-half of the female staff members of the Larned State Hospital, Larned, Kansas, who were between the ages of 18 and 56 years old. Only one-half were available because another, similar experiment was being conducted concurrently. First, an alphabetical list of all personnel was screened for females, and in alphabetical order they were alternately assigned to one of the two experiments. Each prospective S was then sent a recruiting letter (Appendix A) by hospital mail explaining that a research study was being started and requesting their voluntary participation. Prior to this action all supervisors had given their consent to their personnel participating as Ss.

Those female personnel who responded favorably to the recruiting letter were then screened for being in the proper age range, and those who qualified were then sent a second letter (Appendix B) thanking them, and also a release form (Appendix C). As soon as they had time to receive these last two forms they were contacted and appointments were arranged. All but two of those employees contacted completed the experimental procedure, one, because of a death in the family, and the other because of "personal problems" which she did not wish to discuss.

A reserve pool of eleven Ss remained for such eventualities however and "reserves" acted as replacements. These were selected in the order in which they had volunteered.

Equipment

The equipment used in this research consisted of the following:

Temperature Feedback Meter (TFM) with a signal output of 100 mm per ^{o}F, modified for a servo-pen recorder of 100,000 ohms or greater. The TFM was equipped with a lighted dial that fluctuated from readings of "-25" to "+25" with the needle pointing to "0" when at rest in the vertical position. The TFM was also equipped with two potentiometers, one which centered the dial and the other used for both calibration and the translation of electronic input into specific Fahrenheit temperatures.

The thermistor was a round temperature sensor approximately 2mm in diameter, partially embedded in a square of epoxy non-conductor, approximately 1 cm square. The thermistor was wired to the TFM so that as it sensed changes in temperature, those changes were transferred to the TFM. The thermistor was attached to the S at the point it was exposed from its epoxy base.

"Heath" Servo-Pen Recorder, Model EV20B, single speed (2 in. per min.).

"Heath" chart paper, ten inches wide by 120 feet long. The paper was ruled into a grid of one-inch square divisions. Each square was subdivided into ten rectangles. Hence, when the recorder's

pen was placed at its starting point in the center of the paper, it was free to traverse five one-inch square divisions in each direction.

A deeply padded reclining chair.

A "Norelco" reel-type tape recorder.

A "Taylor" brand laboratory-type thermometer scaled for Fahrenheit temperature recordings.

Procedure

Three rooms were used for the research procedures. The first room was an office, the second a waiting room, and the third the experimental room. During the course of the experiment the experimental room was used for that project exclusively. This room measured approximately fourteen feet by nine feet and the S's reclining chair was located at the approximate center. There was one window to the chair's left front and another directly behind it. Both windows were fitted with black window shades that reduced the light markedly. When the electric lights were turned off the amount of light still varied with the time of day and weather conditions. This light fluctuation was therefore only partially controlled, not measured and was never commented upon by any S. The E did notice, however, that when the electric lights were turned on, Ss blinked their eyes and the pupils were often observed to contract.

To the left of the reclining chair there was a table on which the TFM and pen recorder were placed. Directly behind the table, and to

the left and rear of the reclining chair was a chair which the E occupied during the trials proper. To the left of the E, on the floor, was the tape recorder.

The temperature of the room was recorded by a standard thermometer (^{o}F) and its readings were recorded for each session. These readings ranged from 70^{o}F to 73^{o}F over all trials. This temperature range was not considered to be a variable.

From the beginning of the first baseline trial, an effective attempt was made to insure that each S experienced two trials per day--one before noon and one after noon. On several occasions the nature of the S's employment prevented a rigid adherence to this schedule, but in all, there were surprisingly few exceptions.

All Ss were given three initial trials under the following conditions. The Ss were conducted into the lighted experimental room and invited to be seated in the reclining chair. This chair was then tilted back to the full reclining position, which left S lying in a position approximately 45^{o} with respect to the floor. Their feet were supported by a padded platform. Next, each S's left forefinger was rubbed with a standard brand of rubbing alcohol to reduce oil on the skin surface and provide improved contact with the thermistor (sensor) wired to the TFM.

The next step was to attach the thermistor to the "ball" of the S's left forefinger with cellophane tape.

At this point the E turned off the lights and resumed his chair to check the calibration of the TFM, start the servo-recorder and then start the tape recorder. The contents of the tape recorder (Appendix D) lasted approximately 54 seconds, and were interpreted by the E as

being congruent with instructions in relaxation.

When the taped instructions ended, the tape recorder volume was turned to its lowest volume--a procedure that minimized distracting sounds. At the same time a stopwatch was started to time a period of 90 seconds to allow the S an opportunity to practice the instructions. At the end of this time the servo-recorder was stopped and the E turned on the room lighting. The thermistor was removed from the S's forefinger and the chair returned to the upright position. After reconfirming the next appointment, the E thanked the S, and the S left the laboratory.

These three initial trials were termed "baseline" trials because they were meant to sample each S's response to relaxation instructions before introducing the independent variable of differences in instructions.

Following these trials, the Ss were divided into three groups of ten each. The procedure for randomly assigning each S to one of the groups consisted of writing the name of each S on a separate 1X3 slip of paper. All slips were folded and dropped into a small box. The box's contents were then mixed and the slips drawn out one at a time and the names assigned successively to a group. In this manner the first name was assigned to the first group, the second name to the second group, etc.

A description of the three groups is as follows:

Control (C) - the purpose of this group was to provide a measure of the effects of relaxation instructions only that could provide a contrast to the effects of the two treatments described below. The procedure used with this group was to replicate the baseline trials an

additional twenty times.

No Feedback (NFB) - the treatment of this group deviated from the procedures of the baseline trials and C groups in two respects. First Ss in this group were given tape-recorded autogenic instructions (Appendix E) in addition to the relaxation instructions (Appendix D). These NFB instructions required an additional 38 seconds of time, bringing the total instructions time for this group to 92 seconds. The instruction periods were followed by a 90 second pause to allow each S to practice those instructions. Second, after each of the twenty experimental trials the S was requested to fill out a questionnaire form (Appendix G).

This questionnaire was constructed to attempt the acquisition of data about the Ss' subjective experiences during each trial. An examination of the form (Appendix G) shows two types of inquiry. The first is eight Lickert-type "scale" items. Seven of the eight items refer to key phrases in the instructions. One item, "breathing regular-irregular" appears in the baseline and C group (Appendix D) instructions, five additional items "relaxed-serene," "finger warm-cool," "arm light-heavy," "alert-sleepy" and "forehead warm-cool" were contained in this NFB group. The seventh item, "concentrated on instructions-mind wandered from instructions" referred to the instructions given in the Feedback group described below. The eighth item was added to try to evaluate the extent of Ss' feelings of general well being. The second type of inquiry was two general questions regarding Ss' self reports on their physical and mental/emotional experiences. The C group was not requested to fill out the questionnaire because many phrases, expecially the "finger warm-cool" item might tend to influence these Ss'

behavior.

