DIASTOLIC BLOOD PRESSURE AND HEART RATE IN RELATION TO ANGER AND FEAR AND PERSONALITY TRAITS

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ABSTRACT

This investigation sought to examine the psychophysiology of anger and fear in relation to the Funkenstein or norepinephrine-epinephrine (NE-E) hypothesis. Funkenstein (1955) hypothesized that NE-like responses are characteristic of anger and E-like responses are characteristic of fear or anxiety. The hypothesis, in conjunction with supportive empirical evidence, suggested diastolic blood pressure (DBP) and heart rate (HR) to be promising physiological indicants of anger and fear. An Intrasympathetic Balance Score (ISB) was formulated for the purpose of quantifying both physiological variables along a single continuum. The 24-hour reliability of the ISB and its constituent scores was established in a preliminary investigation.

An attempt was made to induce affective anger and fear in 100 male Ss during a psychological stress session. A modified version of the Mood Adjective Check List was employed during the stress session for the purpose of measuring anger and fear. Conjunctively, personality inventory data were collected for the purpose of drawing relationships with the check list and physiological data. Inventory responses were obtained from the Activity Preference Questionnaire, the Fenz version of the Manifest Anxiety Scale, and the Buss-Durkee Hostility Inventory. Also included were factors U.I. 18 and U.I. 20 from the Cattell 12 Objective-Analytic Battery.

The Funkenstein hypothesis proved to be less useful than was anticipated because (a) DBP and HR failed to correlate negatively, (b) the ISB score proved to be less reliable than the component scores themselves, and

(c) the R-correlational analysis failed to yield relationships supportive of the Funkenstein hypothesis. It was also suggested that limitations within the experimental manipulation were contributive to the failure to obtain significant relationships between the physiological, affective, and personality variables.

It was felt that more information might be gained by examining the patterns of Ss responses to the personality inventories. To this end, patterns based on the personality inventory data were identified by means of Q-correlational and factor analytic techniques and an attempt was made to relate these patterns to physiological factor scores. The patterns which did emerge suggested the potential value of this technique for psychophysiological research.

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CHAPTER I

INTRODUCTION

There have been data suggestive of a relationship between psychological emotional states and given bodily changes. Of these, anger and fear have been most intensively investigated, yet unequivocal relationships have not been established. In part the rather convincing non-specificity theory of Cannon (1934) served to impede differentiation research in this area. Cannon believed that all threatening stimuli resulted in the same autonomic response, i.e., a massive and diffuse discharge of the sympathetic-adrenal medullary system. This proposition was based on his research on the adrenal medulla of cats previously confronted by a barking dog. He found the incidence of epinephrine (E) in the blood stream increased whether or not the cat's principal reaction was a rage or fear response. It was also believed at this time that the only hormone secreted by the medulla was E.

It soon became evident that the adrenal medulla secreted, in addition to E, another hormone called norepinephrine (NE). This fact was firmly established in 1955 when Eranko successfully demonstrated that there are two kinds of cells in the adrenal medulla, one type containing predominately E and the other containing predominately NE. Of greater importance for psychophysiology is the evidence suggesting these cells are innervated differentially by subcortical structures. Redgate and Gellhorn (1955), for example, found that in anesthetized animals, the stimulation of certain posterior portions of the hypothalamus elicited E from the adrenal vein whereas stimulation of other areas elicited NE. It was now clearly apparent that the organism at least possessed the biologic capacity to respond differentially to threatening stimuli.

The link between differential medullary hormonal secretion and emotional behavior was first scrutinized empirically by Funkenstein, King, and Drolette (1954). In a later article Funkenstein (1955) traces the genesis of this association. Their initial research dealt with the construction of a sympathetic nervous system reactivity test by examining the blood pressure responses of psychotics to the injection of methacholine, a mimetic of the parasympathetic nervous system. They found psychotics with hypertension to react to the injection in two distinct ways. One group (Group N) responded with only a slight fall in blood pressure with a rapid return to the pre-injection level. The other group (Group E) responded with a much larger and more sustained fall in blood pressure. As an emotional distinction appeared to parallel the physiological distinction, Funkenstein had psychiatrists rate the predominant emotion expressed by each of these patients during their daily activities. Without reporting quantification of the results, Funkenstein nevertheless concluded:

> "When the subject's emotional and physiological ratings were compared, it turned out that almost all of the patients who were generally angry at other people fell in Group N...while almost all those who were usually depressed or frightened were in Group E. (Funkenstein, 1955, p. 72)"

This led Funkenstein to hypothesize that "anger" responses were associated with a NE-like hormonal response and "anxiety" or "fear" responses were associated with an E-like hormonal response.

