THE EYSENCK PERSONALITY INVENTORY AS A
PROGNOSTIC INDEX FOR AUTOGENIC
TRAINING AND BIOFEEDBACK
PROCEDURES

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PREFACE

This study is concerned primarily with the ability of scores on the Introversion-Extraversion Scale of the Eysenck Personality Inventory to predict whether a person can learn to increase left forefinger temperature with relaxation training, autogenic training and biofeedback procedures. Of secondary interest is whether biofeedback is superior to autogenic training and if both are superior to relaxation training for a person to learn how to voluntarily increase left forefinger temperature. A factorial design is used in the analysis of the data, with planned orthogonal comparisons.

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CHAPTER I

INTRODUCTION

The history of self-regulation of the central nervous system (CNS) and the autonomic nervous system (ANS) began in eastern cultures, apparently entering occidental records through the accounts of military physicians and British civil service employees stationed in India. These accounts alleged self-regulation of pain, the effects of burns, heartbeat and respiration. Although often scoffed at, the sources and frequency of these tales eventually attracted the attention of a few men within the pale of science. The rediscovery of hypnosis by Janet and Charcot also encouraged a reappraisal of the eastern reports. Although the results of hypnosis were often spectacular, its clinical application was at times unreliable. Freud, for example, abandoned its practice after several years in favor of free association. Pursuing the question of self-regulation from another path, Johannes Schultz of Germany "westernized" eastern approaches. It occurred to him that the major drawback of hypnosis was that the subject was, or at least thought he was giving up self-control to the operator. Therefore, Schultz combined the volitional aspects of yoga with techniques of his own, and named the new procedure "Autogenic Training," reflecting its autonomous basis (Schultz & Luthe, 1959).

More recently, there has been an increasingly large interest in biofeedback, which is an offshoot of laboratory research in which electronic instruments are used to amplify bodily changes, eg., blood pressure, heart rate, muscle contractions. Bodily changes trigger signals in the external instruments such as a sound or a light, which on repetition can allow a person to identify the cues of internal changes, the first step in learning to control them.

Purpose of the Investigation

The study of the processes involved in autogenic training (AT) and biofeedback procedures seems to be an especially fruitful area for research possibilities. This investigator is especially interested in the clinical application of AT and biofeedback in the treatment of various disorders of organic and/or functional origin. AT is purported to have application in the treatment of a wide range of organic and functional disorders, eg., peptic ulcers, angina, schizophrenia, etc. (Luthe, 1969b, 1969c). With the recent and rapidly increasing interest in biofeedback research, a number of clinics are now training people to control their heart rate, lower blood pressure, change skin temperature, etc. Of particular interest to this investigator was the possibility of finding a means of evaluating a person's prognosis for profiting from AT and biofeedback training. Secondarily, a comparision of the effects of AT and biofeedback provided a research interest.

Autogenic Training

The essential procedure in AT begins with relaxation of the striate muscles following the standard methods of progressive relaxation (Jacobsen, 1938), and then proceeds from this CNS control to ANS control. This is done in part by self-regulation of the blood's flow in different parts of the body. An important part of the instructions is that the subject passively focus on bodily changes, not actively try to make the changes occur. The initial exercises deal with the body feeling "heavy" and then "warm." The next step is regulation of heartbeat, and finally the subject focuses his attention on such tasks as consciously controlling areas such as the gastrointestional tract, traditionally regarded as inaccessible to direct voluntary control (Luthe, 1969a).

That AT has been virtually unknown in the United States, reverts to the mind-body issue, since AT is based on the principle of volition (Luthe, 1970). Arguments that the technique is actually conditioning meet with the observation that focusing attention is a persistent choice. However, as in other areas of interest in psychology, this issue must be sidestepped, observing in passing that there is usually a subjective experience of self-direction and that directions to subjects to selectively focus their attention can result in measurable changes in physiological measurements (eg., Green, Walters, Green, & Murphy, 1969; Green, Green, & Walters, 1970).

Another argument may be that the passive concentration of AT constitutes self-hypnosis rather than AT. The position taken here is that, like the mind-body issue of volition, the point is a moot one; comparatively little is known of either, and it is thought that concentration is better focused on processes than essences.

There is considerable clinical documentation of the successful effects of AT (Luthe, 1969b, 1969c); however, AT has not been the subject of experimental inquiry so extensively. Research has been along two lines: (a) the immediate effects following AT exercises; and,

(b) longrange effects over the course of AT training. It is the former which has most relevance to the current investigation. Changes in peripheral circulation during passive concentration on "heaviness" and "warmth" have been demonstrated by a number of authors (eg., Schultz, 1959; Stovkis, Renes & Landman, 1961; Polzien, 1961). Polzien (1961) found that the rise of skin temperature was more pronounced in the distal parts of the extremities. Depending on the individual subject and duration of passive concentration, the increase of skin temperature in the fingers varied between 0.2 and 3.5°C.

Luthe (1969d) has summarized the findings of various authors on the immediate effects of AT. An increase in the weight of both arms during passive concentration on heaviness has been observed; electroencephalographic (EEG) studies indicate certain changes similar to, but not identical to, those of sleep and hypnosis; blood sugar level decreased when the focus of "warmth" was on the liver region; and a decrease in respiratory frequency has been demonstrated.

Biofeedback

Biological feedback is found at all levels of organization, eg., hormonal balance, as exemplified by the parathormone level. With lowered blood calcium, parathormone output increases, which mobilizes calcium production, which then reduces the level of parathormone output (Morgan, 1965, P. 96). The principle is simple. A person learns how to throw a baseball by visual and neuromuscular feedback. He feels his arm move (kinesthetic feedback), sees where the ball went (visual feedback), and corrects his arm movement the next time. In a similar way, an electronic instrument can detect minuscule internal changes in such processes as blood flow. Biofeedback training requires that the physiological function to be brought under control be monitored to provide for momentary changes and that changes in the physiological measure needs to be reflected to the subject immediately. There must be an awareness of the subject that the bodily changes are related to the perceivable external and/or internal stimuli. Although similar to conditioning, most feedback does not offer an explicit and extraneous reward for a correct response; it merely indicates to the learner when he has entered the desired state.

Clinically, biofeedback procedures have been used successfully for dealing with such things as headaches, insomnia, subvocal speech, and hypertension.

Laboratory studies have dealt with electrodermal activity, EEG activity, etc. Research findings of primary concern to this study are those which deal with the effects of biofeedback procedures on bodily processes considered to be under control of the ANS. Before a review of some of these studies, the distinction between classical and instrumental conditioning needs to be considered. Aside from methodological differences, a distinction which has often been made between instrumental and classical conditioning is that CNS muscular reactions are controlled by instrumental conditioning, while classical conditioning controls the ANS emotional responses (Mednick, 1964, Pp. 52-53). A series of animal studies by Neal Miller and his associates at Rockefeller University in New York set out to specifically deal with the above distinction between the two conditioning methods.

Trowill (1967) used curare to paralyze the skeletalmuscular system, in rats. Electrical stimulation of the pleasure center was used as a reinforcer. Half of the Ss were rewarded for rates below the average and half for rates above the average. Miller and DiCara (1967) replicated the Trowill (1967) experiment, with the modification that after achieving criterior, the Ss were required to meet progressively more difficult criteria for reward. Both groups evidenced statistically significant changes. The rats also learned to respond discriminately to stimuli signaling that cardiac changes would be rewarded.

DiCara and Miller (1968) trained cuarized rats to increase and decrease heart rates to escape and/or avoid electrical shock. Miller and his associates have concluded from the above studies and several others that:

> "These experimental results free us from the shackles of viewing the autonomic nervous system and visceral functions with contempt. They force us to think of the behavior of the internal visceral organs in the same way that we think of the externally observable behavior of the skeletal musculature" (Miller, DiCara, Solomon, Weis, & Dworkin, 1971, P. 358).

Support for voluntary control of autonomic functions is also available from studies with human subjects. Shapiro, Tursky and Schwartz (1964) operantly reinforced 10 male Ss for increasing heart rate and 10 male Ss for decreasing heart rate. Heart rate conditioning was obtained within a single session, without the concomitant effects on systolic blood pressure. It was concluded that heart rate and blood pressure can be differentiated by operant conditioning, and that operant modifications of one autonomic response need not require or result in an overall change in autonomic arousal, in line with the Miller et al. (1971) view on specificity of autonomic responses.

In more than six years of investigation, Green et al. (1970) have studied the combined effects of AT phrases and biofeedback on striate muscular responses, skin temperature and alpha-training. In a three-phase training program, they report that Ss learned to relax muscle tension quite easily, more readily with AT and biofeedback combined than with AT alone. Hand temperature control of "warmth" was significantly aided by biofeedback in comparison to AT alone; however, this was not quantified. In the Green et al. (1970) study it was reported that one S who had practiced yoga could raise his hand temperature $10^{\circ}F$ within $2\frac{1}{2}$ minutes, of the initial trial, with biofeedback.

The Rapprochement of Factor Analysis and the Hypothetico-Deductive Method

H. J. Eysenck (1967) has suggested the need for a rapprochement between the traditional methodology of experimental psychology and the psychology of individual differences. While experimental psychology has attempted to emulate the physical sciences with regard to methodology, he points out that the physical sciences have not neglected typologies, as experimental psychology has, but that throughout history classification and experiment have been "intimately connected." In support of his view, he gives several experimental examples with human and animal subjects where significant results would have been masked if effects due to individual differences had not been considered. He suggests a hypothetico-deductive approach in which some hypothetical personality trait, eg., "extraversion" is conceptualized in terms of an experimental variable, eg., "fatigue."

While the experimental psychologist has neglected description, H. J. Eysenck (1964) indicates that the failure of the factor analysts to make much impact has been that they have been interested only in description. H. J. Eysenck's approach has been to develop a set of theories which he refers to as a "nomological network," linking the major aspects of a descriptive system to causal theories capable of experimental verification, eg., a set of theories relating "extraversion" to lowered "cortical excitation" and heightened "cortical inhibition."

The usefulness of inventories such as the Maudsley Personality Inventory (MPI) and the Eysenck Personality Inventory (EPI) in experimental studies then seems to be as a means of partialling out variability due to individual differences on one or both of the dimensions of extraversion-introversion and neuroticism-stability.

The Hierarchical Organization of Personality

H. J. Eysenck's (1970) conceptualization of the personality dimensions of extraversion-introversion and neureticism-stability is a hierarchical model, dealing with four levels of behavior organization. The lowest level consists of specific responses, i.e., acts which are observed once and may or may not be characteristic of the individual. The second level consists of habitual responses, i.e., specific responses which tend to recur under similar conditions. At the third level or organization, habitual responses are organized into theoretical constructs called traits. At the fourth level, traits are organized into theoretical constructs called types, eg., "extraversion." These four levels correspond closely to the four types of factors in factor analysis. An "habitual response" is a "specific response" divested of its error component and made into a specific factor; a "trait" is a system of "specific responses" divested of its error and specific variance; and, a "type" is a system of "specific responses" divested of its error, specific, and group-factor variance (H. J. Eysenck, 1947).

Because of the factor analytic basis of the EPI, a note is due on the two schools of factor analysis associated with the names of Spearman and Thurstone. For several years a battle ensued between these two factor analytic camps as they often yielded entirely different, and at times apparently irreconcilable differences (H. J. Eysenck, 1970). In the Spearman tradition, tests are selected and correlated over the experimental population, to obtain a general factor (type), satisfying statistical criteria such as vanishing tetrad differences. In the Thurstone approach, tests are selected and intercorrelated over the experimental population to obtain group factors (traits), meeting the statistical criteria of simple structure and orthogonality.

Thurstone (H. J. Eysenck, 1970) added a refinement in terms of oblique factors and second-order factors, making the two camps' differences more reconcilable. For trait-level hypotheses, primary factors are extracted from the matrix of intercorrelations; and for type-level hypotheses, second-order factors are then extracted (H. J. Eysenck's preference). The Spearman followers, on the other hand, extract the second-order factors first, which they call "general factors" and the primary factors second, which they call "group factors."

The Nature of Extraversion-Introversion and Neuroticism-Stability

At the highest level of personality description, extraversion and introversion and neuroticism and stability can be viewed as the idealized end points on two continuums, with the majority of people scoring at the intermediate on both dimensions (H. J. Eysenck, 1967).

High E-scale scores on the EPI are indicative of extraversion. "High scoring individuals tend to be outgoing, impulsive and uninhibited, having many social contacts and frequently taking part in group activities" (H. J. Eysenck & S.B.G. Eysenck, 1968, P. 6).

High N-scale scores on the EPI are indicative of emotional lability and overreactivity. "High scoring individuals tend to be emotionally overresponsive and to have difficulties returning to a normal state after emotional experiences" (H. J. Eysenck & S.B.G. Eysenck, 1968, P. 6).

H. J. Eysenck (1960b) reports that research supports the view that the N factor is closely related to the inherited degree of lability of the autonomic nervous system, with individuals high on the N scale being characterized by high autonomic lability. The E factor is considered to be closely related to the excitation-inhibition balance in the central nervous system (H. J. Eysenck, 1960b, 1970). Introverts are postulated to be characterized by strong excitatory and weak inhibitory potentials, while extraverts are characterized by weak excitatory and strong inhibitory potentials (H. J. Eysenck, 1960b, 1970).

According to H. J. Eysenck's (1960a) formulations, the excitation-inhibition balance and autonomic lability deal with the genotypic differences in extraversion-introversion and neuroticism-stability respectively. These genotypic differences are thought to be measured in terms of experimental laboratory phenomena such as conditionability and vigilance. Observable behavior (traits) is viewed as a function of these constitutional differences interacting with the environment which give rise to descriptive phenotypic differences in extraversion-introversion, best measured with inventories such as the MPI and EPI. He does indicate that this distinction between laboratory tests as genotypic and inventories as phenotypic is not an absolute distinction.

As empirical verification for his formulations about these constructs, H. J. Eysenck (1967) has related the excitation-inhibition balance to studies in experimental psychology dealing with "fatigue" and autonomic lability to studies dealing with "drive" or "emotionality."

The laboratory studies on the phenomena of conditioning, vigilance, motor learning, etc., are intended to test H. J. Rysenck's (1957) postulate of individual differences and the typological hypothesis, which are stated as follows:

> "Human beings differ with respect to the speed with which excitation and inhibition are produced, the strength of the excitation and inhibition produced and the speed with which inhibition is dissipated. These differences are properties of the physical structures involved in making stimulus-response connections" (H. J. Eysenck, 1956, P. 114).

> "Individuals in whom excitatory potential is generated slowly and in whom excitatory potentials so generated are relatively weak, are thereby predisposed to develop extraverted patterns of behaviour...; individuals in whom excitatory potentials so generated are strong, are thereby predisposed to develop introverted patterns of behaviour..." (H. J. Eysenck, 1957, P. 114).

H. J. Eysenck's Activation and Arousal Theory

H. J. Eysenck's theoretical notions regarding the two dimensions of extraversion-introversion and neuroticism-stability have gradually evolved with an increasing accumulation of empirical data over the past thirty years. In reviewing H. J. Eysenck's work, it is apparent that his theoretical formulations have not remained static, but rather they change in line with empirical findings, and with changes in theoretical formulations, new areas of empirical investigation are pursued. The intent of this presentation of the current status of H. J. Eysenck's theory is not an attempt to support or refute its soundness, but rather to present the stage of evolvement of his theory. No attempt will be made in this current investigation to evaluate his "physiologizing" and "neurologizing." H. J. Eysenck (1967) indicates that his attempt to establish a physiological basis for the extraversion-introversion and neuroticism-stability dimensions in terms of arousal and activation has only limited support at this point, and that he must rely on a "nomological network" of hypotheses, deductions, and experimental findings.

H. J. Eysenck uses the term "arousal" to refer to activity of the reticular formation (RF) and the term "activation" to refer to autonomic activity. In neural transmission there are two loops, connected with each other. The cortico-reticular loop is concerned with information processing, cortical arousal and inhibition. The cortico-reticular loop is considered to be related to the extraversion-introversion dimension (H. J. Eysenck, 1967). Neural information ascends the classical afferent pathways and relays to the specific projection area in the cortex; it also sends collaterals to the RF, which sends arousal messages to the cortex. The cortex also instructs the RF to continue to send or inhibit arousal messages to the cortex (Gellhorn & Loofburrow, 1963).

The second loop involved in neural transmission involves the RF and the visceral brain. The visceral brain also sends collaterals to the RF and has an arousing effect on the cortex in a similar way to neural information ascending the classical afferent pathways

(Gellhorn & Loofburrow, 1963). This loop is considered to be related to the neuroticism-stability dimension (H. J. Eysenck, 1967).

There is a partial indpendence existing between autonomic activation and cortical arousal; activation always leads to arousal, but arousal need not involve activation (H. J. Eysenck, 1967).

Gray (1967) has compared H. J. Eysenck's (1967) position on the excitation-inhibition balance as it relates to the extraversion-introversion dimension with Russian work in the Pavlovian tradition on "weakness of the nervous system." He postulates that the dimensions of "strength of the nervous system" and extraversion-introversion are identical, with the weak nervous system corresponding to the introvert. He also postulates that the dimension of introversion-extraversion and "equilibrium in dynamism" are identical, with the introvert corresponding to the individual with a predominance of "excitation in dynamism", i.e., an individual with the ability to form positive conditioned reflexes rapidly. In reviewing the Russian research on sensory threshholds, transmarginal inhibition, drug effects, and conditioning, he states that similar results have been obtained as in the Anglo-American studies with introverts. Gray (1967) interprets these findings in terms of level of arousal involving the RF, in line with H. J. Eysenck's (1967) most recent theoretical formulations relative to the excitation-inhibition balance.

The Eysenck Personality Inventory as a Prognostic Index for Autogenic Training and Biofeedback Procedures

Since AT and biofeedback procedures appear to be based on physiological principles, a question presenting itself is which evaluative technique(s) might best measure whether an individual would be expected to profit from AT and biofeedback procedures. One approach would be to establish a psychophysiological laboratory in which a variety of laboratory procedures could be used to determine an individual's need for AT and biofeedback procedures and to predict the successfulness of such procedures. Some standard laboratory procedures from psychological research might prove useful in such a laboratory, eg., psychophysical procedures, classical and operant conditioning procedures, the rod-and-frame test used in "field independence-dependence" studies, and procedures used in studies of "levelers" and "sharpeners." While a psychophysiological laboratory is considered to be a basic research requirement, its immediacy has practical drawbacks monetarily, both for the research and for the clinical evaluation of individuals in local clinical settings. An alternative would seem to be the development or utilization of a psychological test based on physiological and/or psychophysiological principles, in brief, a shortcut to actual physical measurement. Such a testing instrument would require sufficient validity and reliability, and above all, relevancy to the AT and biofeedback procedures.

The EPI might prove to be a useful testing instrument as a prognostic index for successful AT and biofeedback procedures, as the two dimensions, extraversion-introversion and neuroticism-stability, considered to be measured by the E-I and N-S scales respectively, are operationally defined in terms of constructs relevant to AT and biofeedback. The E-I scale has been regarded as an index of a person's "condition-ability," with low E-I scores (introversion) associated with higher "conditionability," and the N-S scale as an index of "autonomic reactivity," with autonomic lability associated with high N-S (neurotics) scores (H. J. Eysenck & S.B.G. Eysenck, 1968).

Since AT and Biofeedback are considered to involve the potential for acquiring new internal responses, an index of "conditionability," i.e., the E-I scale seems especially relevant to AT and biofeedback. It would be expected that introverts would more readily profit from AT and biofeedback training than would extraverts.

From the laboratories of H. J. Eysenck and others, H. J. Eysenck and S.B.G. Eysenck (1969) have reported impressive support for the extraversion-introversion construct. They report that more than fifty separate predictions show that introverts do better on vigilance tests, have longer after images, have weaker figural after effects, preserve visual fixation better, show greater tolerance for sensory deprivation but less tolerance for physical pain, and show better performance on critical flicker fusion (CFF) thresholds.

It has also been demonstrated that cortical arousal is more marked in introverts and cortical inhibition in extraverts, with EEG studies, studies on evoked potentials and CFF thresholds, and in drug studies where CNS stimulant drugs have been found to have introverting effects on a wide variety of experimental tests, while CNS depressant drugs have been found to have an extraverting effect (H. J. Eysenck & S.B.G. Eysenck, 1969).

While H. J. Eysenck reports strong, positive support for his theoretical formulations about extraversion-introversion, Storms and Sigal (1958) have pointed out, that in some of the experiments reported by H. J. Eysenck, there are definite methodological and measurement problems, and hence research findings are not always as unequivocal as Eysenck presents them. Storms and Sigal (1958) have also questioned the interpretations offered by H. J. Eysenck in support of his physiological formulations about the extraversion-introversion dimension. However, there does seem to be enough experimental support to warrant employing the E-I scale as a prognostic index for success in AT and biofeedback, whether Eysenck's "physiologizing" has a sound basis or not. In other words, the current study is not attempting to test the soundness of Eysenck's psysiological explanations, but rather on an empirical basis, it deals with the usefulness of the E-I scale of the EPI for predicting successful performance with the training procedures employed in this study.

Research Findings Relative to the Extraversion-Introversion Dimension

A comprehensive literature review of all research relevant to the extraversion-introversion dimension, as measured by the MPI and EPI, is beyond the scope of this paper. An attempt will be made to review only those studies offering empirical tests of the greater "conditionability" of introverts in comparison to extraverts.

In an eyeblink conditioning experiment, Franks (1956) hypothesized that hysterics and dysthymics should condition equally well and normals less well than either "neurotic" group. There were 20 Ss in each group. The UCS was an air puff, and the CS a tone through headphones. The UCR and CR were defined as eyeblink and psychogalvanic responses (PGR). There was no significant difference in acquisition for the normals compared with the two neurotic groups (combined).