Feedback (FB) - the treatment procedure for this group was the same as that for the NFB group with the exception that Ss were allowed to observe the TFM, and in addition to the NFB instructions (Appendix E) the tape-recorded instructions in the second paragraph of Appendix F were added. These FB instructions required an additional 19 seconds of time beyond the NFB instructions, so that to the initial C instructions of 54 seconds there was an added 38 seconds of NFB instructions and the additional 19 seconds brought the instruction time to 111 seconds. Following this instruction period, each S was allowed 90 seconds to practice those instructions. The first paragraph of Appendix F is identical to the C instructions. As with the NFB group, the FB Ss filled out the questionnaire (Appendix G), after each of the twenty experimental trials.

Operational Hypotheses

When the means for left forefinger temperatures of the three initial baseline trials are compared with the temperature means of the last three experimental trials it will be found that when the three groups' means are compared by a one-way analysis of variance at the .05 level of significance:

1. The temperature recordings made at the start of trials will be higher for the FB group than the NFB group, and that both groups will be higher than the C group.

2. The temperature recordings made at the end of instructions will be higher for the FB group than the NFB group, and that both groups will be higher than the C group.

3. The temperature recordings made at the end of trials will be higher for the FB group than the NFB group, and that both groups will be higher than the C group.

4. The temperature recordings made on the average of the last 90 seconds, based on samplings every 6 seconds, will be higher for the FB group than the NFB group, and that both groups will be higher than the C group.

CHAPTER III

MEASUREMENTS AND RESULTS

As previously noted, the statistical instrument for evaluating all "objective" data, i.e., the temperature recordings, was a single-factor analysis of variance (AOV). This is the analysis Winer (1962) refers to as "Model I." The AOV was selected for several reasons. First, a Fahrenheit temperature scale is conventionally regarded as an interval scale (Stevens, 1958), and since the procedures for calibrating the TFM and the corresponding responses of the pen recorder indicate a recording system that correctly reflected the variations in a laboratory thermometer, the assumption of an interval scale seemed satisfactory. Second, the experimental procedures for carrying out the experiment were such as to reasonably insure that the performances of each group were independent of one another. Although it might be argued that every S had three baseline trials with the same instructions and that the FB and NFB groups subsequently received much the same type of instructions, the distinctions between the uses of the independent variable instructions seem operationally distinct. Third, the procedures for recruiting Ss and assigning them to groups seems to have provided adequate assurance that the sampling had been random. Granted these assumptions, the single factor AOV seemed to be the statistical instrument of choice for evaluating the results of the temperature recordings. It should be kept in mind that, in performing the preliminary analyses, the term

"group" has a somewhat different meaning. Since Ss were not assigned to groups until the baseline data had been collected, the reference to "groups" has a post hoc quality even though the rules for the sampling procedures had previously been established. An α level of 10 S was chosen.

All Ss served as their own controls in the sense that the means of their last three experimental trials was compared to the means of their first three "pre-experimental" baseline recordings. It seemed advisable however to perform a cross-check to determine whether the assumption of randomness in assigning Ss to groups was tenable. Therefore, a single factor AOV was performed on the mean baseline scores comparing groups on each of the four variables.

Table I summarizes the AOV comparing the baseline averages of the FB, NFB and C groups on the first variable--the temperature recordings at the onset of the trial as S began receiving relaxation instructions. It will be noted that there were no statistically significant differences between groups.

Table II presents a summary of the AOV comparing baseline averages for the three groups on the second variable, the temperature recordings recorded at the end of the instructions. At this point the nonsignificant F again reflects the assumption that there are no systematic differences between the groups' finger temperatures.

Table III shows the results of the AOV comparison of the three group means on the baseline trials for the third variable, which is the average temperature recording for each group at the end of the baseline trials. Again, the statistical differences between groups is nonsignificant.

TABLE I

SUMMARY OF ANALYSIS OF VARIANCE BASELINE ($\bar{X}$ OF INITIAL THREE TRIALS), VARIABLE #1: TEMPERATURE AT START OF INSTRUCTIONS

SOURCE	df	MS	F
Groups	2	38.9148	1.9925
Error	27	19.5302	

F (2,27 df) = 3.35 nonsignificant at .05 level

TABLE II

SUMMARY OF ANALYSIS OF VARIANCE BASELINE ($\bar{X}$ OF INITIAL THREE TRIALS), VARIABLE #2: TEMPERATURE AT END OF INSTRUCTIONS

SOURCE	df	MS	F
Groups	2	51.3612	2.5160
Error	27	20.4135	

F (2,27 df = 3.35 nonsignificant at .05 level

TABLE III

SUMMARY OF ANALYSIS OF VARIANCE BASELINE ($\bar{X}$ OF INITIAL THREE TRIALS), VARIABLE #3: TEMPERATURE AT END OF TRIAL

SOURCE	df	MS	F
Groups	2	60.7169	2.9776
Error	27	20.3912	

F (2,27 df) = 3.35 nonsignificant at .05 level

Table IV is a summary of the AOV testing possible statistically significant differences between groups based on the fourth variable, the average temperature of each group over all three baseline trials for the period between the end of the instructions and the end of the trial. This average is based on a sampling of temperature readings every six seconds. Although it is once again to be noted that the results are nonsignificant, a rather interesting observation becomes evident. When the F values for the four variables are compared, there is a constant although slight, increase in the F values as the variables reflect a progression of intra-trial time from the beginning of the trial (Table I) to its conclusion (Table IV). The F is then largest of all for the average temperature from the cessation of the instructions to the end of the trial (Table IV). This has occurred during the time when the data that has been collected is based on every S having been given the same treatment procedure. The only apparent answer is that this small but progressive increase in F values is a chance occurrence. The possibility that the E unwittingly treated Ss differently in some way due to the group they were in is precluded by the fact that Ss were randomly assigned to groups after the baseline trials had been completed.

The main dependent variable of the experiment is the mean of the last three trials minus the mean of the baseline data for each of the four previously-described variables. The results of these data was evaluated by one-way analysis of variance. The rationale for the use of these analyses is the same as for the use of that instrument for the evaluation of the baseline data comparing groups for, each of the four variables. An α level of .05 was chosen.

TABLE IV

SUMMARY OF ANALYSIS OF VARIANCE BASELINE ($\bar{X}$ OF INITIAL THREE TRIALS), VARIABLE #4: AVERAGE TEMPERATURE BETWEEN END OF INSTRUCTIONS AND END OF TRIAL (90 SECOND PERIOD SAMPLED EVERY 6 SECONDS)

SOURCE	df	MS	F
Groups	2	67.1648	3.0952
Error	27	21.6996	

F (2,27 df) = 3.35 nonsignificant at .05 level

The results for the first variable are presented in Table V. It can be seen that when the mean temperature of the last three trials is compared with the baseline, the differences in those temperatures with respect to the beginning of instructions is nonsignificant. Figure 1 presents a visual display of the frequency of Ss at each temperature interval for Variable #1 for each group.

For the second variable--the mean temperature at the end of instructions--the temperature increase across the three groups is nonsignificant as shown in Table VI. Figure 2 presents a visual display of the frequency of Ss at each temperature interval for Variable #2 for each group.