Surprisingly, researchers did not accord this hypothesis much attention, leaving it to remain dormant over the years. However, a number of review articles (Breggin, 1964; Buss, 1961; Martin, 1961; Mason, 1968; Schildkraut and Kety, 1967) have proposed the Funkenstein hypothesis as the most promising model for investigating the physiological and endocrinological correlations of anger and fear.

A REVIEW OF THE LITERATURE

Psychoendocrinological Research

Funkenstein (1955) finds support for his hypothesis in Goodall's (1951) study wherein aggressive, attacking animals (i.e., lion, cat) were found to have a predominance of NE in the adrenal medulla whereas E was predominant in animals (i.e., baboon, rabbit) that depend primarily on flight for survival. Of interest is the fact that man was found to have a predominance of E; although others have found (West, Shepherd, & Hunter, 1951) NE to be predominant in the medulla of the infant.

Additional naturalistic support for the Funkenstein hypothesis is found in Elmadjian, Hope, and Lamson's (1957) catecholamine data obtained from athletes engaged in hockey and boxing contests. A bioassay of pre- and post-game urine samples was used to determine the change in NE and E levels. Disregarding the technical and metabolic difficulties with this technique (Mason, 1968), there still remains the problem of identifying the stimulus responsible for the change of catecholamine concentration in the urine. In some instances the post-game urine sample was not obtained until three hours after the contest had terminated, suggesting a confusion in the stimulus responsible for the change. Nevertheless the authors reported active aggressive players had a much higher NE-E ratio than players who simply watched the game. As a partial control, they also examined the catecholamine excretion of three subjects (Ss) engaged in strenuous physical activity with little or no emotional involvement. These Ss did not show a significant increase in either amine which suggested the emotional and not the physical involvement was the major determinant of the increased catecholamine levels of the athletes.

In the same article Elmadjian et al. (1957) reported data obtained from ten psychiatric patients examined at staff conferences. They employed a 22-category psychiatric rating scale to classify the emotional behavior of each patient. By separately examining a continuum characterized by active aggressive behavior at one end and passive self-effacing behavior at the other, they were able to demonstrate a positive relationship between aggressive responses and urinary NE excretion rate. Conversely the one individual who scored at the other extreme had a very high E excretion rate.

Cohen and Silverman (1959) report two studies which were both supportive of Funkenstein's proposed relationship between catecholamine excretion and emotional behavior. In the first study, they examined six Ss under the influence of centrifugal stress which, by forcing the blood into the periphery of the body, leads to cranial hypotension and eventual blackout. Since NE increases and E decreases peripheral vascular resistance, Cohen and Silverman reasoned that Ss with the highest NE and lowest E levels should be able to withstand the highest degree of centrifugal stress. To test this hypothesis, the gravitational or "g-level" resulting in blackout was first established for each S. Urinary catecholamine levels were also assessed during this stress period. The results were in complete agreement with the investigators expectations as g-level tolerance was positively related to NE excretion and negatively related to E excretion. Next the relationship of emotional experience to g-level tolerance and hormonal secretion was established. By means of a post-experimental interview, the principal affect experienced by each S during centrifugal stress was determined. The results strongly supported the Funkenstein hypothesis as Ss high on anxiety had the lowest blackout and the highest E levels. Conversely, Ss who scored high on aggression had the highest blackout and NE levels. The experiment was then repeated on five of the six Ss, only this time two Ss previously exhibiting anxiety were provoked into exhibiting aggression. This tactic was successful in increasing their tolerance to centrifugal stress.

In the second study Cohen and Silverman (1959) successfully extended the generality of the Funkenstein hypothesis. Mecholyl, a hypotensive drug, was injected in 10 male Ss in order to elicit cardiovascular and hormonal responses similar to those elicited by centrifugal stress. To render the situation more stressful, Ss were also chastised throughout the injection period. Subjective behavior was psychiatrically assessed after the injection period and urine samples were examined for NE and E content. Although sample size was small, the results were unequivocal in that all Ss with psychiatric ratings of anxiety exhibited hypotensive blood pressure responses while Ss classified as aggressive gave hypertensive responses. Additional support was provided by the catecholamine data as anxious Ss had the highest increase in urinary E and aggressive Ss had the highest increase in urinary NE.