In the Franks (1956) study, conditionability was found to be unrelated to the N-S scale, as measured by the Maudsley Medical Questionnaire and Guilford's D and C scales, but was related to introversion, as measured by the Guilford R. scale. A series of eyeblink conditioning studies have employed the Taylor Manifest Anxiety Scale (MAS), in which it has been argued that the total effective drive strength is in part a function of internal anxiety, and it has been hypothesized that Ss with a greater degree of anxiety would possess more drive and form eyeblink CRs better. Franks (1956) suggests that manifest anxiety is related to strong conditionability only to the extent that anxious people are introverted, and that while the MAS correlates with measures of neuroticism, it has also been shown to have a slight correlation with measures of introversion.

Franks (1956) indicates that the poor conditionability of hysterics supports the hypothesis that hysterics are in a state of cortical inhibition and dysthymics in a state of cortical excitation and that the relationship of conditionability for both "neurotic" groups and the normals to extraversion-introversion and not neuroticism, is supportive of excitation-inhibition being closely related to extraversion-introversion. The behavior of introverts might be described in terms of over-conditioning and cortical excitation and that of the extraverts in terms of under-conditioning and cortical inhibition.

In a second study, Franks (1957) followed the same experimental procedure as in the Franks (1956) study, with 60 undergraduate males as Ss. The findings were in line with the previous study. Introverted Ss conditioned considerably better than extraverted Ss, and no correlation was found between conditionability and neuroticism.

Willett (1960), as part of a larger study, predicted there would be a correlation between different conditioning measures (eyelid conditioning, salivary conditioning, verbal conditioning, and spatial conditioning) and that all conditioning measures would correlate significantly with a reliable measure of extraversion-introversion. Twenty undergraduate males as Ss. The Ss were administered the MPI, along with several other tests. They eyeblink conditioning procedure followed that of Franks (1956, 1957). He was unable to replicate the findings of the above two studies, obtaining a low negative correlation between extraversion-introversion and eyeblink conditioning. Results from the salivary conditioning experiment were inconclusive.

In the verbal conditioning phase of the Willett (1960) experiment there was a slightly negative relationship found between verbal conditioning and neuroticism. The Ss as grouped by the E-I scale, were more variable in their performance. In the spatial conditioning phase of the Willett (1960) experiment, a slightly negative correlation was obtained with introversion ($r = -0.250$). Willett (1960) concluded that the E-I scale was a poor criterion for differentiating groups of introverts and extraverts.

Vogel (1961) used 89 male Ss in a galvanic skin response (GSR) conditioning experiment. He hypothesized that introverted Ss would form GSR CRs better than extraverted Ss. All Ss were administered the MPI. The Ss were dichotomized into I and E groups, according to the mean score on the E-I scale. The S was tested in a semi-soundproof room, and told it was a test of relaxation. The task was to spell syllables presented on a memory drum, with the CS defined as nonsense syllables, eg., "LAJ." The UCS was a doorbell buzzer. The UCR and CR was the GSR reaction, defined as the change in skin resistance to the CS larger than the S's largest GSR occurring to intervening buffer syllables. The number of times the buzzer was presented prior to achievement of this criterion constituted the count of trials to acquire the CR. The larger score indicated slower conditioning. In accord with the experimental hypothesis, the CR was found to be more quickly acquired and more resistant to extinction in introverted than in extraverted Ss. Differences in GSR conditioning for I and E Ss were statistically independent of differing neuroticism scores. Vogel (1961) interpreted his findings as consistent with the findings of Franks (1956, 1957).

Some experimental studies employing an operant conditioning paradigm rather than a classical conditioning paradigm have also been supportive of higher conditionability of introverts than extraverts. Quay and Hunt (1965) did a study employing 458 incarcerated offenders in the U.S. Navy as Ss. All Ss were administered the EPI. The experimental procedure consisted of a card being presented with a neutrally-toned past tense verb and five personal pronouns. The S was asked to make a sentence with the verb and a selected pronoun. Reinforcement consisted of the E saying "good." Trials 1-26 were not reinforced. For trials 26-85, the E responded "good," to sentences beginning with the pronouns "I" or "we." Trials 86-110 were not reinforced. It was found that introverted Ss developed verbal conditioning better than extraverted Ss. The findings were interpreted as support for H. J. Eysenck's prediction regarding greater conditionability of introverts. There was not a significant relationship of neuroticism to conditionability. Extraversion was significantly related to conditionability ($r = -0.25$).

Jawanda (1966) followed the same experimental procedure as the Quay and Hunt (1965) study, using 120 Ss selected on the Panjabi version of the MPI. Introverted Ss developed verbal conditioning better than extraverted Ss. Goodstein (1967) was unable to replicate the findings of Quay and Hunt (1965) and Jawanda (1966), with a sample of 220 female college students. He found no significant difference between introverted and extraverted Ss in verbal conditionability. There was one difference, procedurely, which might have accounted for some of the difference, in that Goodstein (1967) selected Ss, based on scores on the Guilford R scale.

While several studies are reported in the literature in which predictions have been made about E scorers and I scorers on the MPI with regard to hypnotic susceptibility, no studies have been reported along the lines of this current investigation. A recent study by Stoudenmire (1972) is thought to provide some support for greater "conditionability" of I scorers than E scorers on the EPI, in muscle relaxation training. He selected 18 Is and 18 Es, all female undergraduates, and hypothesized that Is would learn to relax better than Es. Standard tape-recorded instructions were used for the relaxation training sessions. The Ss were trained in groups of three Is and three Es. Each group received three sessions of muscle relaxation training. There was a significant decrease in anxiety state measures (STAI Anxiety State Scale and MAACL Anxiety Today Form) for Is but not Es, which was interpreted as "tentative support" for Eysenck's theory of faster learning and conditioning of Is when compared to Es.

Development of the Maudsley Personality Inventory (MPI)

The MPI was constructed to measure the two personality dimensions of extraversion-introversion (E) and neuroticism-stability (N). While the MPI was not employed in the present experimental study, as the forerunner of the EPI, a review of the development of the MPI seems cogent, especially since research findings employing the MPI are cited as supportive of the construct validity of the EPI (H. J. Eysenck & S.B.G. Eysenck, 1968, 1969).

H. J. Eysenck (1956) and H. J. Eysenck and S.B.G. Eysenck (1969) have outlined the procedure followed in the construction of the MPI. Items from Guilford's multifactorial questionnaire and the Maudsley Medical Questionnaire (MMQ) (H. J. Eysenck, 1952) were subjected to an item analysis with a sample of 200 men and 200 women, all British born, white, and with the majority between 20 to 35 years of age. Twenty four items were selected for the N scale which showed a significant relationship with Guilford's Cycloid (C) scale but an insignificant relationship with Guilford's Rhathymia (R) scale for both sexes. Twenty four items were selected for the E scale which had a significant relationship with the C scale for both sexes. A factor analysis was then performed for the 48 items, and two factors (N and E) were extracted. A rotation according to simple structure was performed; and the N-scale items were found to cluster together as were the E-scale items.

Knapp (1962) reports that in more than 20 different normal samples, the correlation between the N and E scales averaged around -.15. While the N and E scales have been found to be almost virtually independent for normal samples, when neurotic samples, or normal individuals with high neuroticism scores only are considered, correlations range from -.30 to -.40 between the N and E scales. This finding is attributed to the nonlinearity of the regression lines at high introversion scores (Knapp, 1962), an explanation which Bursill (1965) views as quite weak. H. J. Eysenck (1967) has attempted to account for this relationship between extraversion-introversion and neuroticism-stability in neurotic samples and for individuals with high N-scale scores in terms of autonomic activation and cortical arousal being synonymous where strong emotions are involved; i.e., for the high N individual, even mild stimuli (which would ordinarily involve only cortical arousal) elicit autonomic activation.

In a review of research with the MPI, Knapp (1962) reports that high reliability has been demonstrated. For many samples split-half and Kuder-Richardson reliability coefficients have ranged between .75 and .85 for the E scale and between .85 and .90 for the N scale. For a sample of more than 100, test-retest reliabilities were .83 for the E scale and .81 for the N scale.

Negligible differences due to age, sex and class differences have been found with the MPI; the E and N scales are nearly independent of intelligence; and negligible effects due to response set have been demonstrated (Knapp, 1962). Since all of the N-scale items are keyed "yes," H. J. Eysenck (1962) explored the possibility of an acquiescence response set. Measures of extraversion (MPI), neuroticism (MPI), authoritarianism, indecisiveness (the number of "?" responses), and acquiescence (the number of "yes" responses) were submitted to a facotr analysis. The MPI scales showed negligible loadings, with coefficients of .07 or less on the two response set factors.

Validity of the Maudsley Personality Inventory (MPI)

The validation of the MPI will be considered in terms of factorial validity, concurrent validity, validity by nominated groups, and construct validity.

Factorial Validity. Two studies have demonstrated the correlation between the N and E scales of the MPI and the factors they purport to measure. Hildebrand (1958) administered a large battery of intelligence and personality tests to 145 neurotic, male inpatients and 25 male soldiers. A centroid analysis was performed on the data, and three factors, "introversion-extraverion," "neuroticism," and "general intelligence" were extracted.

Bendig (1960) computed factor loadings for several measures of neuroticism and anxiety. He termed the two independent factors "extraversion-introversion" and "emotionality." He reports factor loadings from .78 to .79 for the E scale of the MPI for his extraversion-introversion factor and factor loadings from .64 to .78 for the N scale of the MPI, for his emotionality factor.

Concurrent Validity. Knapp (1962) reports that the MPI scales have been shown to correlate highly with several other scales purporting to measure the dimensions of extraversion-introversion or neuroticism-stability or related constructs. However, a review of this fairly extensive area of research does not seem essential.

Validity by Nominated Groups. S.B.G. Eysenck (1962) asked judges to nominate people based on descriptions of extraversion and introversion, and neuroticism and stability. The nominated Ss completed the MPI. Mean extraversion scores for Ss nominated as most extraverted were significantly higher than those nominated as most introverted. Mean neuroticism scores for Ss nominated as most neurotic were significantly higher than those nominated as most stable.

Construct Validity. Three lines of research have been pursued in attempting construct validation of the MPI - observational studies, studies on drug effects and studies relating the neuroticism-stability and extraversion-introversion dimensions to various experimental phenomena of perception, conditioning, motor learning, verbal learning, autonomic reactivity, etc.

In several studies utilizing the MPI with psychiatric diagnositc groups, and in line with predictions from H. J. Eysenck's theory, dysthymic neurotics have been shown to have high scores on neuroticism and low scores on extraversion, while psychopaths and hysterics have been shown to have high scores on neuroticism but to score higher on extraversion than the dysthymics (Knapp, 1962).

Also in line with predictions from H. J. Eysenck's theory, numerous drug studies have been carried out in which it has been postulated and demonstrated that depressant drugs change behavior in an extraverted direction while stimulant drugs change behavior in an introverted direction, as measured by the MPI (Knapp, 1962).

The variety of laboratory construct validation studies carried out with the MPI is quite numerous in the experimental literature. Some of the areas of study have included eyeblink conditioning, verbal conditioning, motor learning, reminiscence and drive, figural after effects, etc., in which predictions have been made and demonstrated relative to the extraversion-introversion and/or neuroticism-stability dimensions as measured by the MPI, from H. J. Eysenck's theory (Knapp, 1962).

Development of the Eysenck Personality Inventory (EPI)

The EPI is a further refinement of the MPI. There are two parallel forms (Forms A and B), each consisting of 24 N-scale items and 24 E-scale items, answered "yes" or "no." A Lie (L) scale (9 items in each form) is also included to detect response distortion, i.e., the tendency to put oneself in a socially favorable light (H. J. Eysenck & S.B.G. Eysenck, 1968).

About a dozen factor analytic studies, employing more than 30,000 Ss were carried out in constructing the EPI (S.B.G. Eysenck, 1960; H. J. Eysenck & S.B.G. Eysenck, 1962). The Ss were widely representative of the English population, varying in sex and age composition. Some of the Ss were university students, some middle-class groups, and some working-class groups. The final factor analytic study had a matrix of 108 entries, which included all items of Forms A and B of the EPI.

The orthogonality of the E and N scales of the EPI has been demonstrated. The slight correlation between N and E which was present in the MPI for normal samples, was removed by adding, subtracting and rewriting items and then subjecting them to repeated factor analysis. For both forms of the EPI the correlation for normal Ss is .04; for an American college sample, correlations between scales are .01 (Form A) and -.11 (Form B) (H. J. Eysenck & S.B.G. Eysenck, 1962). Farley (1967) reports correlations between .12 and -.16 between E and N for seven

English samples; and, Colstan (1969) reports a correlation of -.055 between E and N for 557 Australian military recruits. Information could not be found in the experimental literature about whether the nonlinearity of regression lines for high N scores applies to the EPI as well as the MPI.

Test-retest reliability for two groups of English Ss range from .84 to .94 for both forms and between .80 and .97 for the separate forms of the EPI. Split-half reliabilities for normal Ss are .86 for E (both forms); .89 for N (both forms); .75 for E (Form A versus B); and, .89 for N (Form A versus B) (H. J. Eysenck & S.B.G. Eysenck, 1962).

In a critique of the EPI, Lingoes (1965) has raised the point that if the EPI and MPI are found to correlate as high or higher for E and N than both forms of the EPI, the MPI could be considered another form of the EPI. Also, if there are to be two forms of the EPI, if one or both EPI forms correlates significantly higher with the MPI than the equivalent forms coefficients of .75 and .86 for E and N respectively, the MPI should be considered as one of the two forms. Lingoes (1965) further notes that if the MPI correlates much less with either of the EPI forms, justification should not be made for EPI validity based on MPI research findings. It is surprising that correlative studies are not reported in the literature for the MPI and EPI.

On the EPI, a significant trend has been demonstrated for E and N to decline with age. Correlations with sex are negligible. There is a trend, though not significant, for working-class people to score higher than middle-class people on the N scale (S.B.G. Eysenck, 1960).

Normative data for the EPI is available for American college students and for selected occupational groups and clinical groups (H. J.

Eysenck & S.B.G. Eysenck, 1968).

Validity of the Eysenck Personality Inbentory (EPI)

Factorial Validity. White, Eysenck, and Soveif (1969, Ch. 19) report the end results of an extensive factorial analysis employing the EPI, the Cattell Personality Inventory and the Guilford Personality Inventory. The E and N factors were found to overlap in their variances only to the extent of 1%, giving additional support for the orthogonality of E and N. The higher order factors (E and N) were found to be replicable across sex and from one investigator's set of questions to another.

Concurrent Validity. Rather than carry out an extensive review of the correlationship studies of the EPI with various "anxiety" scales and other personality inventories, let it be noted that there have been many studies demonstrating a relationship of the N and E scales to related constructs of other tests (H. J. Eysenck & S.B.G. Eysenck, 1968).

Validity by Nominated Groups. In a study similar to the S.B.G. Eysenck (1962) study with the MPI, S.B.G. Eysenck and H. J. Eysenck (1963) had independent judges nominated Ss as extraverted or introverted, and stable or unstable. The nominated Ss took the EPI. Mean extraversion scores on the EPI for Ss nominated as extraverted were significantly higher than those nominated as introverted. Mean neuroticism scores on the EPI for Ss nominated as unstable were significantly higher than those nominated as stable.

In a study employing self ratings, Vingoe (1966) asked Ss to rate themselves on a seven-point scale of extraversion-introversion, after completing the EPI. Dividing the Ss according to their self ratings and dichotomizing on EPI extraversion scores yielded criterion groups that were significantly different. Vingoe (1968) has replicated these findings.

Construct Validity. Most support for the construct validation of the EPI is cited from MPI research. Transfer of MPI findings to the EPI seems justified if there is a high correlation between the two tests. To date, correlational studies comparing the MPI and EPI have not been reported in the literature. In line with predictions from H. J. Eysenck's theory, utilizing the EPI with psychiatric diagnostic groups, it has been shown that dysthymic neurotics have high scores on neuroticism and low scores on extraversion, while psychopaths and hysterics have high scores on neuroticism but score higher on extraversion than the dysthymics (H. J. Eysenck & S.B.G. Eysenck, 1968).

Skin Temperature as a Dependent Variable Measure

In AT the achievement of "warmth" in the extremities is thought to indicate the presence of a psychological state of passive volition, rather than active volition, and hence it seems that temperature of the extremities would provide an appropriate index of ANS relaxation. Selection of skin temperature, more specifically hand temperature, as the dependent variable of interest in the current study was also based upon the experimental procedure of Green et al. (1967), in which hand temperature was used as an indicator of ANS relaxation.

Razran (1961) and other researchers, have demonstrated that the normal response in the hands to an alerting stimulus, which causes attention to be focused on peripheral processes is vasoconstriction, accompanied by a decrease in skin temperature, generally considered to be an increase in autonomic tension. Vasodialation in the hands is accompanied by an increase in temperature, and is generally considered to be evidence of autonomic relaxation, which also suggests the appropriateness of hand temperature as the dependent variable of choice in the current study.

Lacey (1950) has demonstrated that there is marked individual variability in autonomic response under stressful conditions. However, since the focus of the present study is on decreased peripheral tension rather than increased peripheral tension, his finding does not seem to provide a major difficulty.

The summary of physiological factors involved in skin temperature is from information presented by Guyton (1966).

The surface temperature of the skin is influenced by several internal and external factors. Rate of blood flow through the skin, vasodialation and vasoconstriction of various structures of the skin, the temperature and humidity of the surrounding environment, and the movement of air all influence skin temperature.

Just beneath the skin is a continuous venous plexus, supplied in the most exposed body parts (hands, feet, ears) from the arterioles to the veins. A high rate of blood flow causes heat to be conducted from the body core to the skin; a reduction in rate of blood flow decreases heat conduction from the body core.

The heat conduction to the skin by the blood is controlled by the degree of vasoconstriction of the arterioles supplying blood to the venus plexus. Vasoconstriction is controlled almost entirely by the sympathic nervous system. Under sympathetic stimulation, the arterioles supplying the skin are continually in a state of constriction. When sympathetic centers of the posterior hypothalamus are stimulated, the blood vessels are constricted further. When posterior centers of the hypothalamus are inhibited, blood vessels dilate.

Another mechanism influencing blood flow to the skin involves stimulation of the sweat glands. When these glands are activated, they release a substance which diffuses to surrounding tissues causing increased vasodialation of the blood vessels.

Skin temperature varies for body location, and rate of change in skin temperature also varies for body location. At room temperatures below 25°C, indoors, and under ordinary resting conditions, the trunk, head and neck have the highest surface temperature, with the arms and hands lower than the limbs (Plutchik, 1956). Sheard, Williams, and Horton (1941) found that the skin temperature of the forehead, thorax, and the upper portions of the arms and legs lies between 32 and 35°C, with a peripheral temperature gradient from shoulder to finger and from thigh to toe, with the lowest temperature at the toes.

The following finding has bearing on the current investigation: "...measure of the skin temperature of the fingers and toes serve as the most sensitive indicators of the changes of the blood flow of the superficial vessels in order that the rate of heat production may equal the rate of heat loss, keeping the internal temperature constant. Therefore there is some justification in recording finger or toe temperature in experimental work, for these will be maximally sensitive to the effects of stimulation or changed conditions" (Plutchik, 1956, p. 253).

Also relevant to the current study is the finding of Mittleman and Wolff (1939) that major drops in finger temperature were associated with a slight increase in forehead and cheek temperature.

Only one study was found in the literature dealing with differences in skin temperature between men and women. With a sample of two women and four men, Hardy, Milhorst, and DuBois (1941) reported that under basal conditions, skin temperature changes more in women than in men with changes in environmental temperature, and that men sweat more than women.

Also of relevance to the current study would be any findings on skin temperature changes as related to the female menstrual cycle. Rothman and Felsher (1946) stated that direct capillary observation indicates that there is a cyclic variation in the tonicity of cutaneous capillaries with the menstrual cycle. However, Plutchik (1956) indicates the above finding should not be interpreted as strong support for cyclic skin temperature changes associated with the menstrual cycle, as research findings suggest that capillary size has little effect on blood flow.

While a grasp of the physiological factors involved in skin temperature is informational, research studies more directly related to the current investigation are those concerned with the experience of temperature states, eg., "warmth," and with skin temperature changes associated with states of relaxation, hypnosis, etc. There are few such studies reported in the literature.

A study by Winslow, Herrington and Gagge (1937) employed what they referred to as a "comfort vote" method. Ratings were obtained for Ss at rest under various environmental conditions, where the ratings were:

"pleasant" = 1-2; "indifferent" = 3; "unpleasant" = 4; and, "very unpleasant" = 5. There was a sharp increase in ratings of "pleasant" to "very unpleasant" with a 2.5°C rise in average skin temperature. A decrease of more than 4.5°C in average skin temperature was required to evoke ratings of "unpleasant." Whether a small temperature rise or fall was rated as "pleasant," "very unpleasant" or "indifferent" depended on the level of average skin temperature related to 33.5°C.

Hardy (1961) reported a study on thermal sensation in which he found that cold sensation persisted in skin temperature lower than 23 to 25°C and warm sensations near 40°C. He proposed the possibility of two positive feedback loops for regulatory response to environmental thermal stimuli existing for "cold" and "warmth" sensations; i.e., increased vasodialation leads to an increase in "warmth" which in turn leads to increased vasodialation, and increased vasoconstriction leads to an increase in "cold" which in turn leads to increased vasoconstriction.