When the group means of the differences between the final three trials minus the baseline trials for the third variable--the temperature at the termination of the trials--are compared, the F is again nonsignificant. A summary of this comparison is provided in Table VII. Figure 3 presents a visual display of the frequency of Ss at each temperature interval for Variable #3 for each group.

Finally, Table VIII presents a summary of the results for the fourth variable. This variable is concerned with the average temperature from the time the instructions terminated to the end of the trial. The temperatures were read every 6 seconds for 90 seconds and divided by the number of measures, i.e. fifteen. Once more there was no significant difference among the experimental and control groups' means. Figure 4 presents a visual display of the frequency of Ss at each temperature interval for Variable #4 for each group.

In summary, all four analyses of variance showed that, when the FB, NFB and C Ss were compared by group on their increase in finger

TABLE V

SUMMARY OF ANALYSIS OF VARIANCE ($\bar{X}$S OF TRIALS 18–20 MINUS $\bar{X}$S OF BASELINES), VARIABLE #1: TEMPERATURE AT START OF INSTRUCTIONS

SOURCE	df	MS	F
Groups	2	25.4848	1.0167
Error	27	25.0654	

F (2,27 df) = 3.35 nonsignificant at .05 level

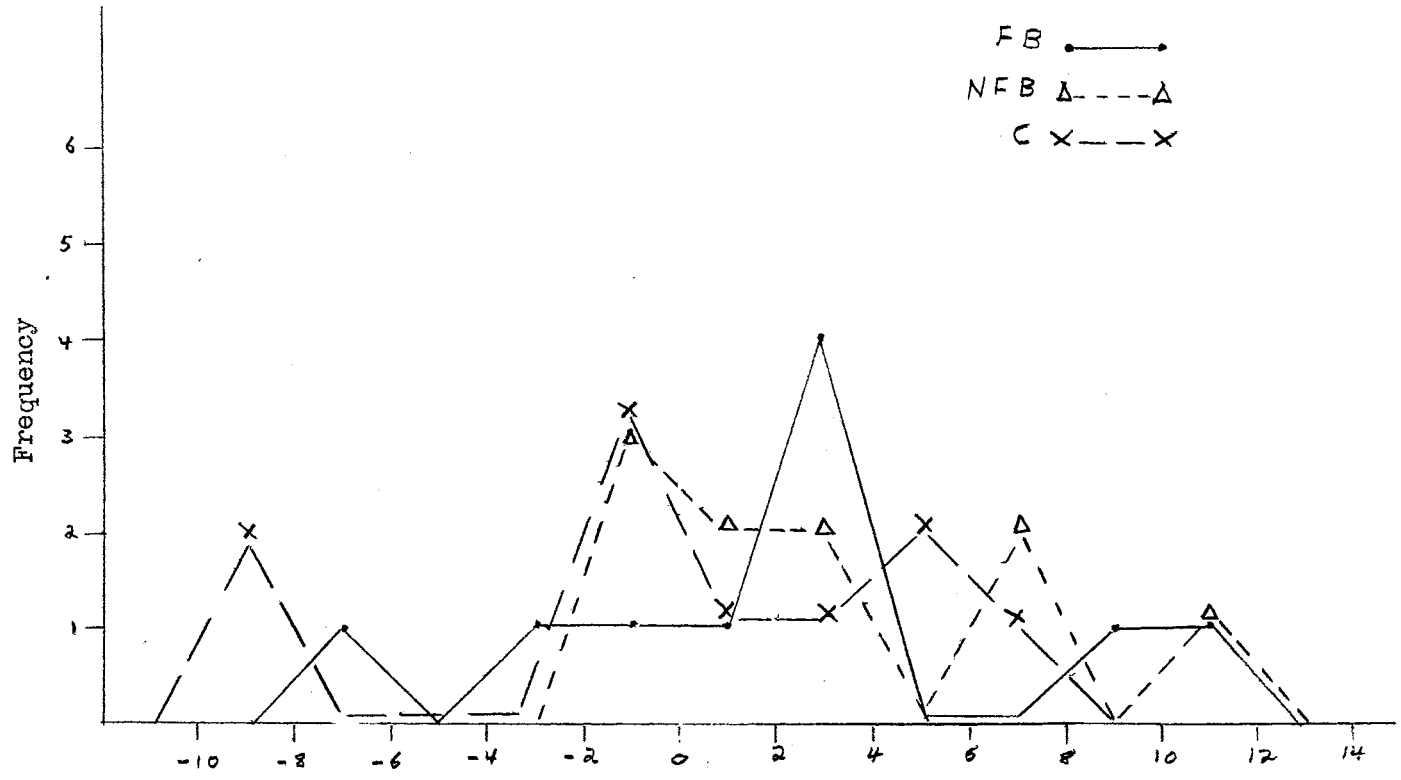

Figure 1. Temperature Change (^{o}F) Variable #1: Start of Instructions for $\bar{X}$s of Trials 18-20 Minus $\bar{X}$s of Baselines

TABLE VI

SUMMARY OF ANALYSIS OF VARIANCE ($\bar{X}$S OF TRIALS 18–20 MINUS $\bar{X}$S OF BASELINES), VARIABLE #2: TEMPERATURE AT END OF INSTRUCTIONS