A limitation of extent psychoendocrine research resides in the frequent neglect of objective referents for classifying the subjective emotional responses. More specifically, endocrine researchers have often failed to explicitly define the measurement devices used to classify their Ss as angry or anxious; thereby making cross-study comparisons difficult, if not impossible. Recognizing this limitation, Fine and Sweeney (1968) examined the Funkenstein hypothesis with a number of standard self-report measures. They subjectived soldiers to a variety of stressors while examining corresponding urinary excretion rates of E and NE. The soldiers were isolated from their comrades for a period of three days during which they were subjected to psychological speed tests, anticipating of cold stress, and finally actual exposure to the cold stimuli. Standard projective devices such as the Thematic Apperception Test and the Rosenzweig Picture-Frustration test were employed to assess aggressive responses. Anxiety was also assessed from several devices including the Minnesota Multiphasic Personality Inventory and the Maudsley Personality Inventory. No attempt was made to relate the subjective responses experienced to the various experimental stimuli to catecholamine excretion rates. However, the results did offer some support for the Funkenstein hypothesis as high aggression Ss, as measured by the Thematic Apperception Test, did have the highest NE/E ratios. The relationships between the anxiety measures and catecholamine levels failed to attain significance.

There are also endocrine studies - although their primary aim has not been to test this hypothesis per se - which have been critical of the hypothesis (Frankenhauser, Mellis, Rissler, Bjorkvail, & Patkai, 1968; Levi, 1967). However, there are two basic limitations of such research.

Either a personality variable unrelated to the anger-fear dimension was used, or frustration was the sole manipulation. It is very likely that frustration alone is generally insufficient to elicit anger-fear behavior in the laboratory. There is some evidence which suggests verbal attack alone or in combination with frustration is much more effective in this respect (Buss, 1966; Gentry, 1970). Since it is unlikely anger and fear were aroused in the critical research, such studies cannot be considered to have examined the differential secretion hypothesis.

Although the evidence supportive of the Funkenstein hypothesis appears to just outweigh the repudiating data, the hypothesis must be considered still largely speculative. Faulty methodology has been employed in the majority of data collection, both supportive and nonsupportive of the hypothesis. Clarification of this issue is attendant upon further research in this area.

Psychophysiological Research

Several psychophysiologists concerned with the physiological correlates of anger and fear have interpreted their results as indirectly supporting the Funkenstein hypothesis. This is the result of the observed similarity in the physiological response pattern elicited by emotional and hormonal stimuli. The similarity of physiological responses elicited by the catecholamines, NE and E, and the emotional stimuli anger and fear, has been most apparent within the cardiovascular system. Table 1, reprinted from Goth (1968), contains the cardiovascular changes associated with the infusion of 4 ug/ml. of E and NE at the rate of 10 ug/min.

Physiological differentiation occurs with cardiac output (CO),

TABLE 1

Cardiovascular Effects of Epinephrine (E) and Norepinephrine (NE)

Physiological Variable	E	NE
Systolic pressure (SBP)	Increased	Increased
Diastolic pressure (DBP)	Decreased	Increased
Mean pressure	Unhanged	Increased
Heart Rate (HR)	Increased	Unchanged or decreased
Cardiac output (CO)	Increased	Slightly decreased
Peripheral resistance (PR)	Decreased	Increased

Note: HR changes not listed in table but reported in text.

peripheral resistance (PR), diastolic blood pressure (DBP), and heart rate (HR); suggesting these are the most likely variables to examine in relation to emotional stimuli. Of these four variables, DBP and HR are the most directly measurable. Their usefulness in examining the differential secretion hypothesis is further supported in a study by Wenger, Clemens, Darsie, Engel, Estess, and Sonnanschien (1960) which found HR to increase and DBP to decrease in response to E infusion; conversely HR decreased and DBP increased with NE infusion.