In an attempt to find a physiological index consistently correlated with hypnotic trance, Reid and Curtsinger (1968) studied changes in respiration rate, pulse rate, systolic and diastolic blood pressure and oral temperature. The physiological measures were taken before trance, during the trance, and five minutes after termination of the trance for 20 volunteer Ss. The Ss were instructed to close their eyes, and to relax their muscles in progressive steps and then to visualize a pleasant scene as the E counted to twenty. Hypnotic depth was judged clinically. Under neutral hypnosis, there was a significant increase in oral temperature, averaging 0.6°F, while there was no significant change in the other physiological indices. An additional nine Ss, were measured under nonhypnotic relaxation, and showed no significant change in oral temperature. For an additional four Ss, signigicant increases in skin temperature of the forehead, palm of the hand, and the chest were also found under neutral hypnosis.

Mittlemann and Wolff (1939) correlated finger temperature changes with introspective reports of Ss' emotions, dreams, associations, expressive behavior, etc. Various emotions as evaluated by the E were correlated with a rise or decrease in skin temperature. Of most interest for this research study, is that relaxation was found to be related to an increase in skin temperature.

In a clinical case report, Craig (1944) measured the finger temperature of a 15-year old girl with Raynaud's disease during a psychiatric interview concerning sexual matters. During the 25-minute interview, her finger temperature dropped 10°C. During the 25-minute period following the interview, her finger temperature increased 4.5°C. This single case study suggests that states of relaxation are associated with increased finger temperature.

Statement of Hypotheses

The major hypothesis of this research study involves the greater "conditionability" of introverts when compared with extraverts, on the E-I dimension of the EPI. It is expected that introverts will perform better in an experimental situation which involves learning new internal responses, when training techniques of relaxation, autogenic training and biofeedback procedures are used.

Hypothesis 1: Introverts will show a greater increase in left forefinger temperature than extraverts.

The second hypothesis of interest in this study concerns the different training conditions to be employed: relaxation training, autogenic training and biofeedback training. It is expected that biofeedback training is superior to autogenic training and both are superior to relaxation training, in bringing about new internal responses.

Hypothesis 2: Biofeedback training is more effective than autogenic training and both are more effective than relaxation training in producing increased left forefinger temperature.

Because of the exploratory nature of this study, no hypotheses are being considered relative to the interaction of the three training conditions with the extraversion-introversion dimension of the EPI.

CHAPTER II

METHOD

Subjects

The Ss were 36 female employees at Larned State Hospital in Larned, Kansas, between 20 and 56 years of age.

An alphabetical list of all employees was obtained from the Larned State Hospital Personnel Department. From this list names of female employees were randomly assigned to two population pools (as a second related research study was being carried out simultaneously). Approximately 150 women were sent copies of Form A and Form B of the Eysenck Personality Inventory (EPI), along with a letter requesting their cooperation in the research project (Appendix A) and a release form (Appendix B).

After excluding the returned EPI protocals for women who were not within the age range of 18 to 56 years of age, and with a Lie (L) score (Forms A and B combined) on the EPI higher than 6, the Interversion-Extraversion (I-E) scale and the Stability-Neureticism (S-N) scale were scored (Forms A and B combined).

A second form letter (Appendix C) was sent to women scoring within the highest 30% and within the lowest 30% on the I-E scale, of the returned EPI protocals.

Approximately half of the women who were sent the second form letter agreed to participate in the experiment. Of the Ss who began the experiment, one S (in the 1-Control group) terminated after completing only about one fourth of the training trials, giving as a reason that her work schedule was too heavy. She was replaced by the next available S, selected at random.

The 36 Ss were divided into two groups of 18 Ss each based on their I-E scores. Ss with scores in the upper 30% on the I-E scale of the EPI are designated as the E group; Ss with scores in the lower 30% on the I-E scale are designated as the I group. Ss in the I and E groups were randomly assigned to one of the three experimental conditions: Control group, No-feedback group, or Feedback group, as outlined in the experimental procedure, after the three baseline trials were completed.

For the sample in this study the mean I-E score for the I group was 17.00 (SD = 2.79), and the mean I-E score for the E group was 32.83 (SD = 3.34). The mean S-N score for the I group was 20.61 (SD = 10.79), and the mean S-N score for the E group was 19.22 (SD = 8.71). The mean L score for the I group was 3.11 (SD = 1.52), and the mean L score for the E group was 2.83 (SD = 1.42). The mean age of I Ss was 40.06 (SD = 10.30), and the mean age of E Ss was 36.28 (SD = 10.52). The means and standard deviations for the I-E, S-N and L scores of the EPI and for age, for each treatment condition, can be referred to in Appendix D (Table XII).

Since the introversion-extraversion and the stability-neuroticism dimensions are considered to be conceptually and empirically independent, a Pearson product-moment correlation coefficient (r) (Guilford, 1956, Pp. 135-153) was calculated between the I-E scores and the S-N scores for the sample in this research study. An r of -.028 suggests only a slightly negative relationship between the I-E scores and the S-N scores, and provides support for the independence of the introversion-extraversion and stability-neuroticism dimensions.

Controlled Variables

While there is considerable individual variability in skin temperature (Guyten, 1966), variability due to sex differences in skin temperature was controlled by restricting the samples to females. The restriction in the age range (18 to 56 years) of Ss was made, as vascular efficiency has been found to be related to the aging process (Guyten, 1966).

Based on a personal communication with Elmer Green (October, 1970), all persons with a history of migraine headaches were restricted from the sample.

Venables and Martin (1967) indicate that a room temperature accurate to 1 or 2°C will ensure that the S's skin temperature will remain within reasonable limits for experimentation, provided there is a short adaptation period to the experimental environment. The temperature within the experimental room was recorded at the beginning of each training trial. Throughout the experimental procedure, the temperature was found to vary between 70° and 75°F, which was considered to be negligible, as Plutchik (1956) reports that environmental temperature from 24°C to 28°C (75.2°F to 82.4°F) produces virtually no change in skin temperature. A 10-minute period of temperature adaptation, in the waiting room proceded each training session.

During the training sessions, extraneous light in the experimental room was minimized by covering the one window with a black shade;

however, extraneous light did vary throughout the day. There was minimal interferring noise as the experimental room was in a quiet, secluded area. There was some unmasked sound from the pen recorder.

Equipment

A Temperature Feedback Meter (TFM) supplied by Rex Instruments, at The Menninger Foundation, Topeka, Kansas, was employed. The TFM is portable and battery operated, and has a signal output of 100 mm per $^{\circ}$F. The TFM was modified for a serve-pen recorder of 100,000 ohms. The TFM has a lighted dial and one potentiometer to center the vertical needle at "0" and another potentiometer for calibration and translation of electronic measures into specific temperature values.

The Thermistor (a temperature sensing device) is approximately 2 mm in diameter, and is partially covered by an epoxy nonconductor, approximately 1 cm square. The thermistor is wired to the TFM and attached with the point exposed from the epoxy base to the skin surface.

The TFM was calibrated by the E in water baths of known temperature, using a "Taylor" laboratory thermometer scaled for Fahrenheit temperature readings. According to Venables and Martin (1967), for most skin temperatures, accuracy of measurement with a thermister can be around 0.1°C.

As the thermister senses temperature increases, the TFM needle deflects to the right on the meter dial (25 gradations on the meter equaling 2.5°F). As the thermistor senses temperature decreases, the TFM needle deflects to the left on the meter dial.

A continuous record for each training trial was obtained with a Heath Serve-Pen Recorder, Model EV20B, single speed, two inches per minute, with an event marker signaling the onset and termination of each session.

Heath chart paper was used for data recording. It is ruled into one inch squares, each subdivided into ten rectangles. When the pen is centered, it can move five one-inch square dimensions in each direction.

Other equipment consisted of a reclining chair, and a Norelco reel-type tape recorder.

Experimental Procedure

Pilot Data

Five pilots Ss were run prior to the experiment to make sure the procedure could be followed smoothly, and to see if clarification was required relative to the tape-recorded instructions, etc. It was determined that a 90 second period was sufficiently long for an experimental trial, in line with AT procedures (Luthe, 1969) and the Green, et al. (1957) procedures. Pilot Ss were run with a thermistor attached to the forehead and thermistor attached to the left forefinger. The TFM was initially calibrated to provide a relative index between forehead and left forefinger temperature as suggested by the procedure of Green et al (1967). The decision to calibrate the TFM for absolute temperature readings was based on there being fairly wide individual differences in skin temperature (Guyton, 1966). Also, O'Connor and McCarthy (1952) express the importance of considering the initial level of skin temperature in research concerned with temperature change, as the temperature change required to produce a standard sensation of warmth is functionally related to initial skin temperature. It might be noted, however, that Hord, Johnson and Lubin (1964) state evidence suggesting that Wilder's (1957) "Law of Initial Value," which states that given a standard stimulus and a standard period of measurement, the response defined as a change from the initial value will tend to be smaller when the initial value is higher, does not apply to skin temperature responses.

The experimental room was approximately 10 ft. by 9 ft. The reclining chair was placed in the center of the room. The TFM and the pen recorder were on a table to the left of the reclining chair. The tape recorder was situated on the floor to the left of the table. During the training trials, the E sat in a chair behind the table.

Baseline Trials

The identical procedure was followed for all Ss for the first three (baseline) trials. Upon entering the experimental room, the E asked the S to be seated in the reclining chair. The chair was then placed in the reclining position. The E then swabbed the S's left forefinger with rubbing alcohol to remove surface impurities from the skin. On the first trial, as the E attached the thermistor to the "ball" of the S's left forefinger, she stated: "This is to help me collect data and is harmless." (This statement was made as some of the pilot Ss had expressed the fear of being shocked the first time the thermistor was attached.) The thermistor was attached with cellophane tape, which according to Plutchik (1956) provides a source of measurement error, though slight, due to pressure on the skin surface, and also because it affects the availability of moisture for evaporation. The TFM dial was not within the S's view throughout the trial.

The E then turned off the lights, checked the TFM calibration and started the serve-recorder. The E then started the tape-recorder instructions, 54 seconds in length, and recorded by the E (Appendix E). Upon termination of the taped instructions, a 90 second trial ensued. The E then stopped the serve-recorder and turned on the room lighting, The E then removed the thermistor and returned the reclining chair to an upright position. The E then thanked the S and confirmed the next appointment time.

The first two baseline trials were given on day 1 and the third during the first session of day 2.

Training Trials

The training trials consisted of 20 sessions, each at the rate of 2 sessions per day, under one of the following three conditions.

Control (C) Group. The same procedure was followed for the 20 training trials as was followed for the three baseline trials.

No Feedback (NFB) Group. The tape-recorded autogenic instructions, 66 seconds in length, and recorded by the E (Appendix E) were given for the 20 training trials, followed by a 90 second trial. The TFM dial was not within the S's view throughout each trial. At the end of each trial, the S was asked to fill out a questionnaire (Appendix F).

Feedback (FB) Group. The tape-recorded instructions, 108 seconds in length, and recorded by the E (Appendix E) were given for the 20 training trials, followed by a 90 second trial. The TFM dial was within the S's view throughout each trial. At the end of each trial, the S was asked to fill out the same questionnaire (Appendix F) as the NFB Ss.

The C Ss were not asked to fill out the questionnaire as phrases in its content were based on the NFB and FB taped instructions.

Notable spontaneous fluctuations of skin temperature have been shown with humans and animals. Steele (1934) demonstrated fairly regular diurnal variations in skin temperature, as much as 2°C on the trunk and 4°C at the extremities. To minimize variability due to diurnal changes in skin temperature, an attempt was made to run the S's two daily trials at the same times each day and to maintain a schedule of trials on consecutive days. Some variability was involved in the scheduled experimental trials due to work schedules, rest days, sick days, etc. In no instance, however, was there an interval of more than three days between trials.

Measurement

At the beginning of each trial, the TFM was set at "0" and the meter reading was recorded. The meter needle was recentered at "0" and the meter reading recorded whenever the needle deflected 25 gradations to the right or left. Meter readings were also recorded at the beginning of the taped instructions, at the end of the taped instructions, and at the end of the 90 second trial, for each trial. Meter readings were then converted to Fahrenheit temperature values.

Each S served as her own control, with temperature change over the course of the training trials being evaluated by subtracting her average temperature for the three baseline trials from her average temperature for the last three training trials (trials 18-20).

Since a measure of left forefinger temperature increase at the end of the 20 training trials was of major interest in the present study, four indexes were considered of importance. The "Start of Instructions" dependent variable is considered to give a measure of the extent to which the S began the experimental procedure with the "set" to increase left forefinger temperature. The "End of Instructions" dependent variable is considered to be a measure of the extent to which the S got the "instructional set" to increase left forefinger temperature, and the "End of the 90 Second Trial" dependent variable is considered to be a measure of increased left forefinger temperature in the period of time after the "instructional set." The dependent variable of primary interest, and considered to provide the most stable, sensitive measure of increased left forefinger temperature is the "Average Temperature Increase Over the 90 Second Trial" (an average of the 15 values sampled every six seconds).

Hypotheses

Null hypotheses 1 - 4 are concerned with initial differences in I and E Ss on the dependent variable measures. If there is a significant difference between I and E Ss in the four dependent variable measures for the three baseline trials, it would suggest inherent differences between I and E Ss even before specific training techniques have been employed.

There is no difference in left forefinger temperature between I and E Ss: (a) where the dependent variable measure is the average of the three Fahrenheit temperature readings at the beginning of the taped instructions for the three baseline trials (Hypothesis o_1); (b) where the dependent variable measure is the average of the three Fahrenheit temperature readings at the end of the taped instructions for the three baseline trials (Hypothesis o_2); (c) where the dependent variable measure is the average of the three Fahrenheit temperature readings at the end of the 90 second trial for the three baseline trials (Hypothesis o_3); and (d) where the dependent variable measure is the average for the three baseline trials of the average Fahrenheit temperature readings for the 90 second trial, sampled every 6 seconds (Hypothesis o_4).

Null hypotheses 5 - 8 concern the randomness of the Ss' assignment to one of the three training conditions (C, NFB, FB). If the Ss' assignment to training condition is indeed random, there should not be a significant difference in the four dependent variable measures for the three baseline trials.

There is no difference in left forefinger temperature between C, NFB and FB Ss: (a) where the dependent variable measure is equivalent to that of Hypothesis o_1 (Hypothesis o_5); (b) where the dependent variable measure is equivalent to that of Hypothesis o_2 (Hypothesis o_6); (c) where the dependent variable measure is equivalent to that of Hypothesis o_3 (Hypothesis o_7); and (d) where the dependent variable measure is equivalent to that of Hypothesis o_4 (Hypothesis o_8).

Hypotheses 9 - 12 are concerned with whether scores on the I-E scale of the EPI have predictive value for a S's success with the training procedures employed.

I Ss show a greater increase in temperature of the left forefinger than the E Ss: (a) where the dependent variable measure is the average of the three Fahrenheit temperature readings for trials 18-20, minus the average of the three Fahrenheit temperature readings for the three baseline trials, at the beginning of the taped instructions (Hypothesis

9); (b) where the dependent variable measure is the average of the three Fahrenheit temperature readings for trials 18-10, minus the average of the three Fahrenheit temperature readings for the three baseline trials, at the end of the taped instructions (Hypothesis 10); (c) where the dependent variable measure is the average of the three Fahrenheit temperature readings for trials 18-20, minus the average of the three Fahrenheit temperature readings for the three baseline trials, at the end of the 90 second trial (Hypothesis 11); and (d) where the dependent variable measure is the average of the three values for trials 18-20, minus the average of the values for the three baseline trials, where the value is an average of the Fahrenheit temperature readings for the 90 second trial, sampled every 6 seconds.

Hypotheses 13 - 16 are concerned with whether FB training is superior to NFB training, and if both are superior to C training in producing increased left forefinger temperature.

FB training is more effective than NFB training, and both are superior to C training in producing increased left forefinger temperature: (a) where the dependent variable measure is equivalent to that of Hypothesis 9 (Hypothesis 13); (b) where the dependent variable measure is equivalent to that of Hypothesis 10 (Hypothesis 14); (c) where the dependent variable measure is equivalent to that of Hypothesis 11 (Hypothesis 15); and, (d) where the dependent variable measure is equivalent to that of Hypothesis 12 (Hypothesis 16).

For the questionnaire data, it is postulated that if inherent constitutional and behavioral differences exist between I and E scorers, significant differences might be expected in their self ratings of their experiential states during the training trials. Likewise, significant differences might be expected in the self ratings of Ss "experiencing" different training conditions, i.e., between the FB and NFB groups.

The eight dimensions rated, on a five-point scale by each FB and NFB S (Appendix F) at the end of each of the 20 training trials were as follows: "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," and "Alert - Sleepy."

For each of the eight dimensions of the questionnaire, the null hypotheses and experimental hypotheses for the I and E scorers, and for the FB and NFB groups are stated as follows:

H_o: Both samples are drawn from the same population, or populations with the same distributions.

H_a: Both samples are drawn from different populations.

Statistical Procedures

Four 2 x 3 factorial designs (Winer, 1962, pp. 140-162, 229-247) were used to test the null hypotheses concerning the inherent differences between I and E Ss on baseline performance and the null hypotheses concerning the randomness of the Ss' assignment to the training groups (C, NFB, FB). In each 2 x 3 factorial design, factor A was the I-E dimension of the EPI, with two levels: I (scores in the lower 30%) and E (scores in the upper 30%); and, factor B was the training group condition to which the Ss were assigned, with three levels: C group, NFB group, and FB group.

H_{o1} and H_{o5} were tested in one 2 x 3 factorial design; H_{o2} and H_{o6} were tested in one 2 x 3 factorial design; H_{o3} and H_{o7} were tested in one 2 x 3 factorial design; and, H_{o4} and H_{o8} were tested in one 2 x 3 factorial design.

Four 2 x 3 factorial designs (Winer, 1962, Pp. 140-162, 229-247) were used to test the null hypotheses of research hypotheses 9 - 12. In all four 2 x 3 factorial designs, factor A was the I-E dimension of the EPI, with two levels: I (scores in the lower 30%) and E (scores in the upper 30%); and, factor B was the training condition employed, with three levels: C, NFB, and FB. Factors A and B are considered to be fixed factors.

The factorial design was chosen because factor A was a classification factor and factor B was independent treatment conditions, with the Ss' assignment to one of the three levels of factor B being random, and because dependent variable measures were considered to be on an interval scale.

The null hypotheses of H_9 and H_{13} were tested in one 2 x 3 factorial design; H_{10} and H_{14} were tested in one 2 x 3 factorial design; H_{11} and H_{15} were tested in one 2 x 3 factorial design; and H_{12} and H_{16} were tested in one 2 x 3 factorial design.

A significant F for any or all of the experimental hypotheses, H_{13}, H_{14}, H_{15}, and H_{16} is considered only partial support for the superiority of both FB and NFB training over the C condition, and for the superiority of FB over NFB training. Where the F was significant, planned orthogonal comparisons (Edwards, 1962, Pp. 140-144) were used to more completely evaluate experimental hypotheses H_{13}, H_{14}, H_{15}, and H_{16}.

The Kolmogorov-Smirnov two-sample test (Siegel, 1956, Pp. 116-127) was chosen to test the null hypotheses for each of the eight ordinal-scale dimensions of the questionnaire data for the I and E groups and for the NFB and FB groups.

CHAPTER III

RESULTS

Baseline Trial Hypotheses

Null hypotheses (H_{o1}, H_{o2}, H_{o3}, H_{o4}) concerning inherent differences in I and E scorers on the four dependent variable temperature measures for the three baseline trials were tested in separate 2 x 3 factorial designs, with α chosen at the .05 level.

The test of H_{o1} is summarized in Table I. The I group and the E group did not differ significantly in average temperature at the beginning of instructions for the three baseline trials; and the null hypothesis (H_{o1}) is assumed.

TABLE I

ANALYSIS OF VARIANCE FOR THREE BASELINE TRIALS
AVERAGE TEMPERATURE AT START OF INSTRUCTIONS

Source	df	MS	F
Extraversion-Introversion (A)	1	28.5113	1.466
Training Group (B)	2	23.1207	1.189
AB	2	35.8194	1.842
Error	30	19.4489	

F (1, 30 df) = 4.17 .05 level
F (2, 30 df) = 3.32 .05 level

The test of H_{o2} is summarized in Table II. The I group and the E group did not differ significantly in average temperature at the end of instructions for the three baseline trials; and the null hypothesis (H_{o2}) is assumed.

TABLE II

ANALYSIS OF VARIANCE FOR THREE BASELINE TRIALS
AVERAGE TEMPERATURE AT END OF INSTRUCTIONS

Source	df	MS	F
Extraversion-Introversion (A)	1	39.8700	1.566
Training Group (B)	2	34.8950	1.370
AB	2	35.8250	1.407
Error	30	25.4627	

F (1, 30 df) = 4.17 .05 level
F (2, 30 df) = 3.32 .05 level

The test of H_{o3} is summarized in Table III. The I group and the E group did not differ significantly in average temperature at the end of the 90 second trial; and the null hypothesis (H_{o3}) is assumed.

The test of H_{o4} is summarized in Table IV. The I group and the E group did not differ significantly in the average for the three baseline trials of the average temperature between the end of the instructions and the end of the 90 second trial; and the null hypothesis (H_{o4}) is assumed.