SOURCE	df	MS	F
Groups	2	21.1316	0.8476
Error	27	24.9318	

F (2,27 df) = 3.35 nonsignificant at .05 level

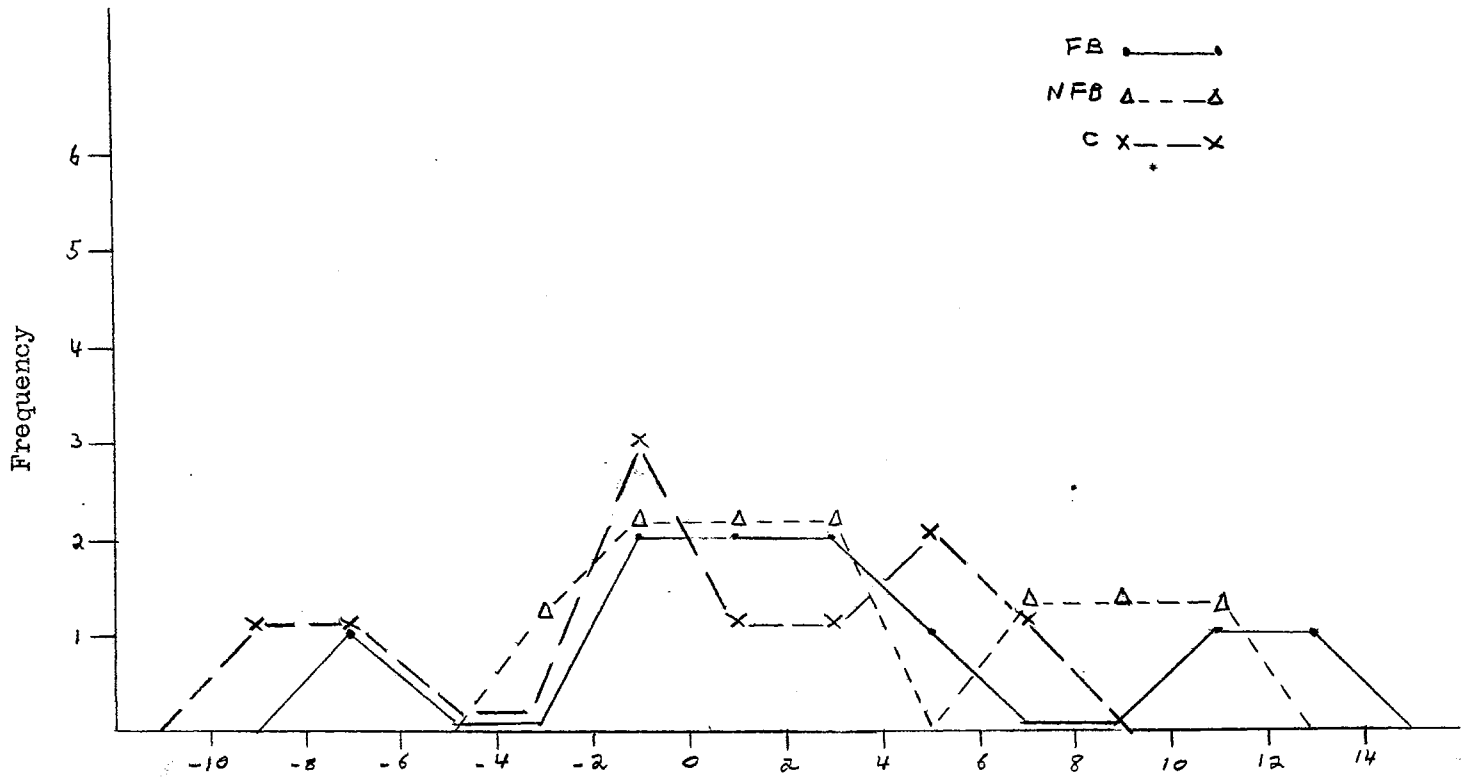

Figure 2. Temperature Change (^{o}F) Variable #2: End of Instructions for $\bar{X}$s of Trials 18-20 Minus $\bar{X}$s of Baselines

TABLE VII

SUMMARY OF ANALYSIS OF VARIANCE ($\bar{X}$S OF TRIALS 18-20 MINUS $\bar{X}$S OF BASELINES), VARIABLE #3: TEMPERATURE AT END OF TRIAL

SOURCE	df	MS	F
Groups	2	17.3176	0.6586
Error	27	26.3666	

F (2,27 df) = 3.35 nonsignificant at .05 level

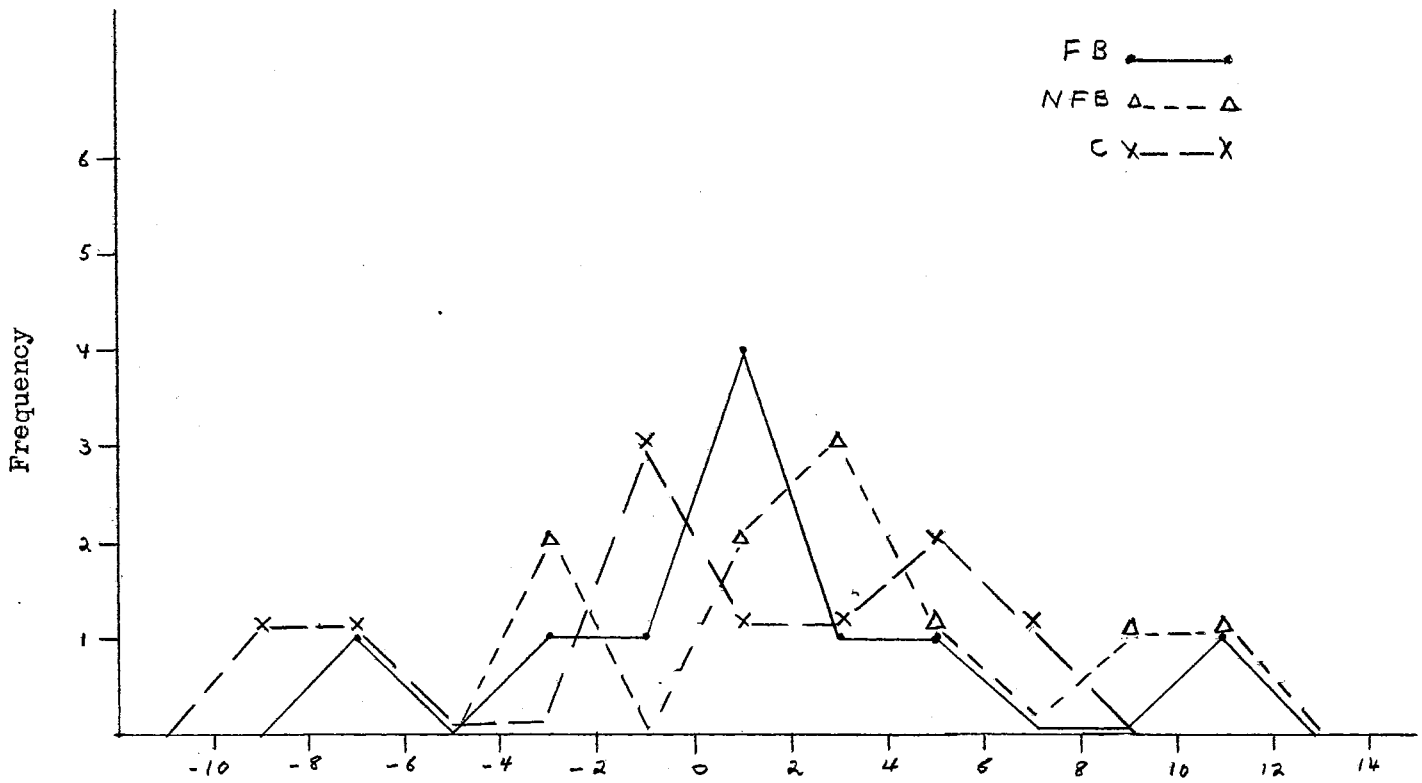

Figure 3. Temperature Change ($^{\circ}$F) Variable #3: End of Trial for $\bar{X}$s of Trials 18-20 Minus $\bar{X}$s of Baselines

TABLE VIII

SUMMARY OF ANALYSIS OF VARIANCE ($\bar{X}$S OF TRIALS 18-20 MINUS $\bar{X}$S OF BASELINES), VARIABLE #4: TEMPERATURES $\bar{X}$S FROM END OF INSTRUCTIONS TO END OF TRIAL (90 SECOND PERIOD SAMPLED EVERY 6 SECONDS)

SOURCE	df	MS	F
Groups	2	25.9973	1.0060
Error	27	25.8420	

F (2,27 df) = 3.35 nonsignificant at .05 level

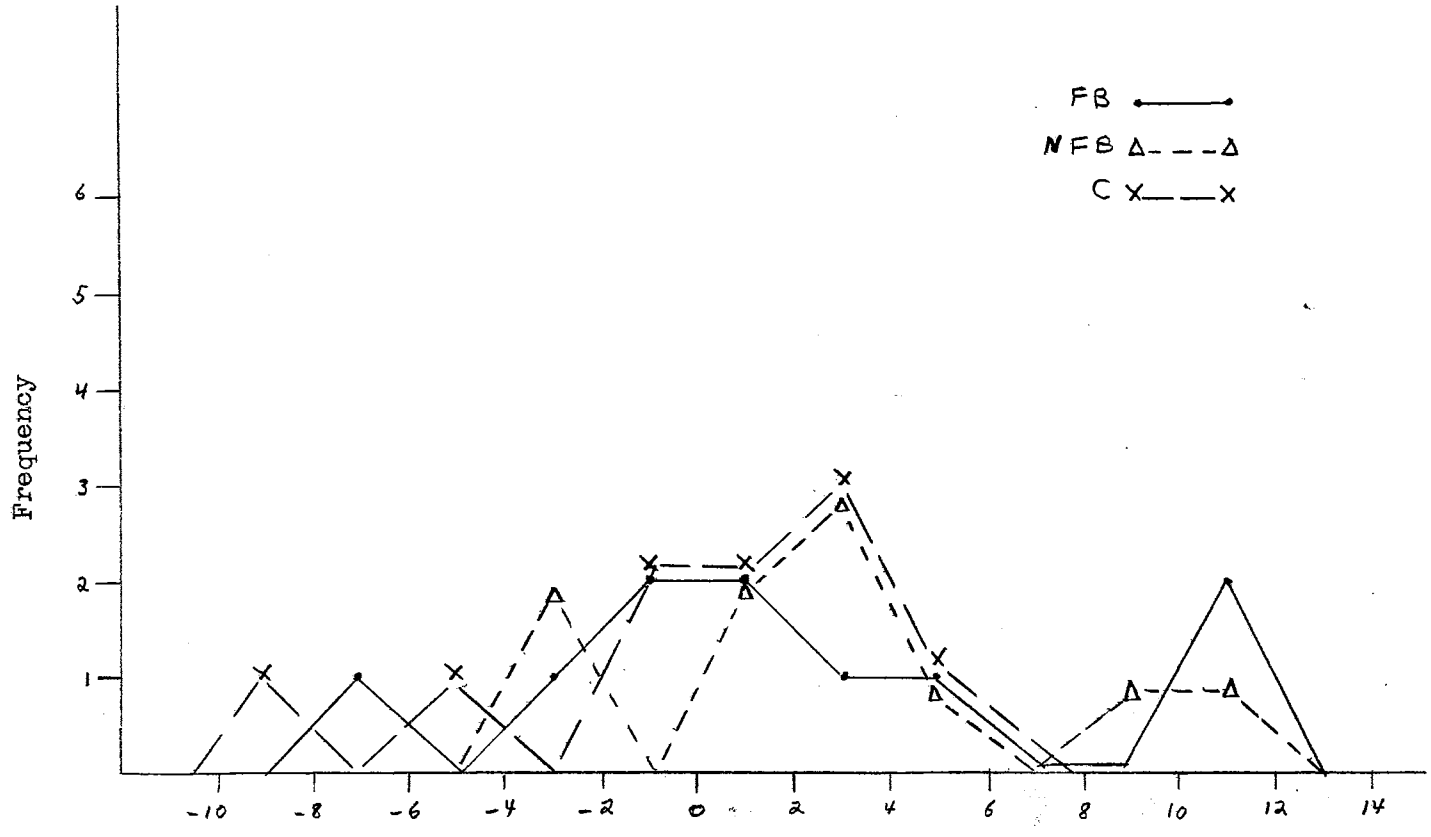

Figure 4. Temperature Change (^{o}F) Variable #4: $\bar{X}$s from End of Instructions to End of Trial (90 Second Period Sampled Every 6 Seconds) for $\bar{X}$s of Trials 18-20 Minus $\bar{X}$s of Baselines

temperature from initial baseline to the eighteenth through the twentieth experimental trials, no statistically significant difference was found on any of the four variables.

Although the F tests failed to show any statistically significant differences in the group means, Table IX presents the data in another, possibly more informative way. The FB and NFB groups show a definite increase in temperature that seems to remain fairly stable over all four variables. The C group's temperature increase however is comparatively small. It would seem therefore that, although no significant difference can be shown for the autogenic and feedback effects, a post hoc evaluation is in order to evaluate the effects of the autogenic instructions, i.e. FB and NFB compared with C, which received only relaxation instructions.

To make this test for differences in the effects of instructions, the Scheffe' Test of Multiple Comparisons (Edwards, 1960, Pp. 154-156) was used. The Scheffe' was chosen because it does not require any prior determination of which groups are to be compared. Although this test does allow for post hoc comparisons, it requires larger group differences for statistical significance than do other tests.

Arguments could be made for other a posterior tests such as having more power and the fact that Table IX suggests that not all possible group comparisons need be made (e.g. FB-NFB comparisons are not nearly as meaningful as FB-C and NFB-C comparisons). Two reasons outweighed these considerations. First, Edwards notes that Scheffe' suggests that the .10 rather than the .05 level of significance be used (to partially counterbalance the test's "conservativeness"). Second, and much more important, an examination of the data strongly suggested that one

TABLE IX

TEMPERATURE INCREASE (DEGREES FAHRENHEIT)
A COMPOSITE DISPLAY OF THE GROUP MEANS
AND VARIANCES FOR EACH EXPERIMENTAL
VARIABLE, MEAN OF TRIALS 18-20
MINUS MEAN OF BASELINE TRIALS

VARIABLE #1: START OF INSTRUCTIONS

GROUP	MEAN	VARIANCE
FB	2.59	28.6542
NFB	2.91	28.1976
C	0.00	21.2187

VARIABLE #2: END OF INSTRUCTIONS

GROUP	MEAN	VARIANCE
FB	2.48	31.1729
NFB	2.86	30.2408
C	0.17	24.6295

VARIABLE #3: END OF TRIAL

GROUP	MEAN	VARIANCE
FB	2.35	34.0175
NFB	2.95	30.1718
C	0.43	24.3712

VARIABLE #4: MEAN OF END OF INSTRUCTIONS TO END OF TRIAL (90 SECONDS)

GROUP	MEAN	VARIANCE
FB	2.14	36.3578
NFB	3.08	30.7134
C	0.06	17.7063

reason for such comparatively large error terms was that in each group there was considerable variability in S's performances. If this was as important as it seemed, then the fact should not be marked by the use of a test that provided power at the expense of "conservatism."

Table X provides a summary of Variable #1. As might be expected from Table X, the largest A value was obtained when the FB and NFB groups were compared with the C group. That value, however, was nonsignificant at the .10 level. The other values were lower and therefore also nonsignificant.

Table XI presents the results of the Scheffe' test on Variable #2, the average readings at the end of the taped instructions. Here too, none of the results are statistically significant.