TABLE III

ANALYSIS OF VARIANCE FOR THREE BASELINE TRIALS
AVERAGE TEMPERATURE AT END OF
90 SECOND TRIALS

Source	df	MS	F
Extraversion-Introversion (A)	1	65.3200	2.480
Training Group (B)	2	45.7600	1.737
AB	2	30.7100	1.166
Error	30	26.3381	

F (1, 30 df) = 4.17 .05 level
F (2, 30 df) = 3.32 .05 level

TABLE IV

ANALYSIS OF VARIANCE FOR THREE BASELINE TRIALS
AVERAGE TEMPERATURE BETWEEN END OF
INSTRUCTIONS AND END OF TRIAL
(90 SECOND PERIOD SAMPLED
EVERY 6 SECONDS)

Source	df	MS	F
Extraversion-Introversion (A)	1	50.1200	1.901
Training Group (B)	2	41.7650	1.584
AB	2	34.7000	1.316
Error	30	26.3717	

F (1, 30 df) = 4.17 .05 level
F (2, 30 df) = 3.32 .05 level

Support for null hypotheses (H_{o1}, H_{o2}, H_{o3}, H_{o4}) suggests there is not an inherent difference between I and E scorers in the four temperature indices prior to the twenty training trials.

Null hypotheses (H_{o5}, H_{o6}, H_{o7}, H_{o8}) concerning the random assignment of Ss to the three training groups were tested in separate 2 x 3 factorial designs, with α chosen at the .05 level.

The test of H_{o5} is summarized in Table I. The C, NFB, and FB groups did not significantly differ in average temperature at the beginning of instructions for the three baseline trials; and the null hypothesis (H_{o5}) is assumed.

The test of H_{o6} is summarized in Table II. The C, NFB, and FB groups did not significantly differ in average temperature at the end of instructions for the three baseline trials; and the null hypothesis (H_{o6}) is assumed.

The test of H_{o7} is summarized in Table III. The C, NFB, and FB groups did not significantly differ in average temperature at the end of the 90 second trial; and the null hypothesis (H_{o7}) is assumed.

The test of H_{o8} is summarized in Table IV. The C, NFB, and FB groups did not significantly differ in the average for the three baseline trials of the average temperature between the end of the instructions and the end of the trial; and the null hypothesis (H_{o8}) is assumed.

Support for null hypotheses (H_{o5}, H_{o6}, H_{o7}, H_{o8}) is considered to provide ample support that the Ss were randomly assigned to the three training conditions (C, NFB, FB).

Training Trials Hypotheses

Null hypotheses (H_{o9}, H_{o10}, H_{o11}, H_{o12}) for research hypotheses H_9, H_{10}, H_{11}, and H_{12} on the four dependent variable temperature measures for the average of the last three training trials (trials 18-20) minus the average of the three baseline trials, were tested in separate 2 x 3 factorial designs, with α chosen at the .05 level.

The test of H_{o9} is summarized in Table V. The I group and the E group did not differ significantly in the average temperature for trials 18-20 minus the average temperature for the three baseline trials at the start of instructions; and the null hypothesis (H_{o9}) is assumed.

TABLE V

ANALYSIS OF VARIANCE FOR START OF INSTRUCTIONS AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS

Source	df	MS	F
Extraversion Introversion (A)	1	58.905	3.12
Training Technique (B)	2	7.089	<1
AB	2	28.750	1.52
Error	30	18.903	

F (1, 30 df) = 4.17 .05 level
F (2, 30 df) = 3.32 .05 level

The test of H_{o10} is summarized in Table VI. The I group and the E group did not differ significantly in the average temperature for trials 18-20 minus the average temperature for the three baseline trials at the end of instructions; and the null hypothesis (H_{o10}) is assumed.

TABLE VI

ANALYSIS OF VARIANCE FOR END OF INSTRUCTIONS AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS

Source	df	MS	F
Extraversion-Introversion (A)	1	44.067	2.38
Training Technique (B)	2	67.898	3.67*
AB	2	17.220	<1
Error	30	18.494	

F (1, 30 df) = 4.17 .05 level
F (2, 30 df) = 3.32 .05 level

The test of H_{o11} is summarized in Table VII. The I group and the E group did not differ significantly in the average temperature for trials 18-20 minus the average temperature for the three baseline trials at the end of the 90 second trial; and the null hypothesis (H_{o11}) is assumed.

The test of H_{o12} is summarized in Table VIII. The I group and the E group did not differ significantly in the average temperature between the end of the instructions and the end of the 90 second trial for trials 18-20 minus the baseline trials; and the null hypothesis (H_{o12})

is assumed.

TABLE VII

ANALYSIS OF VARIANCE FOR END OF 90 SECOND TRIALS AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS

Source	*df*	*MS*	*F*
Extraversion-Introversion (A)	1	44.556	2.19
Training Technique (B)	2	73.515	3.61*
AB	2	17.110	<1
Error	30	20.352	

F (1, 30 *df*) = 4.17 .05 level
F (2, 30 *df*) = 3.32 .05 level

TABLE VIII

ANALYSIS OF VARIANCE FOR AVERAGE TEMPERATURE BETWEEN END OF INSTRUCTIONS AND END OF TRIAL (90 SECOND PERIOD SAMPLED EVERY 6 SECONDS) AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS

Source	*df*	*MS*	*F*
Extraversion-Introversion (A)	1	37.291	1.93
Training Technique (B)	2	68.553	3.56*
AB	2	18.306	<1
Error	30	19.272	

F (1, 30 *df*) = 4.17 .05 level
F (2, 30 *df*) = 3.32 .05 level

The hypothesis that I scorers are superior to E scorers in ability to increase left forefinger temperature with the training techniques employed (C, NFB, FB) is not supported. A perusal of Table IX shows that the obtained means for the I and E groups on the four dependent variable measures are not in the predicted direction. On each dependent variable measures, with high variability for the E Ss than for the I Ss.

TABLE IX

I AND E GROUP MEANS AND STANDARD DEVIATIONS FOR EACH DEPENDENT VARIABLE TEMPERATURE MEASURE (AVERAGE FOR TRIALS 18-20 MINUS AVERAGE FOR BASELINE TRIALS)

DEPENDENT VARIABLE	MEAN I	MEAN E	STANDARD DEVIATION I	STANDARD DEVIATION E
Start of Instructions	.890	.778	4.023	6.201
End of Instructions	1.537	3.749	3.774	5.103
End of 90 Sec. Trial	1.772	3.997	3.758	6.652
Average Over 90 Sec. Trial	1.806	3.841	3.678	5.314

Figures 1 - 4 give a graphic presentation of the temperature change for E and I Ss on the four dependent variable measures. As illustrated in Figure 1, E Ss showed the highest temperature increase, while I Ss showed the greatest decrease on the "Start of Instructions" variable. The range of temperature change scores for E Ss was from -5.40 to 8.33 ^{o}F and for I Ss was from -8.17 to 5.97 ^{o}F. Eleven E Ss demonstrated a temperature increase and seven a decrease. Seven I Ss showed a temperature increase, one no change and ten a decrease.

As illustrated in Figure 2, E Ss showed the highest temperature increase, while E Ss and an I S showed the greatest temperature decrease on the "End of Instructions" variable. The range of temperature change scores for E Ss was from -4.77 to 12.85 °F and for I Ss was from -3.85 to 9.83 °F. Thirteen E Ss showed a temperature increase and five a decrease. Nine I Ss demonstrated a temperature increase and nine a decrease.

As illustrated in Figure 3, an E S showed the highest temperature increase and E Ss showed the greatest temperature decrease on the "End of 90 Second Trial" variable. The range of temperature change scores for E Ss was from -4.62 to 14.92 °F and for I Ss was from -3.22 to 9.88 °F. Fourteen E Ss demonstrated a temperature increase and four a decrease. Nine I Ss showed a temperature increase, one no change and eight a decrease.

As shown in Figure 4, an E S showed the highest temperature increase and E Ss showed the greatest temperature decrease on the "Average Over the 90 Second Trial" variable. The range of temperature change for E Ss was from -4.60 to 13.72 °F and for I Ss was from -2.95 to 9.85 °F. Thirteen E Ss demonstrated a temperature increase and five a decrease. Ten I Ss showed a temperature increase, and eight a decrease.

Null hypotheses (H_{o13}, H_{o14}, H_{o15}, H_{o16}) for research hypotheses H_{13}, H_{14}, H_{15}, and H_{16} on the four dependent variable temperature measures for the average of the last three training trials (trials 18-20) minus the average of the three baseline trials, were tested in separate 2 x 3 factorial designs, with α chosen at the .05 level.

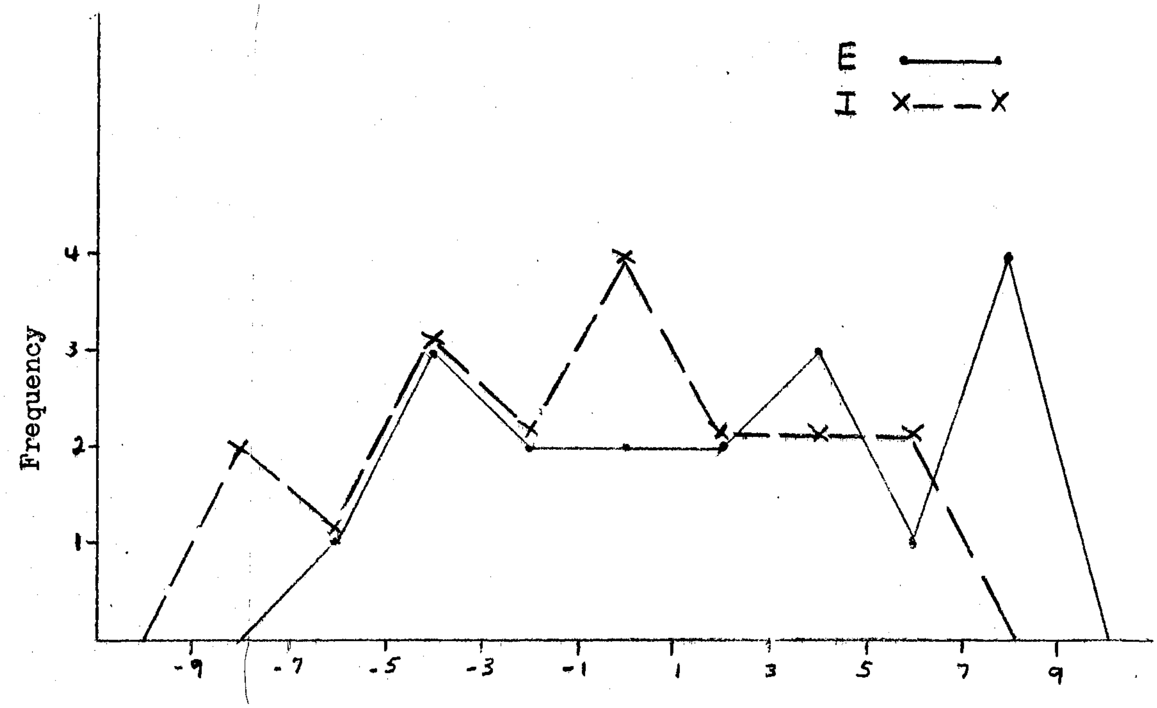

Figure 1. Fahrenheit Temperature Change for Start of Instructions for I and E Subjects

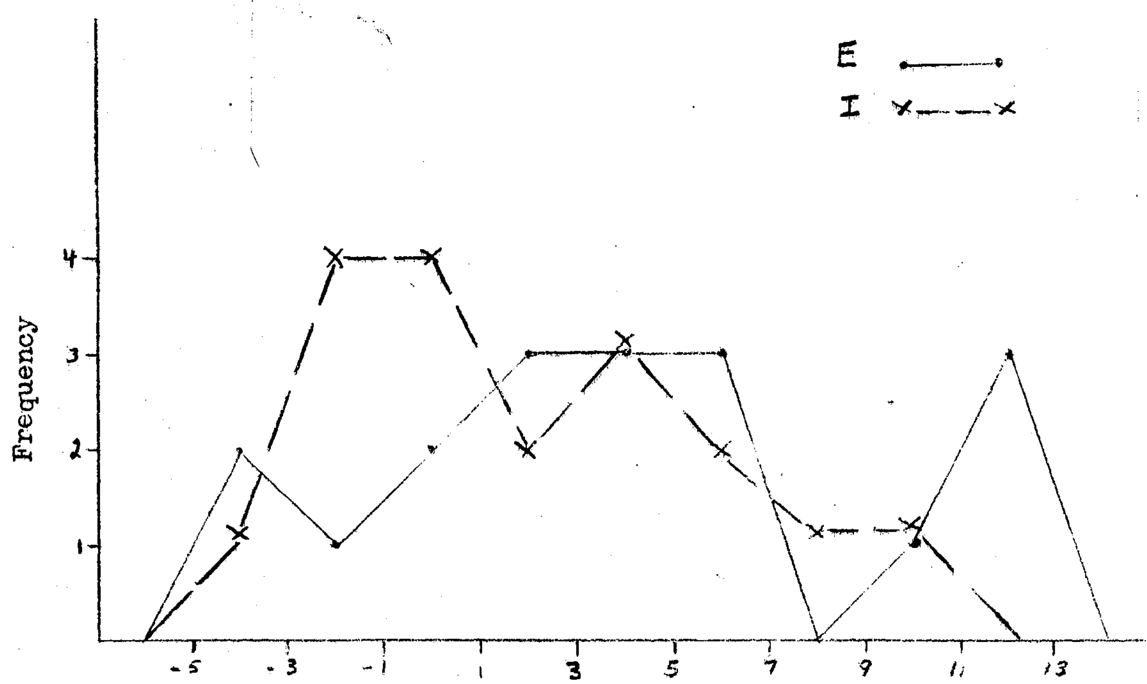

Figure 2. Fahrenheit Temperature Change for End of Instructions for I and E Subjects

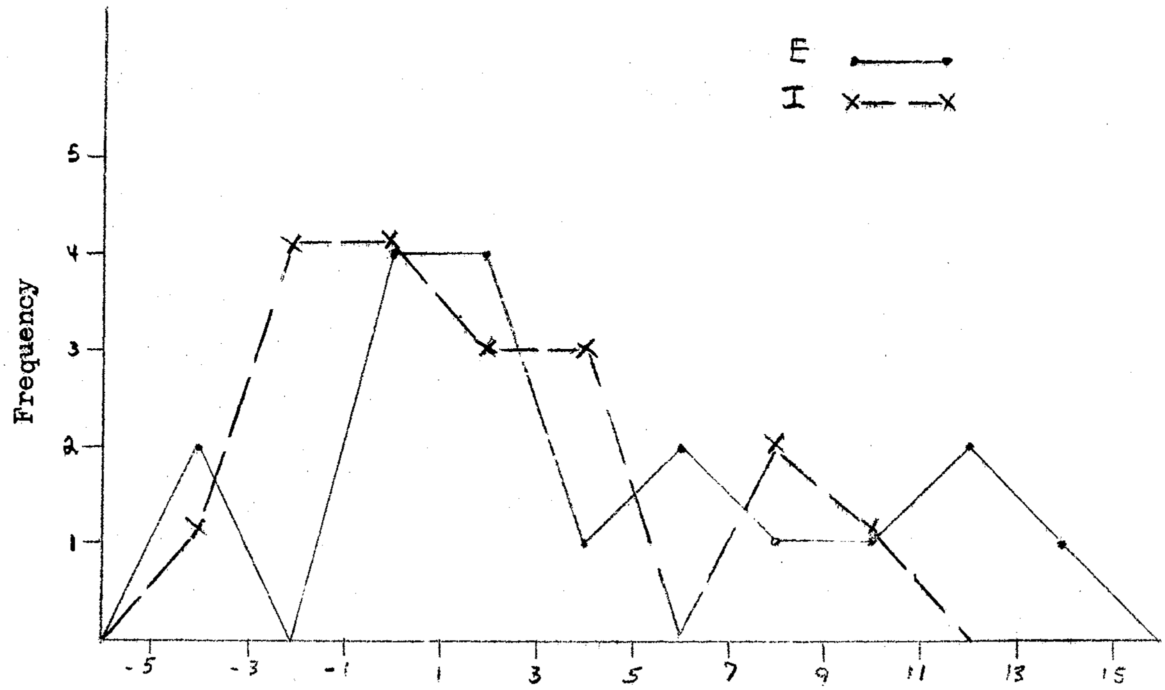

Figure 3: Fahrenheit Temperature Change for End of 90 Second Trial for I and E Subjects

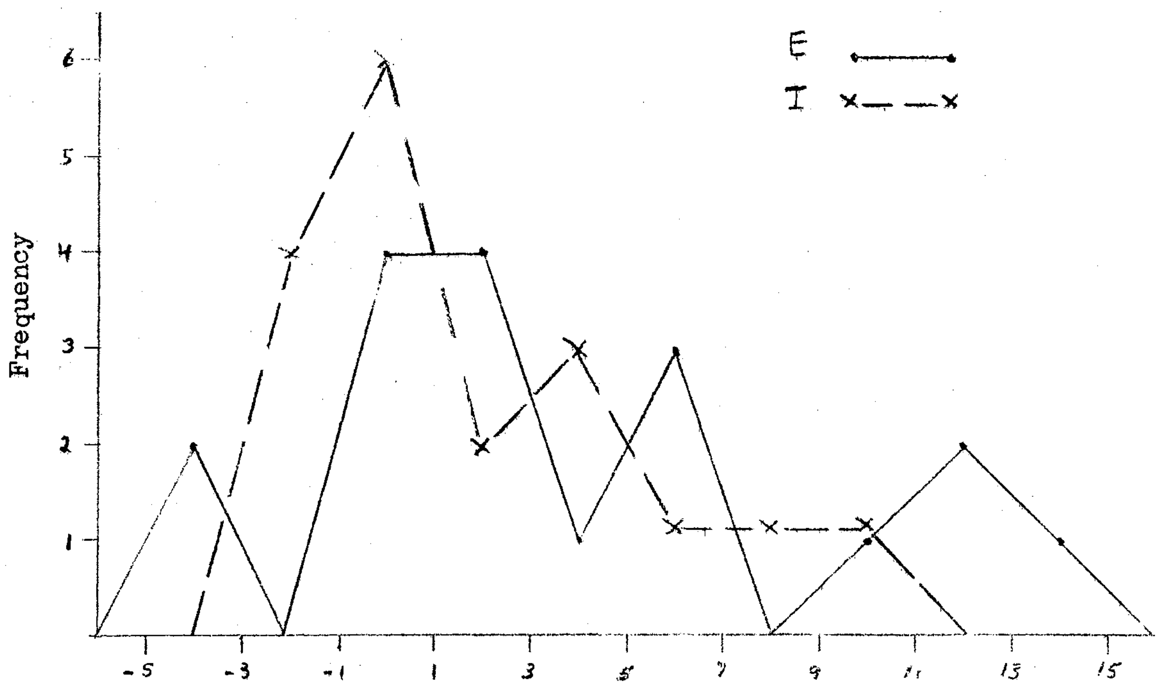

Figure 4. Fahrenheit Temperature Change for Average Over the 90 Second Trial for I and E Supjects

The test of H_{o13} is summarized in Table V. The C, NFB, and the FB groups did not differ significantly in the average temperature for trials 18-20 minus the average temperature for the three baseline trials at the beginning of instructions; and the null hypothesis (H_{o13}) is rejected.

The test of H_{o14} is summarized in Table VI. The C, NFB, and the FB groups differed significantly in the average temperature for trials 18-20 minus the average temperature for the three baseline trials at the end of instructions; and the null hypothesis (H_{o14}) is rejected.

The test of H_{o15} is summarized in Table VII. There was a significant difference in the average temperature for trials 18-20 minus the average temperature for the three baseline trials, at the end of the 90 second trial. The null hypothesis (H_{o15}) is rejected.

The test of H_{o16} is summarized in Table VIII. There was a significant difference in the average of the average temperature between the end of the instructions and the end of the 90 second trial for trials 18-20 minus the baseline trials; and the null hypothesis (H_{o16}) is rejected.

The research hypothesis that FB training is superior to NFB training and that both FB and NFB training are superior to C training for a person learning how to increase left forefinger temperature is partially supported by significant F ratios ($\alpha = .05$) on three of the four dependent variable measures. The nonsignificant F ratio for the start of instructions variable was in the predicted direction.

A perusal of Table X shows that the obtained means for the FB group were higher on all dependent variable measures than for the NFB and C groups and that on all but the start of instructions variable, the NFB means were higher than the C means. The standard deviations for the four dependent variables suggest fairly wide individual variability and consistently higher variability for FB Ss than for NFB Ss and consistently higher variability for NFB Ss than for C Ss.

TABLE X

C, NFB, AND FB GROUP MEANS AND STANDARD DEVIATIONS FOR EACH DEPENDENT VARIABLE TEMPERATURE MEASURE (AVERAGE OF TRIALS 18-20 MINUS AVERAGE FOR BASELINE TRIALS)

	MEAN			STANDARD DEVIATION		
DEPENDENT VARIABLE	C	NFB	FB	C	NFB	FB
Start of Instructions	.171	-2.470	1.243	2.998	4.538	5.010
End of Instructions	.641	2.016	5.273	2.654	4.304	5.217
End of 90 Sec. Trial	.424	2.856	5.374	2.397	4.349	6.797
Average Over 90 Sec. Trial	.573	2.564	5.332	2.465	4.677	5.5551

Figures 5 - 8 give a graphic presentation of the temperature change for C, NFB and FB Ss on the four dependent variable measures. As illustrated in Figure 5, FB Ss and a NFB S showed the highest temperature increase, while a NFB and a FB S showed the greatest temperature decrease on the "Start of Instructions" variable. The range of temperature change scores for C Ss was from -5.40 to 5.97 °F, for NFB Ss was from -7.26 to 7.32 °F and for FB Ss was from -8.17 to 8.33°F.

Five C Ss showed a temperature increase, one no change and six a decrease. Six NFB Ss demonstrated a temperature increase and six a decrease. Seven FB Ss showed a temperature increase and five a decrease.