In Table XII are the A values for Variable #3, the readings at the end of trials. Again the results of the Scheffe' test show that all possible group comparisons fall short of the .10 level of significance.

Finally, Table XIII summarizes the results of the Scheffe' test on Variable #4, the average readings for the last 90 seconds of trials. This average is based on a sampling of temperature readings every six seconds. As in the other Scheffe' tests, here the largest A values occur when one or both of the experimental groups are compared to the control group. Here again, however, none of these A values are signigicant at the .10 level of significance.

The final measurements presented are those based on the Ss' subjective reports in the first part of the questionnaire. The method of presentation of these Lickert-type scales (Appendix G) was such that it seemed reasonable to assume an ordinal scale, since each of the five

TABLE X

SUMMARY OF THE SCHEFFE' MULTIPLE COMPARISONS TEST, VARIABLE #1: START OF TRIAL, MEANS OF TRIALS (18-20) MINUS BASELINE MEANS

COMPARISONS	ΣX Control 0.00	ΣX FB 25.87	ΣX NFB 29.14	A
Control vs. FB	1	-1	0	33.4628
Control vs. NFB	1	0	-1	32.4569
FB vs. NFB	0	1	-1	0.5412
Control vs. FB & NFB	2	-1	-1	50.4350
FB vs. Control & NFB	-1	2	-1	8.5127
NFB vs. Control & FB	-1	-1	2	17.5068

Values nonsignificant at .10 level. Required A value = 125.5777

TABLE XI

SUMMARY OF THE SCHEFFEE' MULTIPLE COMPARISONS TEST, VARIABLE #2: START OF INSTRUCTIONS, MEANS OF TRIALS (18-20) MINUS BASELINE MEANS

COMPARISONS	X CONTROL 1.74	X FB 24.79	X NFB 28.61	A
Control vs. FB	1	-1	0	26.5661
Control vs. NFB	1	0	-1	36.0998
FB vs. NFB	0	1	-1	0.7296
Control vs. FB & NFB	2	-1	-1	41.5334
FB vs. Control & NFB	-1	2	-1	6.1632
NFB vs. Control & FB	-1	-1	2	15.6979

Values nonsignificant at .10 level. Required A value = 124.9083

TABLE XII

SUMMARY OF THE SCHEFFE' MULTIPLE COMPARISONS TEST, VARIABLE #3: END OF INSTRUCTIONS, MEANS OF TRIALS (18-20) MINUS BASELINE MEANS

COMPARISONS	$\bar{X}$ CONTROL 4.34	$\bar{X}$ FB 23.54	$\bar{X}$ NFB 29.53	A
Control vs. FB	1	-1	0	18.4322
Control vs. NFB	1	0	-1	31.7268
FB vs. NFB	0	1	-1	1.7940
Control vs. FB & NFB	2	-1	-1	32.8412
FB vs. Control & NFB	-1	2	-1	2.9084
NFB vs. Control & FB	-1	-1	2	16.2032

Values nonsignificant at .10 level. Required A value = 132.0966

TABLE XIII

SUMMARY OF THE SCHEFFÉ MULTIPLE COMPARISONS TEST, VARIABLE #4: MEAN OF TRIALS 18-20 MINUS BASELINE MEANS

COMPARISONS	ΣX CONTROL -0.65	ΣX FB 21.41	ΣX NFB 30.75	A
Control vs. FB	1	-1	0	24.3322
Control vs. NFB	1	0	-1	24.2980
FB vs. NFB	0	1	-1	4.3617
Control vs. FB & NFB	2	-1	-1	14.2995
FB vs. Control & NFB	-1	2	-1	2.9793
NFB vs. Control & FB	-1	-1	2	28.5522

Values nonsignificant at .10 level. Required A value = 129.4684

spaces that might be checked represented a spatial interval between two adjectives that might be regarded as representing a polarity in intensity on a mutual dimension; e.g., "warm-cool," "alert-sleepy." On the other hand, the assumption of a interval scale or even an "underlying" interval scale seemed to be unjustified because there was no evidence available to support the assumption that the intervals printed on the questionnaires were equal in any psychological sense.

Once the type of scale was determined, the statistical technique to be chosen was quickly narrowed. In choosing the technique Siegel (1956) was the guide because the items used were new and not standardized so a test whose power has been extensively tested seemed advisable. The median test merely allows two samples to be compared for central tendencies, therefore restricting the full use of the frequencies extending toward the polar ends of the "scale." The Wald-Wolfowitz test does assume an underlying continuous scale according to the same author. That author also states that the power of the Moses test of extreme reaction has not been reported, and a survey of the literature fails to disclose any subsequent reporting on this test.

Siegel then continues to describe the randomization test for two independent variables as applicable to small samples (in his numerical example $n_1 = 4$ and $n_2 = 5$).

The choice, then, seemed to lie between the Mann-Whitney U Test and the Kolmogorov-Smirnov (K-S) Test (Siegel, 1956, Pp. 127-128). The main difference between the two seemed to be relative to the question of power, with the Mann-Whitney U Test having slightly more power for small samples and the converse being true for the K-S Test (P. 136). Since the Mann-Whitney U Test was described for "small" samples of 20

or more (P. 120) and the K-S Test for samples "larger" than 40, the latter was chosen on an arbitrary basis since power difference seemed to be of little significance and even the mathematical demonstrations that the Mann-Whitney U distribution approaches statistical normality as the sample size increases seemed rather presumptious for newly-devised "scales." Therefore the K-S Test was adopted for evaluating the "scales" on the questionnaire's subjective reports.

The K-S test employed is designed to compare the differences between two samples with respect to their cumulative frequencies (depending on sample sizes), and whether a given difference between those frequencies is to be expected to have occurred by chance.

Since the questionnaires were prepared for a supplementary, empirical reconnaissance of the Ss' subjective experiences, a two-tailed test was adopted with the significance level of .05 chosen.

Table XIV provides a summary of the results of the questionnaire for the Ss' subjective experiences during the last three experimental trials for the NFB and FB groups. The table presents both experimental groups total frequencies reported at each ordinal point, by item, for the last three experimental trials. As noted below the eighth and last item (Table XIV) there were no differences between the NFB and FB groups on any of the eight items when the K-S Test was used at the .05 level of significance (two-tailed).