As illustrated in Figure 6, FB Ss showed the highest temperature increase, while a C, a NFB and a FB S showed the greatest temperature decrease on the "End of Instructions" variable. The range of temperature change scores for C Ss was from -4.77 to 5.19 °F, for NFB Ss from -4.39 to 9.40 °F and for FB Ss from -3.85 to 12.85 °F. Seven C Ss demonstrated a temperature increase and five a decrease. Five NFB Ss showed a temperature increase and seven a decrease. Ten FB Ss showed a temperature increase and two a decrease.

As illustrated in Figure 7, A FB S showed the highest temperature increase and a C, a NFB and a FB S the greatest temperature decrease on the "End of 90 Second Trial" variable. The range of temperature change scores for C Ss was from -4.60 to 4.52 °F, for NFB Ss was from -4.62 to 9.75 °F and for FB Ss was from -3.22 to 14.92 °F. Six C Ss demonstrated a temperature increase, one no change and five a decrease. Eight NFB Ss showed a temperature increase and four a decrease. Nine FB Ss showed a temperature increase and three a decrease.

As illustrated in Figure 8, a FB S showed the highest temperature increase and a C and a NFB S the greatest temperature decrease on the "Average Over the 90 Second Trial" variable. The range of temperature change scores for C Ss was from -4.62 to 4.94 °F, for NFB Ss was from -4.35 to 9.73 °F and for FB Ss was from -2.95 to 13.72 °F. Six C Ss demonstrated a temperature increase and six a decrease. Eight NFB Ss showed a temperature increase and four a decrease. Nine FB Ss showed a temperature increase and three a decrease.

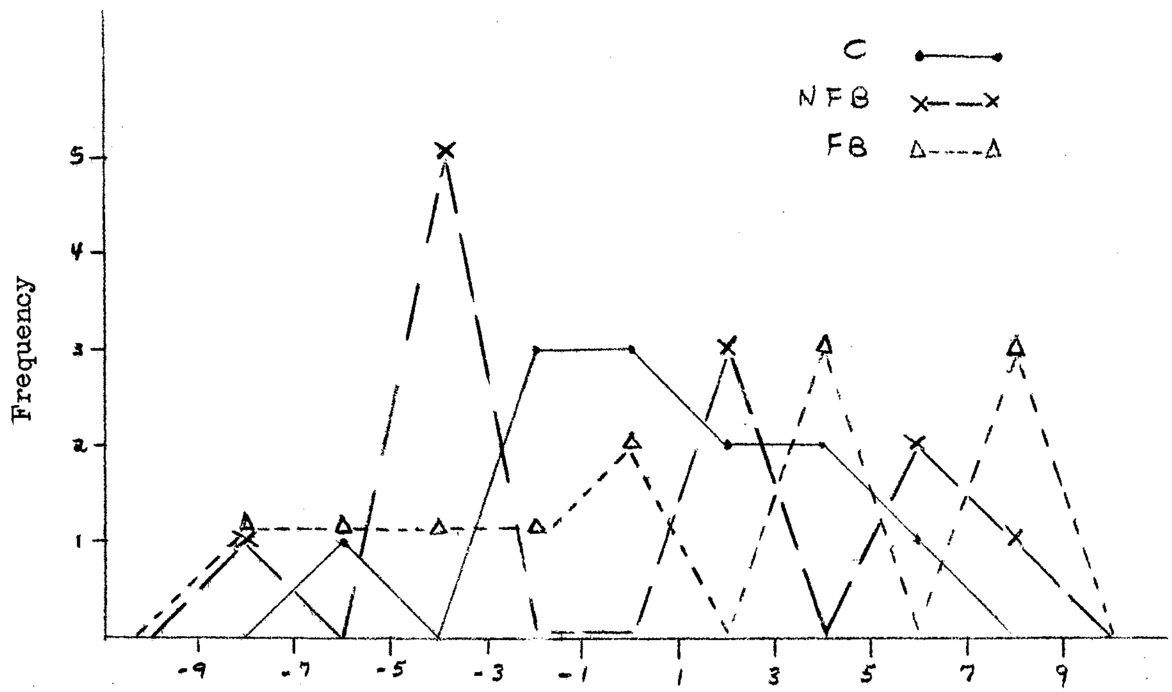

Figure 5. Fahrenheit Temperature Change for Beginning of Instructions for C, NFB and FB Subjects

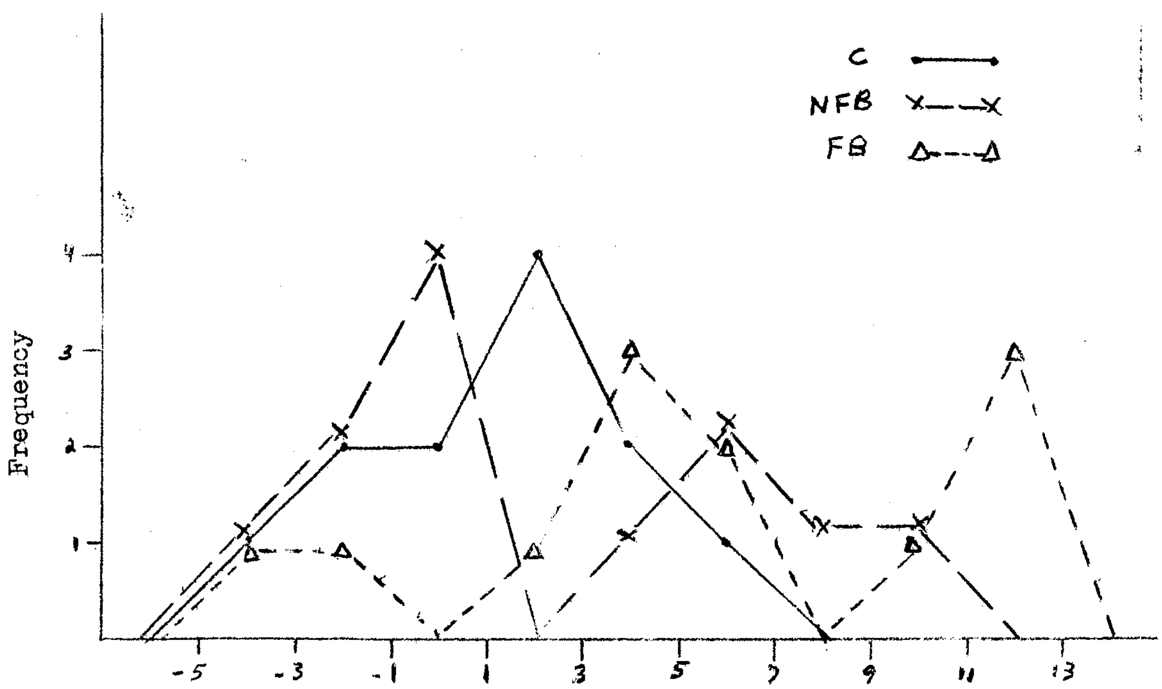

Figure 6. Fahrenheit Temperature Change for End of Instructions for C, NFB and FB Subjects

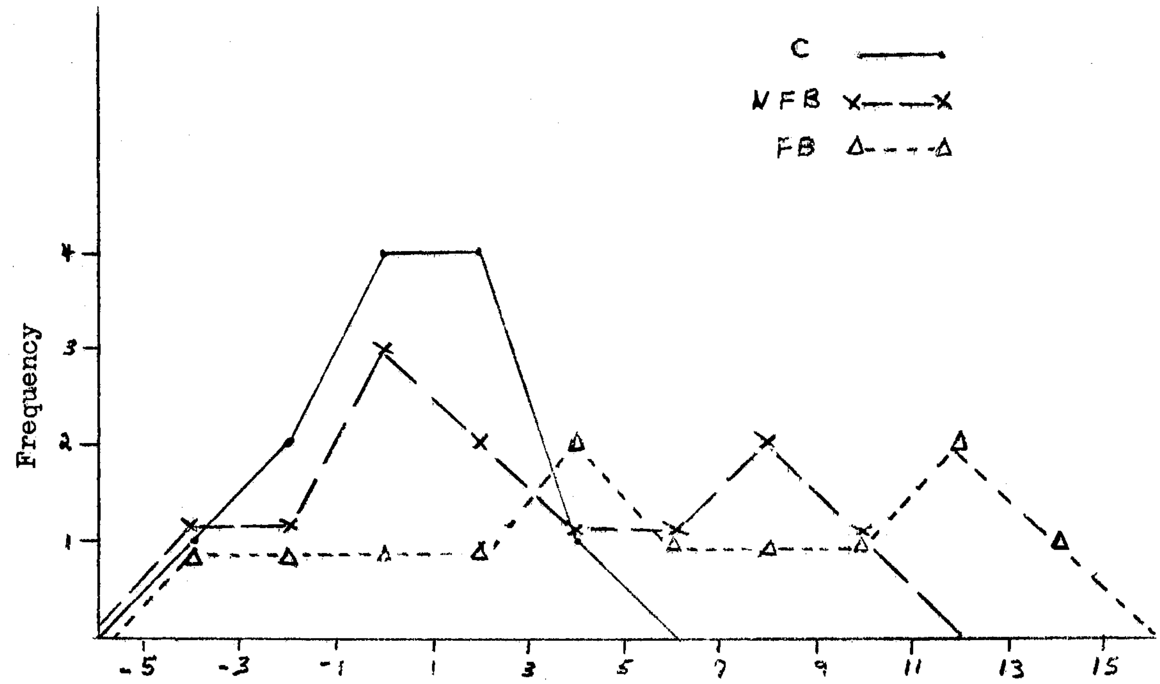

Figure 7. Fahrenheit Temperature Change for End of 90 Second Trial for C, NFB and FB Subjects

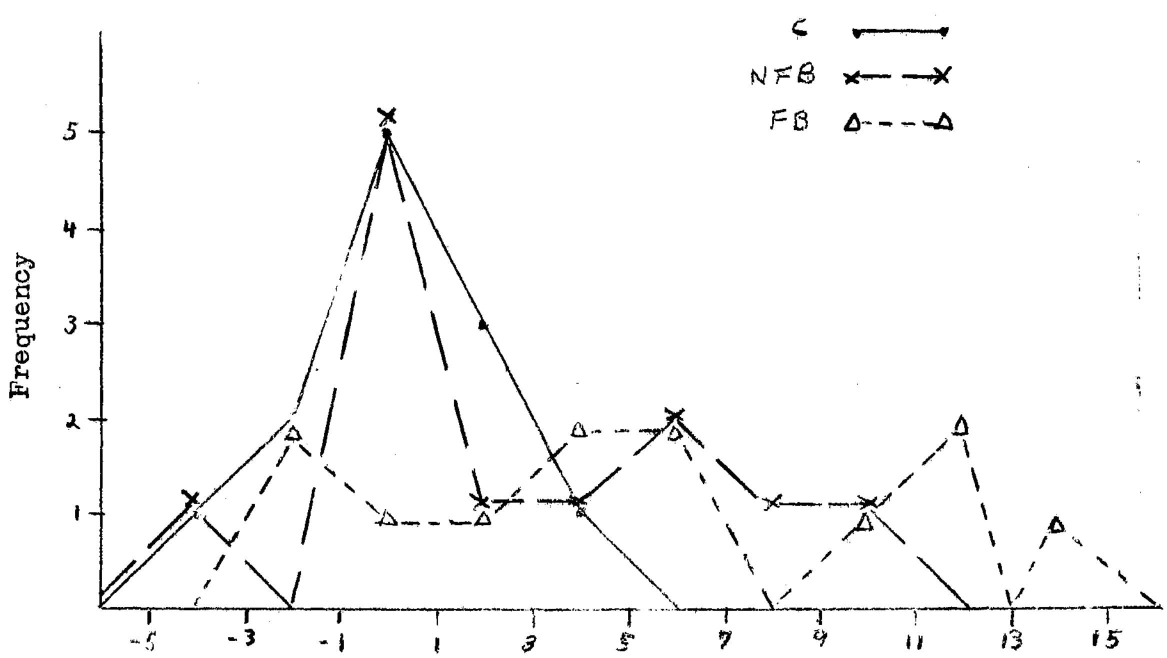

Figure 8. Fahrenheit Temperature Change for Average Over the 90 Second Trial for C, NFB and FB Subjects

Since experimental hypotheses H_{14}, H_{15}, and H_{16} were supported by significant *F* tests, orthogonal comparisons were made, with α chosen at the .05 level (Table XI). The null hypotheses and respective experimental hypotheses are:

$$H_{oa}\colon\ \tfrac{1}{2}\,(\bar{X}_{NFB}-\bar{X}_{FB}) = \bar{X}_{C}$$

$$H_{a}\colon\ \tfrac{1}{2}\,(\bar{X}_{NFB}+\bar{X}_{FB}) > \bar{X}_{C}$$

$$H_{ob}\colon\ \bar{X}_{NFB} = \bar{X}_{FB}$$

$$H_{b}\colon\ \bar{X}_{NFB} < \bar{X}_{FB}$$

The null hypotheses were assumed in all but one of the orthogonal comparisons. H_{oa} was rejected and H_{a} accepted for temperature change at the end of the 90 second trial. This one significant *t* test lends some support, though not strong support, for NFB and FB training to result in a *S*'s ability to increase left forefinger temperature, when compared to the C condition. However, FB training was not significantly different than NFB training in a *S*'s ability to increase left forefinger temperature.

Self-Report Hypotheses

For the questionnaire data, Kolmogorov-Smirnov (K-S) tests were run between those *Ss* who were I scorers (12 *Ss*) and those who were E scorers (12 *Ss*), in the FB and NFB groups (Appendix G, Table XIII).

In the stated hypotheses, "sample" refers to a cumulative frequency distribution, based on the frequency with which the *Ss* rated at each point on the five-point scale for trials 18-20. S_{ni} (x) is the cumulative frequency value. For the K-S tests, "N" is the number of observations for each group, not the number of *Ss* per group. A value of 12 = K_D (numerator of the largest difference between the cumulative frequency distributions) is required for significance at the .05 level. In all but one test for the I and E scorers, the H_o was assumed. For the test on the dimension "Left Arm Light - Left Arm Heavy," K_D = 13, and H_o was rejected and H_a accepted. The samples for I and E were drawn from populations which would vary in central location, and would vary in dispersion. Both I and E Ss most frequently rated "Left Arm Heavy," I scorers at point "4" and E scorers at point "5."

In all of the K-S tests comparing the FB and NFB groups (Appendix H, Table XIV), K_D values were <12, and H_o was assumed.

TABLE XI

PLANNED ORTHOGONAL COMPARISONS FOR C, NFB, GROUP MEANS FOR DEPENDENT VARIABLE MEASURES FOR AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS

DEPENDENT VARIABLE	ORTHOGONAL COMPARISON $\frac{1}{2}(\bar{X}_{NFB}+\bar{X}_{FB})-\bar{X}_C$	$s_{\bar{d}}$	t	ORTHOGONAL COMPARISON $\bar{X}_{FB} - \bar{X}_{NFB}$	$s_{\bar{d}}$	t
End of Instructions	3.003	1.963	1.529	.969	1.755	.552
End of 90 Sec. Trial	3.691	2.059	1.792*	1.025	1.842	<1
Average Over 90 Sec. Trial	3.375	2.004	1.684	2.768	1.793	1.543

t (30 df) = 1.697 .05 level (one-tailed)

The Neuroticism-Stability Dimension and A Re-examination of the Training Trials Data

Since the I-E Scale of the EPI did not prove to be a successful index for predicting a person's ability to learn to increase left forefinger temperature by the three training techniques employed in this study, on an a posteriori basis, data for the four dependent variable measures was arrayed according to the S-N scores on the EPI. The S Ss were defined as those whose scores on the S-N dimension were below the median score, and the N Ss as those whose scores on the S-N dimension were above the median. Null hypotheses and experimental hypotheses were as follows:

$$H_o: \bar{X}_S = \bar{X}_N$$

$$H: \bar{X}_S \neq \bar{X}_N$$

The two-tailed t test for unpaired observations (Steel & Torrie, 1960, Pp. 67-78) was used, with α chosen at the .05 level (Appendix I, Table XV). In no instance was the t test significant and H_o was assumed.

The Extraversion-Introversion and Neuroticism-Stability Dimensions and a Re-examination of the Training Trials Data

Since the experimental hypothesis that I scorers are superior to E scorers in ability to increase left forefinger temperature with the training techniques employed (C, NFB, FB) was not supported, and since an a posteriori evaluation of the dependent variable temperature measurers for the N-S Scale scores indicated a lack of relationship to ability to increase left forefinger temperature, and because of the exploratory nature of this study, it seemed it would be of value for future research to ascertain if there was an interactive effect between the Extraversion-Introversion and Neuroticism-Stability dimensions for the four dependent variable temperature measures. Data for the four dependent variable measures was arrayed for "zone analysis," as suggested by Furneaux (1961) into four quadrants formed by the E-I Scale scores and the N-S Scale scores, where the two dimensions intercepted at the E-I and N-S means for the sample of Ss for this study (Appendix J, Figure 11).

It was hypothesized that there would be a difference between Ss in the four quadrants (N-I, S-I, N-E, S-E) on the four dependent variable temperature measures.

$$H_o\colon\ X_{N-I} = X_{S-I} = X_{N-E} = X_{S-E}$$

$$H_a\colon\ X_{N-I} \neq X_{S-I} \neq X_{N-E} \neq X_{S-E}$$

Analysis of variance (AOV) tests were employed (Winer, 1962, Pp. 46-62) to test the null hypotheses, with α chosen at the .05 level.

Results of the F tests are summarized in Table XVI (Appendix K). For the "Start of Instructions" and "End of Instructions" temperature dependent variables, H_o was assumed. For the "End of 90 Second Trial" and the "Average Over 90 Second Trial" temperature dependent variables, H_o was rejected and H_a accepted.

Scheffé multiple comparison tests were calculated (Edwards, 1962, Pp. 154-156), with comparisons selected on an a posteriori basis after a perusal of the data, for the dependent variable measures which had resulted in a significant F. (For the Scheffé tests, A is the sum of squares for each comparison, and F' is the tabled F value multiplied by the treatment degrees of freedom.) An α level of .10 was chosen for all comparisons, as Scheffé tests are conservative relative to Type I errors (Winer, 1962, P. 89).

Table XVII (Appendix L) summarizes the Scheffé comparisons for the "End of the 90 Second Trial" dependent variable. For seven of the ten comparisons, H_o was assumed. For three of the comparisons, H_o was rejected in favor of H_a, i.e., $\bar{X}_{S-E} > \bar{X}_{S-I}$; $\bar{X}_{S-E} + \bar{X}_{N-I} > \bar{X}_{S-I}$; and, $\bar{X}_{S-E} + \bar{X}_{N-E} + \bar{X}_{N-I} > \bar{X}_{S-I}$. Ss in the S-I quadrant showed significantly less temperature increase for the "End of the 90 Second Trial" temperature dependent variable than Ss in the S-E quadrant. Ss in the S-I quadrant showed significantly less temperature increase than the Ss in the two quadrants (S-E and N-I); and the S-I Ss showed significantly less temperature increase than the Ss in the three other quadrants (S-E, N-E, N-I).

Table XVIII (Appendix M) summarizes the Scheffé comparisons for the "Average Temperature Over the 90 Second Trial" dependent variable. For eight of the ten comparisons, H_o was assumed. For two of the comparisons, H_o was rejected in favor of H_a, i.e., $\bar{X}_{S-E} + \bar{X}_{N-E} > \bar{X}_{S-I}$; and, $\bar{X}_{S-E} + \bar{X}_{N-E} + \bar{X}_{N-I} > \bar{X}_{S-I}$. Ss in the S-I quadrant showed significantly less temperature increase for the "Average Temperature Over the 90 Second Trial" dependent variable than Ss in the two quadrants (S-E and N-E); and the S-I Ss showed significantly less temperature increase than the Ss in the three other quadrants (S-E, N-E, N-I).

There appears to be a relationship between EPI scores and ability to increase left forefinger temperature with the training techniques employed (C, NFB, FB), but not when only E-I or only N-S scores are considered. Rather, these a posteriori findings suggest the importance of taking into account a S's placement in one of the four quadrants N-I, S-I, N-E, S-E).

Means and standard deviations for the four temperature dependent variable measures, when Ss were grouped into the four quadrants are presented in Table XIX (Appendix N). On all four dependent variable measures, the S-E mean temperature increase was higher than N-E, which was higher than N-I, which was higher than S-I.

Figures 12 - 15 (Appendixes O, P, Q, R respectively) give a graphic presentation of the temperature change scores for Ss in the N-I, S-I, N-E and S-E quadrants for the four dependent variable measures. As illustrated in Figure 12 (Appendix O), Ss in the N-E and S-E quadrants demonstrated the highest temperature increase while Ss in the S-I quadrant showed the greatest decrease on the "Start of Instructions" variable. The range of temperature change scores for N-I Ss was from -4.26 to 5.97 ^{o}F, for S-I Ss was from -8.17 to 3.87 ^{o}F, for N-E Ss was from -5.40 to 8.33 ^{o}F, and for S-E Ss was from -3.48 to 7.98 ^{o}F. Four N-I Ss demonstrated a temperature increase and five a decrease. Three S-I Ss showed a temperature increase, one no change and five a decrease. Five N-E Ss demonstrated a temperature increase and four a decrease. Seven S-E Ss showed a temperature increase and two a decrease.

As illustrated in Figure 13 (Appendix P), Ss in the N-E quadrant and an S-E S showed the highest temperature increase while an S-I and an N-E S showed the greatest temperature decrease, on the "End of Instructions" variable. The range of temperature change scores for N-I Ss was from -2.50 to 9.83 ^{o}F, for S-I Ss was from -3.85 to 6.76 ^{o}F, for N-E Ss was from -4.77 to 12.04 ^{o}F and for S-E Ss was from -1.30 to

12.85 °F. Five N-I Ss showed a temperature increase and four a decrease. Four S-I Ss showed a temperature increase and five a decrease. Seven N-E Ss demonstrated a temperature increase and two a decrease. Seven S-E Ss showed a temperature increase and two a decrease.

As illustrated in Figure 14 (Appendix Q), an N-E S showed the highest temperature increase while an S-I and an N-E S showed the greatest decrease on the "End of 90 Second Trial" variable. The range of temperature change scores for N-I Ss was from -2.00 to 9.88 °F, for S-I Ss was from -3.22 to 7.63 °F, for N-E Ss was from -4.60 to 14.92 °F and for S-E Ss was from -0.55 to 11.93 °F. Six N-I Ss showed a temperature increase and three a decrease. Three S-I Ss showed a temperature increase, one no change and five a decrease. Seven N-E Ss showed a temperature increase and two a decrease. Eight S-E Ss showed a temperature increase and one a decrease.

As shown in Figure 15 (Appendix R), an N-E Ss demonstrated the highest temperature increase and the greatest decrease. The range of temperature change scores for N-I Ss was from -2.01 to 9.85 °F, for S-I Ss was from -2.95 to 6.91 °F, for N-E Ss was from -4.62 to 13.72 °F and for S-E Ss was from -0.80 to 12.87 °F. Six N-I Ss demonstrated a temperature increase and three a decrease. Four S-I Ss demonstrated an increase and five a decrease. Seven N-E Ss showed an increase and two a decrease. Seven S-E Ss demonstrated an increase and two a decrease.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

The organization of this chaper will deal first with the research findings of the present study concerning the prognostic value of the EPI E-I scale as an index of whether an individual would be expected to profit from AT and biofeedback procedures, specifically those employed in this study for skin temperature training. The possible interactive effects of the E-I and N-S scales in research studies will then be considered. The importance of personality and/or situational variables in AT and biofeedback research will then be discussed. The effects of the relaxation, AT and biofeedback procedures employed in this current study will then be considered, followed by a discussion of the common features of these and other techniques. The last topic will concern the self ratings of experiential states, as employed in this study, and problems presented in the attempted measurement of experiential states.

The Extraversion-Introversion Scale as a Prognostic Index for Autogenic Training and Biofeedback Procedures

The primary research hypothesis of this study that introverts show a greater increase in left forefinger temperature than extraverts with relaxation, AT and biofeedback training, was not supported. In fact, for this particular sample, the extraverts' average left forefinger temperature exceeded that of the introverts on the dependent variable measures, but not significantly so. Extraverts were also more variable in their temperature performance.

More E Ss showed a temperature increase than a decrease on all four dependent variable measures (Figures 1, 2, 3, 4), while more I Ss showed a temperature increase than a decrease on the "End of 90 Second Trial" variable (Figure 3) and the "Average Over the 90 Second Trial" variable (Figure 4). The highest temperature increase was demonstrated by E Ss on all four dependent variables.

While it appears from the research findings that the E-I scale has limited predictive value for whether a person will benefit from the AT and biofeedback procedures employed in this study, a question which arises is whether there were any peculiar characteristics of the sample of Ss which biased the research findings. E and I scorers showed negligible differences in L scores (mean = 3.11, SD = 1.52 for I scorers; and mean = 2.83, SD = 1.42 for E scorers). The E and I scorers also showed little variability in age (mean = 40.06 yr., SD = 10.30 for I scorers; and mean = 36.28 yr., SD = 10.52 for E scorers). Also an $r = -.028$ between the E-I and N-S scores indicated independence for this particular sample. The potential S pool consisted of returned EPI protocals within the upper and lower 30%. When compared with Percentile Norms for American College Students, for Forms A and B Combined of the EPI (H. J. Eysenck & S.B.G. Eysenck, 1968), the highest I S in the sample had a score of 21 (19th percentile), while the lowest E S in the sample had a score of 28 (50th percentile). The lowest I scorer was at the 1st percentile, while the highest E scorer was only at the 84th percentile. While no solid conclusions can be made from a comparison with this normative sample, the possibility of some bias in the sample might be entertained. The sample did not contain any exceptionally high E scorers, in comparison to exceptionally low I scorers.

The EPI test authors (H. J. Eysenck & S.B.G. Eysenck, 1968) have stressed the importance of selecting only very high E scorers and very low I scorers for research purposes, although they are not explicit. However, if a procedural difference had been followed in this study, eg., only the upper and lower 10% of returned EPI protocals had been included in the potential S pool, and significant results had been obtained, on a pragmatic basis, the E-I scale would seem to be of limited predictive value. If a testing instrument has predictive value for only extreme cases, it would only serve as a gross screening device. To be of value, the E-I scale would have to have predictive value for the individual case. Stephenson (1965), in a critique of the MPI, has offered the criticism that a scale based on R-methodology can not indicate the dynamic conditions which are professed by H. J. Eysenck, but is actually a measure of behavior "in the general context." If the EPI lacks predictive value for the individual case in the clinical setting, it might not prove useful for the purpose intended in this study, i.e., predicting success in AT and biofeedback training.

Another facet to be considered is the parameters involved in "conditionability." While H. J. Eysenck (1967) cites numerous research findings in support of the greater "conditionability" of Is over Es, H. J. Eysenck (1966) himself has indicated that it is meaningless to compare groups of individuals on a test of conditioning unless parameters are precisely specified. He has demonstrated that parameters can be selected in which Es condition better than Is, eg., in eyeblink conditioning, a short CS-UCS interval, a strong UCS and 100% reinforcement favor "conditionability" of Es. Levey (1967) also varied the parameters of partial versus continuous reinforcement, weak versus strong UCS, and short versus long CS-UCS interval in an eyeblink conditioning experiment. With a sample of 144 males, when results were averaged over all three parameters, Es were found to condition better with continuous reinforcement, a strong UCS and a long CS-UCS interval. Hence, Eysenck (1966) suggests that if individual differences are the subject matter of an experiment, the parameters must be chosen in accordance with a specific theory.

Rather than discard the usefulness of the EPI for AT and biofeedback, however, it was decided to explore the data further strictly on a post hoc basis, with future research in mind. While it was not hypothesized whether N scorers or S scorers would perform better on the four dependent variable temperature measures, since the E-I scale had proved to have no predictive value, it seemed possible there might be a significant difference in N and S Ss. Since no significant difference was indicated between N and S Ss, it might be surmised that neither the E-I or N-S scale would have any predictive value for success in AT or biofeedback training.

The Interactive Effects of Extraversion-Introversion and Neuroticism-Stability

It occurred that one further post hoc investigation of the training trials data might prove fruitful for future research hypotheses.

While extraversion-introversion and neuroticism-stability are conceptually and empirically independent dimensions, an individual's E-I and N-S test scores place him in a position in a test space as marked off by Cartesian coordinates (Appendix J, Figure 11). In experimental design, then, it might be of importance to consider the person's position in the test space, i.e., which of the four quadrants (N-I, S-I, N-E, S-E) he occupies. While there is a wealth of research in the literature testing hypotheses involving only the extraversion-introversion dimension or the neuroticism-stability dimension, as measured by the MPI or EPI, for some research purposes the possibility of an interactive effect between E-I and N-S could prove to be crucial. Only a limited number of studies involving hypnotic induction and/or relaxation training have involved H. J. Eysenck's four-fold classification (Furneaux & Gibson, 1961, Hilgard & Bentler, 1963, Paul, 1969a).

In the current study, with the data of the four dependent variable measures regrouped into the four quadrants, the hypothesis was not tested as to which quadrant would have Ss showing the greatest temperature increase, but on a post hoc basis, the data was reanalyzed for hypotheses-seeking purposes. The nonsignificant F test for the "Start of Instructions" dependent variable is interpreted to mean that there was not a difference between Ss in the four quadrants in the "set" with which they began the training sessions. The nonsignificant F test for the "End of Instructions" dependent variable seems to indicate that the Ss within the four quadrants recieved the instruction "set" comparably. The two significant F tests for the "End of the 90 Second Trial" and "Average Over the 90 Second Trial" dependent variable measures are an interesting finding. Evidently there is a difference in how the S performs (increases finger temperature) depending on which quadrant she occupies. On all four dependent variable measures, more S-I Ss demonstrated a temperature decrease than an increase (Figures 12, 13, 14, 15, Appendixes O, P, Q, R respectively), suggesting some individual characteristic(s) of the S-I Ss, which makes them less receptive to the training techniques employed in this study for producing increased left forefinger temperature, as more N-I, N-E and S-E Ss demonstrated a temperature increase than a decrease (Figures 12, 13, 14, 15, Appendixes O, P, Q, R respectively). One exception was that more N-I Ss showed temperature increase than decrease on the "Start of Instructions" variable (Figure 12, Appendix O). While generalizations are not made beyond this immediate sample because of the post hoc nature of this data analysis, the findings with the Scheffé multiple comparisons test might suggest the following hypothesis for future test. Es will increase left forefinger temperature better than Is with AT and biofeedback procedures, with S-Es expected to do better than N-Es; however, for Is, N-Is are expected to do better than S-Is. If the above hypothesis was not supported, the Scheffé tests of this current study might be interpreted to just reflect some peculiarity of this particular sample. Evans (1963) has stressed the merit of determining various interactions between relevant variables on the representative sample before studying samples selected on one or both of the MPI dimensions, a point to be kept in mind for future research.

Predicting from a Hullian type of model, Furneaux (1961) reanalyzed data from a study by Furneaux and Gibson (1961), involving body sway as an index of hypnotic induction. While the experimental findings themselves are not directly relevant to the present study, his use of the Yerkes-Dodson Law (Broadhurst, 1959) suggests possibilities of hypotheses which could be explored relative to AT and biofeedback. Furneaux (1961) reasoned that the extravert has a strong and continuing set to attend to stimuli associated with the activities of other people, and, hence, interpersonal situations lead him to enter states of high drive. A combination of high N and strong drive production in the E through interpersonal relations with the E in the suggestibility tests put N-E beyond the optimum drive level, and thus make him little suggestible. S-I, being low in drive and not motivated highly by interpersonal stimuli, would be below the optimal drive level. S-Es and N-Is would be expected to be intermediate relative to drive and consequently on body sway.

If an hypothesis was made in line with Furneaux's (1961) reasoning, with the task being left forefinger temperature rather than body sway, predictions would be as illustrated in Figure 9.

If the experimental situation was an impersonal one, it might be reasoned that the introvert has a strong and continuing set to attend to stimuli not associated with other people, and that impersonal situations would lead him to enter states of high drive. A combination of high N and strong drive produced in the I in an impersonal situation, puts N-I beyond the optimal drive level, and leads to little left forefinger temperature increase. S-E being low in drive and not motivated by the impersonal stimuli, would be below the optimal drive level. S-Is and N-Es would be expected to be intermediate relative to drive and relative to left forefinger temperature increase, as illustrated in Figure 10.

While it could be argued that the experimental situation in the

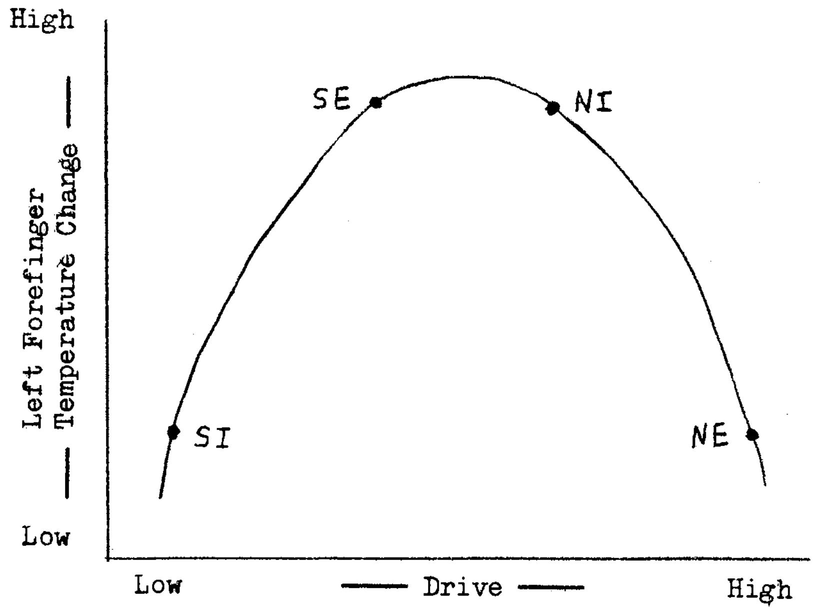

Figure 9. Left Forefinger Temperature as a Function of Drive and H. J. Eysenck's Personality Dimensions (Interpersonal Situation)

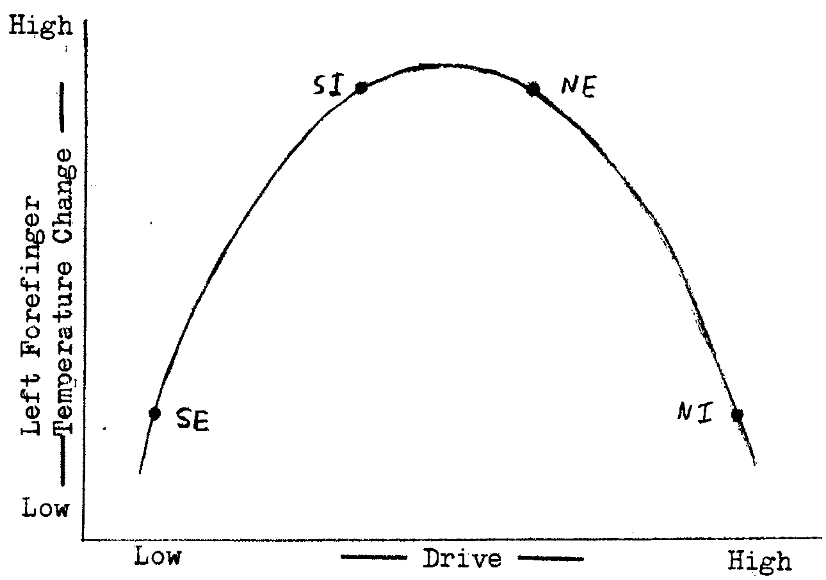

Figure 10. Left Forefinger Temperature as a Function of Drive and H. J. Eysenck's Personality Dimensions (Impersonal Situation)

current investigation is "impersonal" in that instructions were tape-recorded, the possibility of some confounding effect might be considered, i.e., I Ss might have a different motivational "set" than E Ss provided by the relationship of the S to the E throughout the course of the training trials. An important experiment would be one in which the E influence in AT and biofeedback training could be assessed.

While research hypotheses seem fruitful with H. J. Eysenck's four-fold classification, one study by Paul (1969a) did not result in significant differences in cognitive and physiological responsiveness to relaxation training, hypnotically-induced relaxation, or a self-control procedure in N-E, N-I, S-E, or S-I Ss. In this study, 60 Ss covering the range of scores on the E-I and N-S scales of the EPI were the sample.

After motivational instructions, the Ss sat quietly with their eyes open for a 10 minute silent adaptation period (last minute for basal physiological measures of heart rate, respiratiory rate, forearm muscle tension and skin conductance). The 20 Ss assigned to the relaxation group received abbreviated progressive relaxation training; 20 Ss received hypnotic induction emphasizing suggestions of heaviness, drowsiness, relaxation and sleep, and 20 Ss in the control group were instructed to close their eyes and relax. The second session was the same, with stressful imagery. Neither the four-fold classification or the E-I and N-S scales, independently, had a significant relationship to cognitive and physiological responsiveness.

The Importance of Personality and/or Situational Variables in Autogenic Training and Biofeedback Research

Barber (1964) has discussed the inconclusive, and often contradictory, results of studies relating personality variables, eg., extraversion-introversion as measured by the MPI or EPI, to relaxation training, hypnotic induction, etc. He contends that individual differences in response to suggestions (in hypnotic induction) are more often largely a function of situational variables than enduring personality characteristics.

While Barber (1964) is interested specifically in hypnosis, his criticisms related to experimental findings with hypnosis seem to have applicability to AT and biofeedback training. He reports that various studies have shown that "suggestibility" varies with the S-E relationship, and that a S who is suggestible with one E sometimes proves to be unsuggestible with another E. In the current study it is hard to assess the E effect. While instructions were tape-recorded, and hence the experimental situation could be described as an impersonal one, there was still some one-to-one interaction between the Ss and the E. A study could be designed to assess the E effect with AT and biofeedback procedures, where the E was not present in the experimental room for one group but present for another group.

Another important situational variable in hypnotic induction, with applicability to AT and biofeedback is the instructional "set" given to an S (Barber, 1964). It has been demonstrated that if a S is told certain physiological changes will occur, eg., heart acceleration, salivary secretion rate, these functions can be influenced directly or indirectly for Ss under hypnotic induction or in an awake state (Barber, 1965). In the current study, the instructional "set" for all Ss was that they could "become much more relaxed," with the additional instructional "set" that "it is possible to make that finger (left forefinger) become pleasantly warmer by the same way that you relax," for NFB and FB Ss. To illustrate subtle differences in instructional "set," very different results might have been obtained if the Ss were told "you will become more relaxed" or "your finger will become warmer." In the present experiment, the instructions left the "control" with the S.

Another situational factor, not necessarily independent of the E variable is relevant to extrinsic versus intrinsic reward, eg., approval from the E based on voice tone and inflection (Barber, 1965). There might also be an interactive effect between personality variables and extrinsic and intrinsic rewards. For example, the extravert might be expected to be more receptive to extrinsic reward, while the introvert might be more receptive to intrinsic reward.

Effects of Relaxation, Autogenic Training and Biofeedback Training on Left Forefinger Temperature

The Ss in the C, NFB and FB groups evidently did not enter the training sessions with different "sets" relative to temperature increase, as evidenced by the nonsignificant F test for the "Start of Instructions" dependent variable. There appears to be partial support for the research hypothesis, to the extent that the three conditions, C, NFB and FB produced different effects in temperature increase; however, the differential effects were not very large in magnitude. The unsupported part of the research hypothesis was that FB was not found to be superior to NFB in developing left forefinger temperature increase. The inference to be drawn from these findings is that AT and biofeedback procedures may prove to be comparable in their ability to bring about changes in physiological processes considered to be under control of the autonomic nervous system, eg., skin temperature, heart rate, etc.

The highest temperature increase was demonstrated by FB Ss on all four of the dependent variable measures (Figures 5, 6, 7, 8) with more FB Ss showing temperature increase than a decrease. The C Ss showed more temperature decrease than increase on the "Start of Instructions" variable (Figure 5) while the NFB Ss showed more temperature decrease than increase on the "End of Instructions" variable (Figure 6).

One point worthy of note is a statement from Green, et al. (1967): "It should be noted that a subject who exhibits no temperature change during an attempted manipulation of temperature is actually achieving a measure of success because the usual response to volition is a decrement." Such a S is considered to be "demonstrating a balance between active and passive processes." If this is the case, all of the techniques employed in the present study would be judged to be effective, in that C, NFB and FB Ss all showed temperature increase.

One question which warrants experimental investigation, based on the Reid and Curtsinger (1968) finding that oral temperature, as well as forehead, hand, and chest temperature increased under neutral hypnosis, is whether left forefinger temperature increases as an individual relaxes, even when the AT and biofeedback training focuses on bodily functions other than temperature. Since the C Ss in this study also showed temperature increase, it seems likely that left forefinger temperature might increase with various techniques, eg., AT, muscle relaxation, hypnotic induction, biofeedback procedures, etc.

Two research studies have some relevance to the training techniques employed in this current investigation. Barber and Hahn (1963) gave 12 Ss in a "hypnotic induction" group 20 minutes of suggestions of relaxation, drowsiness and sleep. Three groups of control Ss (12 per group) were instructed to sit quietly for 20 minutes while various physiological measures were taken. Hypnotic induction was no more effective in producing relaxation as indicated by reduction in heart rate, respiratory rate and palmar conductance than control instructions. It was concluded that "relaxation," "hypersuggestibility" and other effects historically associated with the word "hypnosis" can be produced by suggestions given Ss who receive "hypnotic induction" or by simple relaxation instructions to a control group. The relevance to the current study seems to be that two apparently different techniques may accomplish the same effect, eg., AT and biofeedback may both accomplish the same effect, eg., AT and biofeedback may both accomplish left forefinger temperature increase comparably.

Paul (1969b) views the major difference between relaxation training and hypnotic induction to be in the focus and affects involved in tension and release of gross muscle groups, defining the task as a "passive" learning situation in which the S gains control rather than a "hypnotic" situation implying operator control and use of indirect suggestions of warmth, relaxation, etc., with instructions to maintain alertness rather than a direct suggestion of relaxation, drowsiness and sleep. In this respect, the C, NFB and FB conditions of this study would have more similarity to the "passive" learning situation of relaxation training.

Paul (1969b) used three groups of 20 each, undergraduate Ss. They received: (a) abbreviated progressive relaxation training as used in systematic desensitization therapy; (2) hypnotic induction emphasizing direct suggestions of relaxation, heaviness, warmth, drowsiness and sleep; or, (3) a selfrelaxation control procedure, as in the Paul (1969a) study.

Relaxation training and hypnotic suggestion were effective in reducing subjective reports of tension and distress within one session. By the second session (a week later), hypnotic suggestion produced significantly greater decreases in physiological arousal than controls, measured by changes in heart rate, muscle tension, and respiratory rate. Relaxation training resulted in greater decreases than the control condition on all physiological measures the first session and maintained the second session. Relaxation training produced significantly greater reductions than hypnotic suggestion in systems not under direct voluntary control (heart rate, tonic muscle tension) in both sessions. The relevance of this finding to the current study is that "passive" motivational sets as provided to the C, NFB and FB groups in the current study might all be expected to bring about change in physiological processes not under direct voluntary control, eg., skin temperature.