Several approaches were used on a post hoc basis to try to systematize the responses of the Ss' to the two questions which allowed them to freely express in their own words what their thoughts and feelings had been during each of the twenty experimental trials, particularly as these responses related to their performance in a trial with respect to

TABLE XIV

SUMMARY OF THE SUBJECTS' QUESTIONNAIRE RESPONSES
A COMPARISON OF THE FEEDBACK AND NO-FEEDBACK
GROUPS' FREQUENCY AT EACH ORDINAL INTERVAL
EXPERIMENTAL TRIALS 18-20

SERENE-ANXIOUS ITEM

	Serene				Anxious	N
	1	2	3	4	5	
Feedback	10	11	8	1	0	30
No Feedback	8	18	3	1	0	30

RELAXED-TENSE ITEM

	Relaxed				Tense	N
	1	2	3	4	5	
Feedback	10	10	9	1	0	30
No Feedback	8	20	2	0	0	30

FINGER COOL-FINGER WARM ITEM

	Finger Cool				Finger Warm	N
	1	2	3	4	5	
Feedback	0	2	6	16	6	30
No Feedback	0	3	4	19	4	30

CONCENTRATED-MIND WANDERED ITEM

	Concentrated				Mind Wandered	N
	1	2	3	4	5	
Feedback	7	7	12	4	0	30
No Feedback	13	11	2	3	1	30

ARM LIGHT-ARM HEAVY ITEM

	Arm Light				Arm Heavy	N
	1	2	3	4	5	
Feedback	1	3	15	6	5	30
No Feedback	0	2	14	4	10	30

TABLE XIV (Continued)

BREATHING REGULAR-BREATHING IRREGULAR ITEM

	Breathing Regular				Breathing Irregular	N
	1	2	3	4	5	
Feedback	15	9	6	0	0	30
No Feedback	16	10	3	0	1	30

FOREHEAD WARM-FOREHEAD COOL ITEM

	Forehead Warm				Forehead Cool	N
	1	2	3	4	5	
Feedback	0	1	14	12	3	30
No Feedback	0	2	7	16	5	30

ALERT-SLEEPY ITEM

	Alert				Sleepy	N
	1	2	3	4	5	
Feedback	13	8	7	2	0	30
No Feedback	10	11	6	3	0	30

Kolmogorov-Smirnov Test (2 df) nonsignificant at .05 level (two-tailed) for all items

their previous and subsequent trials.

Further, the E had a very definite subjective impression that on many trials there seemed to be a qualitative discrepancy between the Ss' subjective statements and their performance. This was based not on topics requiring a great deal of inference, e.g. "I felt calm," but rather the frequency with which the S reported experiencing finger warmth when indeed she did not produce a finger temperature recording that corresponded to that statement. At least a partial explanation is that as Ss become more experienced in AT, they begin to experience physiological and psychological changes as anticipatory responses because they can rehearse the E's instructions and react to them while waiting for the AT or AT-like session to begin.

CHAPTER IV

DISCUSSION AND SUMMARY

Discussion

When an experiment is focused on empirical inquiry rather than testing theoretical disparities, an evaluation of negative results is essentially limited. There is a temptation to employ the *deus ex machina* of *post hoc* theorizing that must be set aside in favor of continuing empirical reporting.

In the present experiment, the reasons for the failure to obtain group differences are based on the examination of the raw data. The ratios of the differences in group means to the error variances was simply too low. The reason for this was that although the performances of some Ss was to impressively change their ability to change their finger temperatures, that ability was not related to the instructions they received. In each group there were some Ss who demonstrated substantial change and others who showed either little change or some change in a negative direction, i.e., their left forefingers became cooler as measured by the methodology used.

It might be argued that an analysis of covariance or an analysis of variance with each S as her own control would have reduced the error variance and produced statistically significant results. There are two reasons why one of those procedures was not used.

First, the experimental design was concerned with establishing group differences based on instructions to the Ss. Although each group shared some amount of instruction, this degree of mutual experience was balanced by a comparison of initial performance (baseline means) with final performance (means of trials 18-20). Since all Ss had the opportunity to demonstrate temperature change based on a naïve performance, group comparisons of these changes should be a function of their instructions. Therefore an analysis of covariance would be a case of taking mathematical advantage of a control that had already been provided for in the experimental design. The use of an analysis of variance in which there are repeated measures on the same S, with each S acting as her own control is patently non-applicable because it refers to a S's experiencing more than one treatment condition, (Winer, 1962, P. 298). Since the design was not factorial, the consideration of possible confounding is not relevant. Above these considerations however is the fact that individual Ss demonstrated the ability to markedly change their finger temperature (Table IX), but this performance was not statistically related to the instructions they received. These temperature changes are graphically presented in Figures 1 - 4. The same statement is true of those Ss who demonstrated little ability, no ability, or "negative" tendencies to produce that change.

The second reason for using the design chosen was that it seemed important in an empirical type experiment to demonstrate that one type of experience was in some way superior to another. In other words, do people as a group respond more to one experience than to an apparently similar yet possibly (on a subjective level) different experience?

The emphasis here is on the practical question of performance enhancement.

Related to the question of practicality is that of clinical change, i.e., changes in Ss' subjective experiences. (Changes in behavior outside the experimental setting might be even more clinically important, but the experiment did not provide measures for this type of behavior.) The subjective reports by most Ss indicated an improved sense of well being, regardless of group membership. However, it very often seemed that the quality of the subjective reports was not related to the empirical results of the trial. A report of a heavier left arm and a warmer finger did not necessarily reflect a change in temperature, either from the beginning of a trial to its end, or from the previous trial to the current one. Although the literature on the relationship of change in skin temperature to subjective experience in such change seems virtually nonexistent, Hendler and Hardy (1960) did report that this relationship is slight. The most reasonable hypotheses appear to be those of O'Connor and McCarthy (1952) that subjective perceptions of temperature changes are a function of the magnitude of change and of Winslow, Herrington and Gagge (1937) that such perceptions of change are related to deviations of temperatures from the norm.

On reflection, it would seem that, on a performance basis, the type of S is more important than the types of instructions. It might be asserted that a report of clinical improvement by Ss is important regardless of temperature change, but the possibility of polite acknowledgements to the E must not be ruled out, even though the E had the distinct impression of at least temporary improvements of well being in many Ss over many trials.

It is possible that, since many AT patients required several months to acquire the skills that enabled them to effect desired changes, there were too few trials. This point is at least muted by the data however, because in the span of twenty (or twenty three) trials some Ss did quite well.

If the Ss were still available, the desired follow-up would indicate a posteriori interviews with those Ss who did "best" and "poorest" in an attempt to identify at least the main variables involved in performance. Unfortunately however, these Ss are no longer available due to the E's geographic remoteness from them.

There are two major conclusions that are inferred from the present study, given the nature and scope of the dependent variable. First, the characteristics of an individual S outweigh the instructional procedure employed. Second, there appears to be a need for experimental exploration into the variables concerned with which Ss might be chosen and prepared to achieve maximum benefit from a given procedure.

In planning the suggested research, a different orientation might be possible. The motivation of Ss might be substantially changed if they were offered hope that a particular clinical symptom might be alleviated. It should be noted however, that the major drawback to most of the findings in AT is due to the lack of experimental control because each patient was constantly monitored on subjective states, and the procedures were modified to accommodate individual needs.

Although not reflected in the data, it is a subjective impression of the E that the most important variable might be the capacity of the S to maintain that curious capacity of "passive effort." It is quite possible that the experiment itself is important in itself only in that

it provides an indication of Ss who can develop the capacity for this effort.

In conclusion, it seems quite possible that the exploration of one physiological measure out of the context of a clinically meaningful situation renders the results and meaning of such a measure artificial. Despite the volume of literature presently available, this area of inquiry still appears very much subject to Skinner's dictum that empirical observation must provide a strong base before an investigator can hope to launch a systematized theory (Skinner, 1938).