Common Features and Dissimilar Features of the Training Procedures

Gillman and Brenman (1959) have discussed common features in all standard hypnotic induction techniques. All of these techniques: (a) place extensive limits on sensory intake; (b) limit bodily activity; (c) restrict attention; (d) provide narrow and monotonous stimulation; and, (e) alter the quality of bodily awareness. These features would also seem to apply to AT and biofeedback procedures as employed in this study.

The C, NFB and FB conditions all placed limits on sensory intake in that the experimental room was darkened and there was minimal auditory stimulation, eg., noise. In all conditions, C, NFB and FB, bodily activity was limited as the Ss were in a reclining position.

With regard to restricted attention and narrow and monotonous stimulation, it seems there was some variability in the techniques provided by different instructional "sets." In the NFB group, the technique for temperature increase relied on relaxation and imagery, eg., "warmth," while added information provided by the needle reading of the meter was available to the FB S. C Ss had no instructional "set" about temperature increase.

It was observed by the E that one difference was possible for C and NFB Ss in comparison to FB Ss. C and NFB Ss could close their eyes, while the FB Ss eyes had to remain open to focus on the temperature meter. That many C and NFB Ss did close their eyes was noted by the E, but not measured. Barber (1965) has indicated that the "eyes-closed recumbent position adopted by the S during the hypnosis session" has not been satisfactorily assessed as an experimental variable. Likewise, "eyes closed" could be a significant factor in comparisons between AT and biofeedback.

With regard to altering the quality of bodily awareness, through instructional "set," all conditions, C, NFB and FB focused the S's attention on bodily awareness.

One other difference seems notable, while C, NFB and FB all place focus on awareness of internal processes, the FB S must keep some focus on a source of external stimulation, the feedback meter. A methodological improvement could be the use of a visual or auditory signal which would not require such persistent attending. However, the temperature meter does provide the S with feedback of fine gradations of change. The main point being made here is that feedback, itself, is a source of stimulation.

That the NFB and FB S filled out a questionnaire, could have provided them a "set" to focus more attention on bodily awareness during the training trials, than C Ss.

Self Ratings of Experiential States

The questionnaire filled out by each NFB and FB S at the end of each of the training sessions was included in the procedure for empirical, hypothesis-seeking purposes. Key words and phrases used in the tape-recorded instructions were used for six of the eight ratings. While two of the ratings ("Breathing Regular—Breathing Irregular;" and "Relaxed—Tense") also had application to the C group, the C Ss were not asked to fill out the questionnaire, as some of the ratings dealt directly with temperature, eg., "Finger Cool—Finger Warm." From the statistical analysis of the questionnaire ratings, it might be concluded that they were of limited value. However, a perusal of the frequency data reveals that most of the ratings were in the direction which would be expected from the "set" provided by the tape-recorded instructions. In the comparisons of NFB and FB Ss, and the comparisons for I and E Ss, ratings were in the direction of "Serene," "Relaxed," "Finger Warm," "Concentrated on Instructions," "Arm Heavy," and "Breathing Regular." For "Forehead Cool—Forehead Warm" most Ss rated at the middle point. The one finding which was not expected, given the "set" from the tape-recorded instructions is that most Ss rated in the direction of "Sleepy" rather than "Alert."

For future research purposes, investigation of experiential states might take into account that NFB Ss might be able to more readily focus on experiential states because they do not have the external distraction provided by the feedback meter, as FB Ss do. Also, differences in experiential states of I and E Ss could be further investigated, with one possible prediction being that Is might be expected to be more "tuned in" to sources of internal stimulation while the "stimulus-seeking" E would be more "tuned in" to external sources of stimulation.

In the current behavioristic Zeitgeist the exploration of experential states is an untaped area of investigation in psychology. It seems there is practical importance to recognize the heuristic value of phenomenal reports in new perceptual areas eg., biofeedback research, by persons capable of discriminating experiential reports. With the recent interest in biofeedback research in psychology, hopefully there will be an attempt to identify experiential dimensions adequate for specification of events at the level of complexity of the actual situations.

Psychologists who would have psychology emulate the physical sciences have stressed that only observable behavior is the appropriate subject matter for scientific investigation. However, as Zener and Gaffron (1962) have pointed out, the primary difference between the physicist and the psychologist is that experiential phenomena are irrelevant to the physicist (measurement error), while in many instances experiential phenomena are of central importance to the psychologist.

One area of research which has dealt with experiential states is psychophysical research, where intersubjective agreement of observers has been considered to be requisite. However, if intersubjective agreement is considered to be mandatory, then the study of all complex perceptions would be disqualified.

In support of the pursuance of the study of experiential states, even though on the frontier of psychological inquiry:

> "...if experience is accepted as a reality, and if the universe is accepted as orderly, then to the extent that relevant conditions, internal and contingent as well as external, are similar, the experiences of two comparable individuals under similar conditions should be similar. Complete assurance of experiential identity is not obtainable. It is neither reasonable to expect nor necessary as a methodological postulate for research" (Zener & Gaffron, 1962, P. 557).

CHAPTER V

SUMMARY

This exploratory study dealt with the ability of Eysenck Personality Inventory (EPI) Extraversion-Introversion (E-I) scores in the upper 30% (E group) and the lower 30% (I group), for a sample of 36 Larned State Hospital, Larned, Kansas, female employees, 20-56 years of age, to predict "success" in learning to increase left forefinger temperature, utilizing three training conditions. Since introverts (Is) as measured by the E-I scale of the EPI are considered to be more "conditionable" than extraverts (Es), it was postulated that Is could more readily learn to increase left forefinger temperature. All Ss received three baseline trials, in which they were given tape-recorded instructions to relax and take deep breaths. The Ss were then randomly assigned to one of three training conditions (12 Ss each): Control (C) group, which received the same instructions as used in the baseline trials; No-Feedback (NFB) group, which recieved additional tape-recorded autogenic instructions, eg., for S to passively focus on "warmth" of the finger; and, Feedback (FB) group, which received additional tape-recorded instructions to observe a temperature meter, with a needle indicating temperature change. All Ss were seated in a reclining position, with thermistor attached to the left forefinger, but only the FB Ss could view the temperature meter. All Ss received 20 training trials, two trials daily. NFB and FB Ss filled out a questionnaire at the end of each training trial, with eight dimensions (key autogenic words), related on a five point scale. It was hypothesized that I Ss would show greater temperature increase than E Ss. It was also hypothesized that FB Ss would show greater temperature increase than NFB Ss, and both would show greater temperature increase than C Ss.

The two hypotheses were tested in 2 x 3 factorial designs ($\alpha = .05$), with four dependent variable temperature measures for: (a) Start of Instructions; (b) End of Instructions; (c) End of 90 Second Trial; (d) Average Over the 90 Second Trial, where the dependent variable measure was the average temperature (Fahrenheit) of the three baseline trials subtracted from the average temperature for the last three training trials. The hypothesis that Is would show greater temperature increase than Es was not supported. The hypothesis that FB would show greater temperature increase than NFB and both show greater temperature increase than C was partially supported in that there was a significant difference in training conditions; however, FB was not found to be superior to NFB, with orthogonal comparison tests ($\alpha = .05$). A post hoc evaluation utilizing t tests ($\alpha = .05$) revealed no relationship of the Neuroticism-Stability (N-S) dimension of the EPI to temperature increase. A further post hoc analysis with data regrouped into the four quadrants of the N-S and E-I dimensions (N-E, N-I, S-E, S-I), revealed that Ss in the S-I quadrant showed less temperature increase than Ss in the other three quadrants, as tested by Scheffé multiple comparison tests ($\alpha = .10$). Experiential ratings were in line with the instructional "set" provided the FB and NFB Ss with the exception that Ss rated toward the "Sleepy" end of the "Alert—Sleepy" dimension.

The EPI did not prove to have predictive value for "success" with AT and biofeedback procedures used in this study, when the E-I scale or the N-S scale were considered independently; however, further investigation is warranted relative to the interactive effect of the E-I and N-S scales as they apply to AT and biofeedback procedures. An hypothesis which could be tested, based on the Yerkes-Dodson Law is that S-E and N-I Ss in an interpersonal experimental situation would show greater temperature increase than S-I and N-E Ss, while S-I and N-E Ss would show greater temperature increase in an impersonal experimental situation than S-E and N-I Ss.

Training procedures used in this study and procedures such as hypnotic induction and muscle relaxation training might be further explored in terms of their common features. Another area for future research is relative to the effects of the external stimulation provided by the feedback procedure itself.

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APPENDIXES

APPENDIX A

INITIAL LETTER SENT TO SELECTED LARNED STATE HOSPITAL FEMALE EMPLOYEES

Dear ____________________:

I am contacting you, with the approval of your supervisor, to ask you to participate in a research project. At the present I am concerned with some of the characteristics of the Eysenck Personality Inventory (the two forms stapled to this letter). What I would like you to do is answer the questions on both forms as honestly as you can. Although my professional and personal ethics prohibit any deception about why I ask you to answer these questions, I am still able to be quite frank when I tell you that this is in no way an attempt to invade your privacy or to find out about you as an individual. What _is_ being investigated is the Inventory, _not_ you. In the future I hope to use some staff members who participate now, in other experiments, if they should volunteer; therefore, I ask you to fill in your name, age, etc.

If you should still feel that you do not wish to participate, please be assured that you are under no obligation whatsoever to do so, although I would appreciate your returning these blank forms to my office on Sellers Building. However, if you would like to help with this project and participate in future research, I feel you would find it interesting. I want to give you my sincere thanks and ask you to follow these instructions.

1. Please leave these forms stapled as they are.
2. Sign the release form.
3. Fill in the information on the front of the forms (name, etc.).
4. Read the instructions carefully.
5. Turn the form over and try to answer each question, answering as frankly as you can. Since it is the test that is on trial and _not_ you, I have no interest in any particular answer. I merely place scoring keys over the form, and record numbers. Later, I may find that some persons' score would make them invaluable subjects for other research procedures.
6. Please complete and return these forms at your earliest convenience. Your supervisor has agreed to let you do this during the work day.

As a footnote, I would like to stress that I am not investigating psychopathology. Only female staff members are eligible for this program. I am interested in a much too neglected area - the psychology of normal people. With the cooperation of the staff, Larned State Hospital will be able to function as an institution where research is an integral part of its contribution to the community.

Sincerely yours,

Myrna Carlton, M.S.
Psychologist

APPENDIX B

RELEASE FORM ACCOMPANYING INITIAL LETTER SENT TO SELECTED LARNED STATE HOSPITAL FEMALE EMPLOYEES

R E L E A S E   F O R M

I hereby give my consent and approval that my responses to the Eysenck Personality Inventory be used for research purposes. I understand that although my name will be on the protocol, the information obtained will be kept in strict confidence by the experimenter.

Signature:____________________________

Date:________________________________

APPENDIX C

SECOND LETTER SENT TO LARNED STATE HOSPITAL FEMALE EMPLOYEES RETURNING THE EYSENCK PERSONALITY INVENTORY WITH SCORES IN UPPER 30% OR LOWER 30% ON THE INTROVERSION-EXTRAVERSION VARIABLE

Dear__________________:

Thank you for filling out your Inventory Questionnaire. It was appreciated because it helped make possible enough data to make statistical analysis possible. At this time another, more detailed, procedure is being prepared, and your continued cooperation would be greatly appreciated.

As it happens, there appear to be techniques which make possible the direct voluntary control of involuntary processes. As a result, these techniques have made it possible to regulate heartbeat, blood pressure, breathing, body temperature, etc., without the use of chemicals or hypnosis. The present study is concerned with procedures that might decrease the training time necessary for such changes to occur.

When some of these changes take place, it has also been found that changes in inner experience can also occur. For example, many people report that as they perform some of the exercises involved they become far less tense and able to relax without the side effects produced by chemicals such as tranquilizers. It is hoped - but by no means guaranteed that by learning some of these exercises, the people participating in these exercises may be able to gain more control over everyday tensions without the need of equipment or chemicals. To the extent that these procedures can be shown to be effective with people experiencing ordinary stresses it will become more likely that they will be of help in working with people having severe emotional disturbances.

Your supervisor has agreed to your taking the necessary time off work to participate. The time required will be two 15-minute sessions per day over a period of eleven days. Actually, the time from the first session to the last will cover approximately two weeks because there will be days during this period when you will not be on duty ("comp." time, weekends, etc.).

Enclosed are three froms with specific dates representing the weeks I would like to work with you. You will notice that each of the two forms covers a 24-hour day for seven days. Please check the hours you will be on duty for each day of the three weeks. The extra days are to allow for times when sickness or emergencies might prevent your appearing for your appointment. If there are any hours when your duties seriously conflict with your being present while on duty, please use an "X" for that time; otherwise, use a " " to show that you are on duty and available for that time on that day. When you have returned these forms you will be sent an appointment card showing the times and place we will meet.

It is understood, of course, that your participation in this research is completely voluntary.

Thank you for helping, and I look forward to sharing an interesting experience with you.

Sincerely yours,

Myrna Carlton, M.S.
Psychologist

APPENDIX D

TABLE XII

MEANS AND STANDARD DEVIATIONS FOR I-E, S-N, and L SCORES OF THE EPI, AND FOR AGE

		I-C					I-NFB		
S#	I-E Score	S-N Score	L Score	Age	S#	I-E Score	S-N Score	L Score	Age
1	17	16	3	34	7	14	10	2	44
2	16	41	2	41	8	19	23	3	56
3	18	21	6	52	9	20	20	2	26
4	15	41	4	50	10	15	9	1	33
5	20	19	5	45	11	20	30	3	56
6	21	13	3	36	12	14	27	4	22
$\bar{X}$	17.83	25.16	3.83	43.00	$\bar{X}$	17.00	19.83	2.50	39.50
SD	2.11	11.45	1.35	6.69	SD	2.71	7.95	.96	19.65

		I-FB					E-C		
S#	I-E Score	S-N Score	L Score	Age	S#	I-E Score	S-N Score	L Score	Age
13	20	11	4	34	19	33	12	2	48
14	21	13	4	42	20	33	14	3	42
15	15	10	6	29	21	35	9	2	47
16	15	4	1	55	22	32	24	1	23
17	13	35	2	35	23	28	3	5	47
18	13	28	1	31	24	32	24	1	28
$\bar{X}$	16.17	16.83	3.00	37.67	$\bar{X}$	32.17	14.33	2.33	39.17
SD	3.18	10.92	1.82	8.75	SD	2.11	7.63	1.37	9.95

TABLE XII (Continued)

	E-NFB					E-FB			
S#	I-E Score	S-N Score	L Score	Age	S#	I-E Score	S-N Score	L Score	Age
25	29	19	2	34	31	35	35	4	38
26	39	16	4	38	32	31	29	3	44
27	33	13	1	26	33	33	24	4	29
28	29	21	4	55	34	41	31	1	20
29	30	21	5	21	35	29	31	2	49
30	35	11	2	26	36	34	9	5	38
$\bar{X}$	32.50	16.83	3.00	33.33	$\bar{X}$	33.83	26.50	3.33	36.33
SD	3.64	3.85	1.41	11.20	SD	3.76	8.48	1.35	9.53

	C					NFB			
	I-E	S-N	L	Age		I-E	S-N	L	Age
$\bar{X}$	25.00	19.75	3.08	41.08	$\bar{X}$	24.75	18.33	2.75	36.42
SD	7.47	11.14	1.55	8.69	SD	8.39	6.42	1.23	4.04

	FB			
	I-E	S-N	L	Age
$\bar{X}$	25.00	21.67	3.08	37.00
SD	9.50	10.90	1.61	9.17

	I					E			
	I-E	S-N	L	Age		I-E	S-N	L	Age
$\bar{X}$	17.00	20.61	3.11	40.06	$\bar{X}$	32.83	19.22	2.83	36.28
SD	2.79	10.79	1.52	10.30	SD	3.34	8.71	1.42	10.52

	All Ss			
	I-E	S-N	L	Age
$\bar{X}$	24.92	19.92	2.97	38.17
SD	8.49	9.83	1.48	10.58

APPENDIX E

TAPE-RECORDED INSTRUCTIONS FOR THREE BASELINE TRIALS FOR ALL SUBJECTS AND TWENTY TRAINING TRIALS FOR CONTROL 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."

TAPE-RECORDED INSTRUCTIONS FOR TWENTY TRAINING TRIALS FOR NO FEEDBACK 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 warmer, especially my forefinger. As my finger becomes warmer, my forehead becomes cool ... and even cooler as my finger becomes warmer.'"

TAPE-RECORDED INSTRUCTIONS FOR TWENTY TRAINING TRIALS FOR FEEDBACK 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 the 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 <u>make</u> 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 F

QUESTIONNAIRE COMPLETED BY ALL NO FEEDBACK AND FEEDBACK SUBJECTS AT THE END OF EACH OF THE TWENTY TRAINING TRIALS

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?

APPENDIX G

TABLE XIII

QUESTIONNAIRE CUMULATIVE FREQUENCY DATA FOR TRIALS 18-20 FOR I AND E GROUPS CAST FOR KOLMOGOROV-SMIRNOV TESTS

	Serene 1	2	3	4	Anxious 5
$S_{36I}(X)$	10	28	32	35	36
$S_{36E}(X)$	12	22	36	36	36
$S_{36I}(X)-S_{36E}(X)$	- 2	6	- 4	- 1	0
	Relaxed 1	**2**	**3**	**4**	**Tense 5**
$S_{36I}(X)$	7	29	31	35	36
$S_{36E}(X)$	13	27	36	36	36
$S_{36I}(X)-S_{36E}(X)$	- 6	2	- 5	- 1	0
	Finger Cool 1	**2**	**3**	**4**	**Finger Warm 5**
$S_{36I}(X)$	0	4	16	31	36
$S_{36E}(X)$	1	2	11	21	36
$S_{36I}(X)-S_{36E}(X)$	- 1	2	5	10	0

$K_D(N=36) = 12$ .05 level (two-tailed)

Note.—Denominator for Each Cumulative Frequency Value = 36

TABLE XIII (Continued)

	Concentrated on Instructions 1	2	3	4	Mind Wandered from Instructions 5
$S_{36I}(X)$	9	26	33	35	36
$S_{36E}(X)$	11	25	30	35	36
$S_{36I}(X)-S_{36E}(X)$	- 2	1	3	0	0

	Left Arm Light 1	2	3	4	Left Arm Heavy 5
$S_{36I}(X)$	0	6	17	35	36
$S_{36E}(X)$	1	1	12	22	36
$S_{36I}(X)-S_{36E}(X)$	- 1	5	5	13*	0

	Breathing Regular 1	2	3	4	Breathing Irregular 5
$S_{36I}(X)$	14	30	33	35	36
$S_{36E}(X)$	13	23	32	36	36
$S_{36I}(X)-S_{36E}(X)$	1	7	1	- 1	0

	Forehead Warm 1	2	3	4	Forehead Cool 5
$S_{36I}(X)$	0	8	27	34	36
$S_{36E}(X)$	2	2	21	30	36
$S_{36I}(X)-S_{36E}(X)$	- 2	6	6	4	0

TABLE XIII (Continued)

	Alert 1	2	3	4	Sleepy 5
$S_{36I}(X)$	1	3	6	22	36
$S_{36E}(X)$	3	7	17	25	36
$S_{36I}(X)-S_{36E}(X)$	-2	-4	-11	3	0

APPENDIX H

TABLE XIV

QUESTIONNAIRE CUMULATIVE FREQUENCY DATA FOR TRIALS 18-20 FOR FB AND NFB GROUPS CAST FOR KOLMOGOROV-SMIRNOV TESTS

	Serene 1	2	3	4	Anxious 5
$S_{36FB}(X)$	12	23	34	36	36
$S_{36NFB}(X)$	10	27	34	35	36
$S_{36FB}(X)-S_{36NFB}(X)$	2	-4	0	1	0
	Relaxed 1	**2**	**3**	**4**	**Tense 5**
$S_{36FB}(X)$	8	26	33	36	36
$S_{36NFB}(X)$	12	30	34	35	36
$S_{36FB}(X)-S_{36NFB}(X)$	-4	-4	-1	1	0
	Finger Cool 1	**2**	**3**	**4**	**Finger Warm 5**
$S_{36FB}(X)$	1	1	9	26	36
$S_{36NFB}(X)$	0	5	18	26	36
$S_{36FB}(X)-S_{36NFB}(X)$	1	-4	-9	0	0

$K_D(N=36) = 12$ .05 level (two-tailed)

Note.—Denominator for Each Cumulative Frequency Value = 36

TABLE XIV (Continued)

	Concentrated on Instructions 1	2	3	4	Mind Wandered from Instructions 5
$S_{36FB}(X)$	11	25	31	36	36
$S_{36NFB}(X)$	9	26	32	34	36
$S_{36FB}(X)-S_{36NFB}(X)$	2	-1	- 1	2	0

	Left Arm Light 1	2	3	4	Left Arm Heavy 5
$S_{36FB}(X)$	1	1	13	29	36
$S_{36NFB}(X)$	0	6	16	28	36
$S_{36FB}(X)-S_{36NFB}(X)$	1	- 5	- 3	1	0

	Breathing Regular 1	2	3	4	Breathing Irregular 5
$S_{36FB}(X)$	15	28	33	35	36
$S_{36NFB}(X)$	12	25	32	36	36
$S_{36FB}(X)-S_{36NFB}(X)$	3	3	1	- 1	0