Summary

The experiment was designed to support the feasibility that the use of a biofeedback technique would enhance suggestions based on autogenic training (AT) in enabling subjects to increase the temperature of the left forefinger. One group, receiving only tape-recorded relaxation instructions, was used as a measure of control, providing a comparison of relaxation only with the two experimental groups which received: (a) tape-recorded autogenic instructions; and (b) tape-recorded autogenic instructions plus a biofeedback technique. All three groups (10 Ss each) were given a three-trial baseline experience during which each S's pre-experimental performance could be determined by averaging the mean of her temperatures for the four variables based on the relaxation instructions. The dependent variable was the mean temperature of the last three of the twenty post-baseline experimental trials minus the mean temperature of the baseline trials for each of the four variables. A one-way analysis of variance was used to compare the means of the three groups, and all resulting F values were statistically

nonsignificant at the .05 level of probability. Post hoc Scheffe' comparisons also failed to yield significant results at the .05 level of probability.

An attempt was also made to use a subjective questionnaire to find results which might supplement the data of the major dependent variable. Eight Lickert-type scales were used, each based on a dimension suggested in the AT instructions. Ss also had the opportunity to report their feelings and thoughts in their own words. The scales were evaluated by the Kolmogorov-Smirnov Test, and were found to be statistically nonsignificant at the .05 level. Efforts to relate the subjective reports of Ss to their performances resulted on in the E's subjective opinion that the Ss were at times reporting that their fingers were becoming warmer when the objective data reflected that this statement was not supported by objective measures of finger temperature.

A suggestion was made that the nature of the study was empirical, and that post hoc rationales are inappropriate. Further, it was suggested that additional experimentation based on current knowledge should be based on a clinical, empirical base even at the expense of laboratory control.

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APPENDIXES

APPENDIX A

RECRUITING LETTER

Dear (name of prospective S):

I am contacting you, with the approval of your supervisor, to ask you to participate in a research project. The experience is one usually reported as pleasant and involves no invasion of your privacy. Participation involves approximately fifteen minutes twice a day for eleven consecutive working days. You are not, of course, expected to be present on your days off or if an emergency should arise requiring your presence elsewhere.

I would like to stress that participation in this research is on a completely voluntary basis.

In the event you would care to participate, I would like you to contact either myself or Mrs. Baier at the Outpatient Department (Ext. #352).

I think you might find this an opportunity to have an interesting and possibly rewarding break in your work routine. Please consider contacting me before this letter slips your mind.

Thank you.

Cordially,

Patrick Carlton, M.S.

APPENDIX B

REPLY LETTER

Dear (name of prospective S):

Thank you very much for expressing an interest in this research project. Soon after you receive this letter I will be contacting you to arrange an appointment schedule. The laboratory is on the third floor of the Gheel Building. Room 305 is the waiting room, and I will meet you there.

I also would like to request that you sign the enclosed release form as required by the hospital's Ethics Committee, and return the form to the Outpatient Department.

Again, thank you for volunteering. I look forward to working with you.

Cordially,

Patrick Carlton, M.S.

APPENDIX C

RELEASE FORM

I hereby give my consent to participate in this research project being conducted by Mr. Patrick Carlton at Larned State Hospital, Larned, Kansas. My consent was obtained freely and I hereby volunteer to participate. I understand that while all information derived from this experiment will be associated with my initials and at times with my name, such information will be kept in strict confidence by Mr. Carlton.

Signature:_____

Date:_____

APPENDIX D

INSTRUCTIONS FOR BASELINE TRIALS AND C GROUP

Actually this is a simple exercise in which you begin by taking a slow, deep breath and letting that breath come slowly out ... as that breath comes out, you will find that your whole body relaxes ... now as you take in another deep breath, you will find that you become much more relaxed as you slowly let out that breath ... try it ... fine ...

APPENDIX E

INSTRUCTIONS FOR NFB GROUP

Actually this is a simple exercise in which you begin by taking a slow, deep breath and letting that breath come slowly out ... as that breath comes out, you will find that your whole body relaxes ... now as you take in another deep breath, you will find that you become much more relaxed as you slowly let out that breath ... try it ... fine ...

Now, as you continue to relax, quietly focus your attention on your left hand, especially the forefinger. You will notice that it is possible to make that finger become pleasantly warmer by the same way that you relax - not by actively trying, but by just letting it happen ... Now, repeat to yourself. "My body is relaxed and heavy ... as my body sinks into relaxation, my mind is calm but alert, and I notice my left hand is becoming warm, especially my forefinger. As my finger becomes warmer, my forehead becomes cool ... and even cooler as my finger becomes warmer."

APPENDIX F

INSTRUCTIONS FOR FB GROUP

Actually this is a simple exercise in which you begin by taking a slow, deep breath and letting that breath come slowly out ... as that breath comes out, you will find that your whole body relaxes ... now as you take in another deep breath, you will find that you become much more relaxed as you slowly let out that breath ... try it ... fine ...

Now, as you continue to relax, quietly focus your attention on your left hand, especially the forefinger. You will notice that it is possible to make that finger become pleasantly warmer by the same way that you relax ... not by actively trying, but by just letting it happen ... You will notice a dial on the table at your left. As your finger becomes warmer and your forehead cooler, the needle on that dial will move to your right. The needle may go all the way to the right, in which case I will center it again so that you can see yourself making even more change. Again, do not try to make the dial move ... just watch it move as you quietly concentrate on repeating to yourself, "My body is relaxed and heavy ... as my body sinks into relaxation, my mind is calm but alert, and I notice my left hand is becoming warm, especially my forefinger. As my finger becomes warmer, my forehead becomes cool ... and even cooler as my finger becomes warmer."

APPENDIX G

QUESTIONNAIRE ON SUBJECTIVE EXPERIENCES

Session #_____

QUESTIONNAIRE

Instructions

In the eight scales below, please make a check on each scale on the line you judge to be the right distance between the two words describing your experiences in this - AND ONLY THIS - session. If for example, you feel that on the eighth scale you were midway between "sleepy" and "alert," you would check the middle line on that scale. If you feel that you were more sleepy than alert, you would check a line closer to the word "sleepy."

Serene	___	___	___	___	___	Anxious
Relaxed	___	___	___	___	___	Tense
Finger Cool	___	___	___	___	___	Finger Warm
Concentrated on Instructions	___	___	___	___	___	Mind Wandered from Instructions
Left Arm Light	___	___	___	___	___	Left Arm Heavy
Breathing Regular	___	___	___	___	___	Breathing Irregular
Forehead Warm	___	___	___	___	___	Forehead Cool
Alert	___	___	___	___	___	Sleepy

In addition to the above report, what were:

1. Your physical sensations during this session?

2. Your thoughts and feelings during this session?

VITA

Patrick Henry Carlton

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE BIOFEEDBACK TECHNIQUE AS A FACILLITATOR IN AUTOGENIC TRAINING

Major Field: Psychology

Biographical:

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