	Forehead Warm 1	2	3	4	Forehead Cool 5
$S_{36FB}(X)$	1	3	24	32	36
$S_{36NFB}(X)$	1	7	24	32	36
$S_{36FB}(X)-S_{36NFB}(X)$	0	- 4	0	0	0

TABLE XIV (Continued)

	Alert 1	2	3	4	Sleepy 5
$S_{36FB}(X)$	4	8	12	20	36
$S_{36NFB}(X)$	0	2	11	27	36
$S_{36FB}(X)-S_{36NFB}(X)$	4	6	1	3	0

APPENDIX I

TABLE XV

COMPARISON OF S AND N MEANS FOR DEPENDENT VARIABLE MEASURES FOR AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS

DEPENDENT VARIABLE	$\bar{X}_N$	$\bar{X}_S$	$s_{\bar{d}}$	t
Start of Instructions	- .336	1.225	1.485	- .984
End of Instructions	3.492	3.483	1.381	.006
End of 90 Sec. Trial	3.436	3.649	1.495	- .142
Average Temperature Between End of Instructions and End of Trial	3.268	3.705	1.439	- .302

$\underline{t}$ (34 $\underline{df}$) = 2.04 .05 level (two-tailed)

APPENDIX J

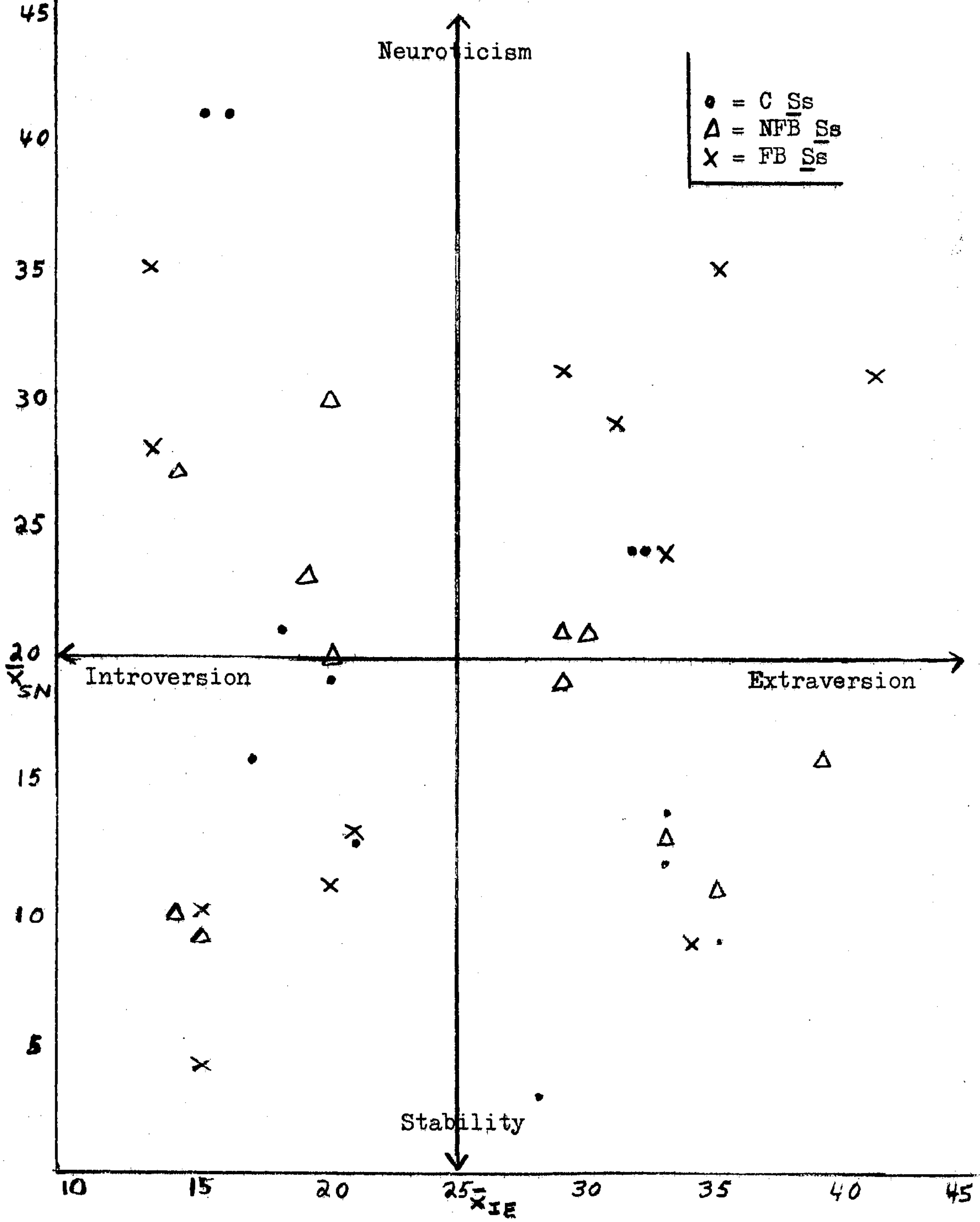

Figure 11. Graphic Presentation of C, NFB, and FB Ss on Dimensions of Extraversion-Introversion and Neuroticism-Stability (EPI Forms A and B Combined)

APPENDIX K

TABLE XVI

SUMMARY OF F TESTS PRECEDING SCHEFFE' TESTS FOR DATA ARRAYED INTO N-I, S-I, N-E, AND S-E QUADRANTS FOR DEPENDENT VARIABLE MEASURES OF AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS

DEPENDENT VARIABLE	df	TREATMENT MS	df	ERROR MS	F
Start of Instructions	3	44.620	32	18.408	2.423
End of Instructions	3	32.061	32	19.924	1.609
End of 90 Sec. Trial	3	153.879	32	10.274	14.977***
Average Temperature Between End of Instructions and End of Trial	3	148.270	32	11.260	13.167***

$F(3, 32\ df) = 2.92$ .05 level

APPENDIX L

TABLE XVII

SCHEFFE' MULTIPLE COMPARISONS TEST FOR AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS FOR END OF 90 SECOND TRIALS, FOR DATA ARRAYED INTO N-I, N-E, S-I AND S-E QUADRANTS

COMPARISON	ΣX_{N-I} 25.42	ΣX_{S-I} 6.48	ΣX_{N-E} 40.23	ΣX_{S-E} 42.99	A
S-E > S-I		-1		1	74.054*
S-E > N-I	-1			1	17.150
N-E > S-I		-1	1		63.281
N-E > N-I	-1		1		12.185
N-I > S-I	1	-1			19.929
S-E + N-E > S-I		-2	1	1	91.416*
S-E + N-E > N-I	-2		1	1	19.416
S-E + N-I > S-I	1	-2		1	56.938
N-E + N-I > S-I	1	-2	1		51.411
S-E + N-E + N-I > S-I	1	-3	1	1	73.672*

F (3,32 df) = 2.28 .10 level
(F') (MS_{Error}) = 70.274 (Required A Value for Significance)

APPENDIX M

TABLE XVIII

SCHEFFE' MULTIPLE COMPARISONS TEST FOR AVERAGE TEMPERATURE FOR TRIALS 18-20 MINUS AVERAGE TEMPERATURE FOR THREE BASELINE TRIALS FOR AVERAGE TEMPERATURE BETWEEN END OF INSTRUCTIONS AND END OF TRIAL, FOR DATA ARRAYED INTO N-I, N-E, S-I, AND S-E QUADRANTS

COMPARISON	ΣX_{N-I} 27.44	ΣX_{S-I} 5.06	ΣX_{N-E} 38.89	ΣX_{S-E} 41.38	A
S-E > S-I		-1		1	73.285
S-E > N-I	-1			1	10.795
N-E > S-I		-1	1		63.581
N-E > N-I	-1		1		7.283
N-I > S-I	1	-1			27.825
S-E + N-E > S-I		-2	1	1	91.130*
S-E + N-E > N-I	-2		1	1	11.938
S-E + N-I > S-I	1	-2		1	63.809
N-E + N-I > S-I	1	-2	1		58.510
S-E + N-E + N-I > S-I	1	-3	1	1	79.275*

F (3,32 df) = 2.28 .10 level
(F') (MS_{Error}) = 77.018 (Required A Value for Significance)

APPENDIX N

TABLE XIX

N-I, S-I, N-E, AND S-E MEANS AND STANDARD DEVIATIONS FOR EACH DEPENDENT VARIABLE TEMPERATURE MEASURE, FOR AVERAGE OF TRIALS 18-20 MINUS AVERAGE FOR BASELINE TRIALS

DEPENDENT	MEAN				STANDARD DEVIATION			
VARIABLE	N-I	S-I	N-E	S-E	N-I	S-I	N-E	S-E
Start of Instructions	.53	-2.31	1.72	2.88	3.63	3.89	4.83	3.75
End of Instructions	2.68	.39	4.28	4.46	4.11	3.00	5.02	4.44
End of 90 Sec. Trial	2.82	.72	4.47	4.78	4.06	3.08	5.80	4.22
Average Over 90 Sec. Trial	3.05	.56	4.32	4.60	3.96	2.07	5.80	4.37

APPENDIX O

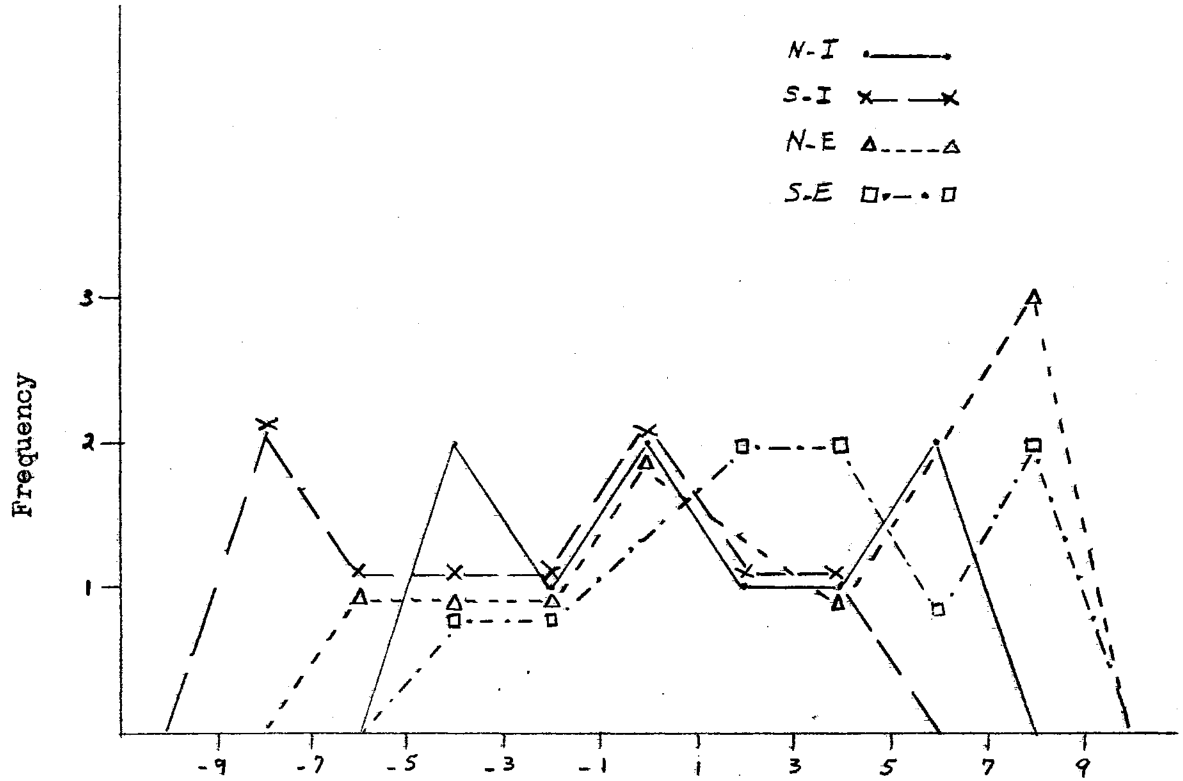

Figure 12. Fahrenheit Temperature Change for Start of Instructions for N-I, S-I, N-E and S-E Subjects

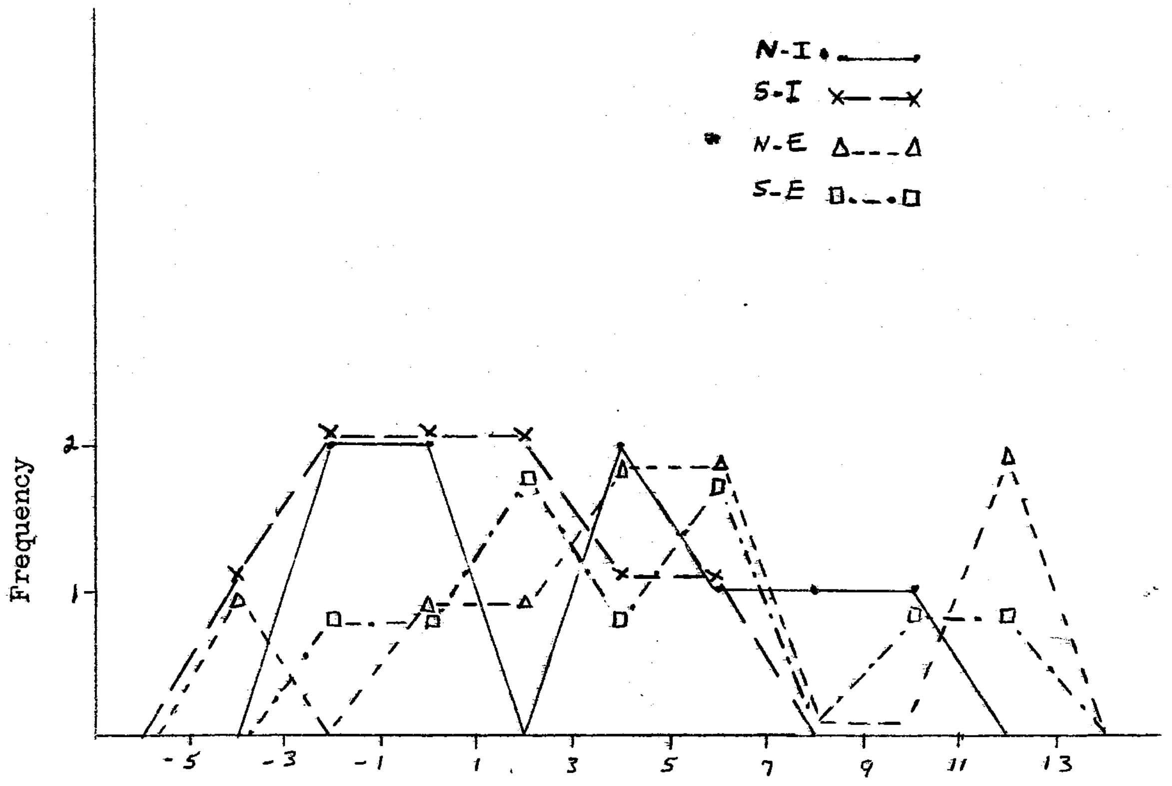

Figure 13. Fahrenheit Temperature Change for End of Instructions for N-I, S-I, N-E and S-E Subjects

APPENDIX Q

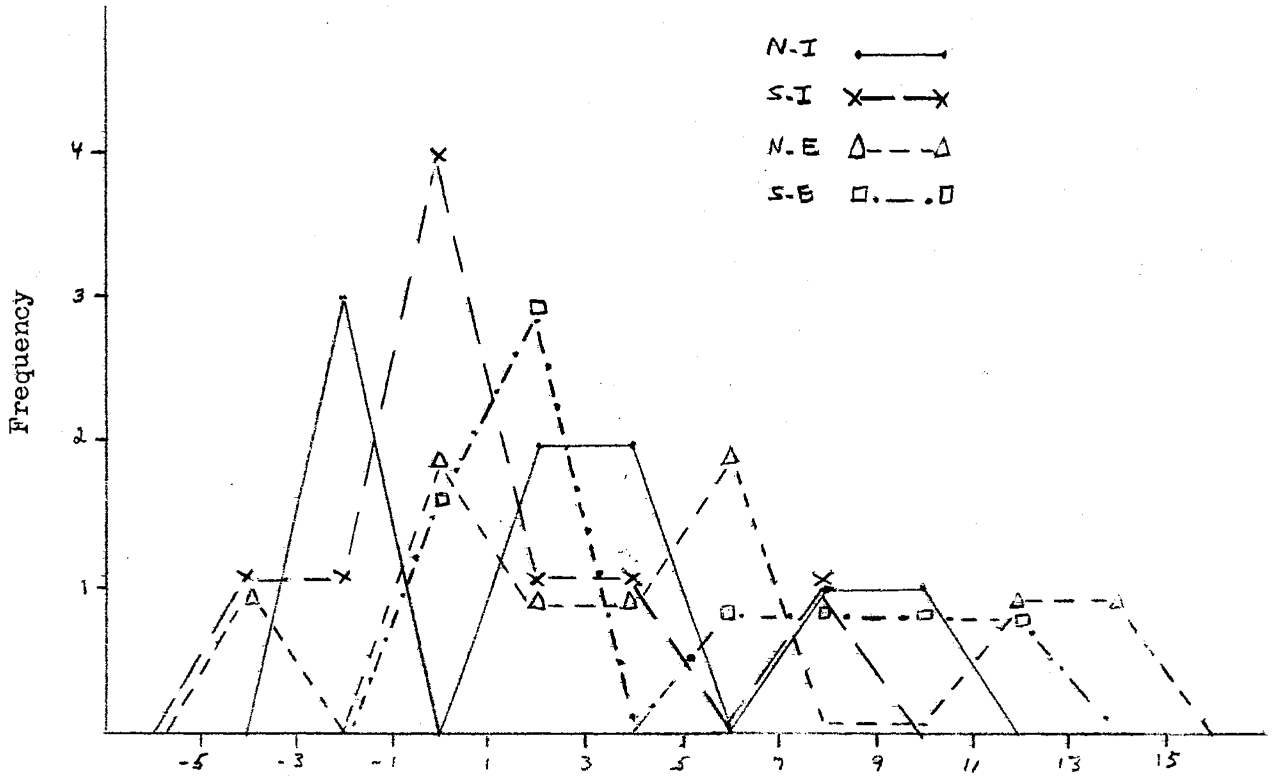

Figure 14. Fahrenheit Temperature Change for End of 90 Second Trial for N-I, S-I, N-E and S-E Subjects

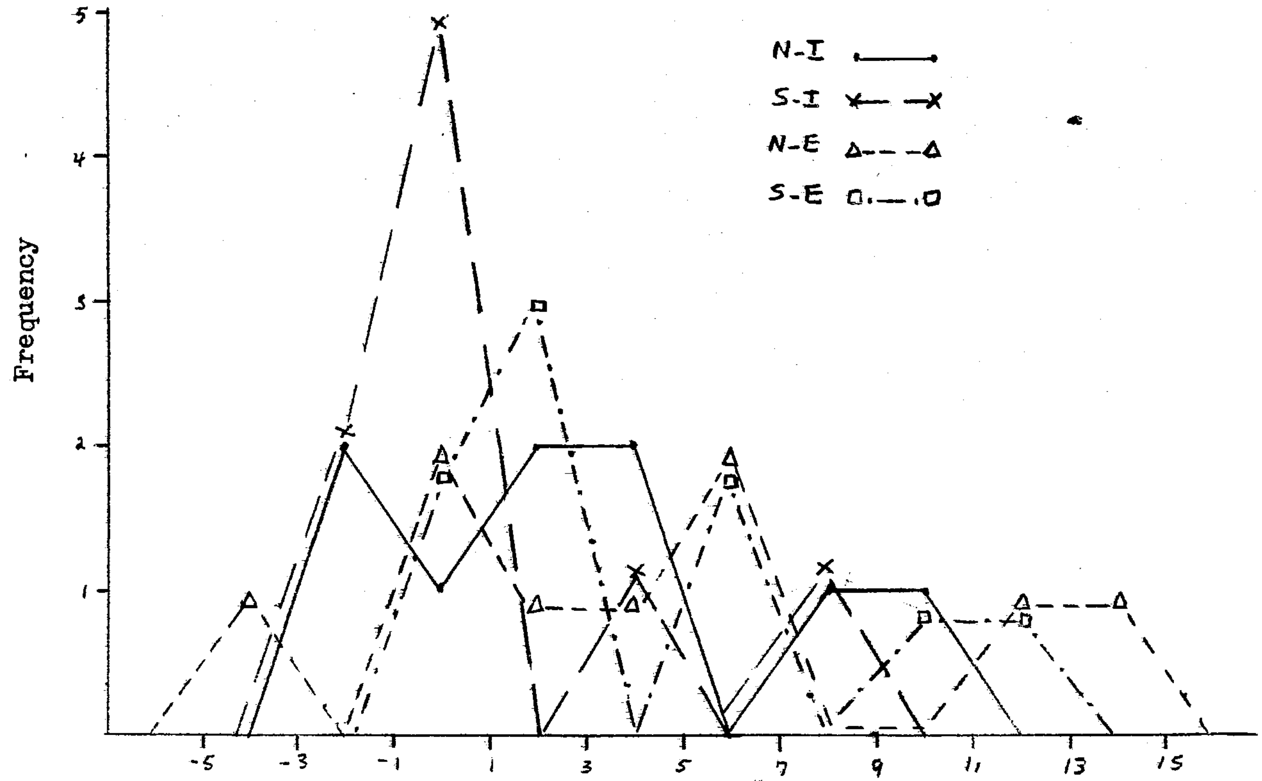

Figure 15. Fahrenheit Temperature Change for Average Over the 90 Second Trial for N-I, S-I, N-E and S-E Subjects

VITA

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