Two theoretical concepts have been invoked to account for the direct and opposite action of the catecholamines on HR and DBP. The first concept is the receptor theory, which proposes the walls of smooth muscles to have two kinds of receptors, alpha and beta, which are differentially receptive to the hormones NE and E (Innes & Nickerson, 1965). In the peripheral musculature, stimulation of alpha receptors leads to vasoconstriction while stimulation of beta receptors leads to vasodilatation. The two opposing actions of constriction and dilatation are evidenced physiologically by corresponding increases and decreases in DBP. To explain the differential DBP responses to the catecholamines, it is assumed NE activates the alpha receptors and E activates the beta receptors.

Cardiac muscle, on the other hand, is assumed to be innervated almost entirely by beta receptors which at this site are highly responsive to E and only partially responsive to NE. At the theoretical level, therefore, one would expect HR to increase in response to both hormones. Empirically, however, it has been found that HR decreases under the influence of NE (Wenger et al., 1960). The concept of homeostatic control has been offered to account for this discrepancy. The slight increase in HR to NE stimulation raises the arterial pressure. However, the walls of the arteries contain pressure or stretch receptors which are extremely sensitive to the changes in vascular pressure. Therefore, with the increase in arterial pressure there is a corresponding increase in the frequency of afferent signals to the cardioinhibitory center of the medulla oblongata. As the initial direct acceleratory effect of NE is only minor, the net effect is bradycardia or a reduction in HR.

It is problematic whether the receptor theory and homeostasis are operative in the studies employing the emotional stimuli of anger and fear. The mechanism underlying the responses of physiological variables to exogenous E and NE may bear little or no relationship to the mechanisms underlying the responses of similar variables to emotional stimuli.

Nevertheless the psychophysiological studies were examined principally for the effects of anger and fear stimuli on HR and DBP. The Funkenstein or differential secretion hypothesis would predict an increase in HR and a decrease in DBP to fear stimuli, and conversely a decrease in HR and an increase in DBP to anger stimuli.

In 1953, Ax performed his classic study which successfully differentiated Ss on the basis of their respective physiological responses to anger and fear stimuli. In spite of operating within a laboratory setting, he ingenuously contrived distinct stimuli designed to elicit anger and fear, respectively.

> "The fear stimulus consisted of a gradually increasing intermittent shock stimulus to the little finger which never reached an intensity sufficient to cause pain. When the subject reported the sensation, the experimenter expressed surprise, checked the wiring, pressed a key which caused sparks to jump near the subject, then exclaimed with alarm that this was a dangerous high-voltage short circuit. The experimenter created an atmosphere of alarm and confusion. After five minutes from the time the subject reported the shock, the experimenter removed the shock wire, assuring the subject that all danger was past, that the circuit had been found and repaired. (Ax, 1953, p. 435)"

A period of 15 minutes intervened between the anger and fear situations. The anger stimulus consisted of the appearance of a rude and arrogant polygraph operator who criticized and roughly adjusted Ss for a period of time equal to that of the fear session. All Ss were exposed to both situations, with approximately half the Ss receiving the fear stimulation first and the remainder receiving the anger stimulation first. Four physiological variables showed significantly greater average reactions for anger and three variables showed greater average reactions for fear. The former were HR falls, DBP rises, number of galvanic skin responses (GSR), and a number of muscle tension increases (MT). The latter variables were skin conductance increases (SC), number of MT peaks, and respiration rate increases (RR). An examination of the respective fear and anger physiological response profiles suggested a relationship to the Funkenstein hypothesis. The fear pattern was in definite accordance with the physiological pattern elicited by E. However, Ax felt the anger profile resembled a combined NE and E response pattern.

The similarity of physiological responses to emotional and hormonal stimuli has been confirmed by Ax, Bamford, Beckett, Domine, and Gottlieb (1969). At the same time of the 1953 study five of the Ss were also given E and NE injections. Although not reported previously, Ax et al. found a fairly close relationship between the anger and NE profiles and between the fear and E profiles.

An experiment very similar in design to the Ax (1953)study was performed by Schachter (1957). In fact, he even used data from 15 of the Ss employed in the Ax study. In addition to anger and fear stimulation, Schachter confronted Ss with cold-pressor stimulation which was intended to elicit pain. The physiological response patterns to anger, fear, and pain resembled, as in the Ax study, the differential responses elicited by E and NE. To test the viability of this relationship, Schachter devised a physiological classification scale which ranged from "marked NE-like" through "mixed NE-E" to "marked E-like" effects. However, the criteria used to determine a S's position on the continuum were poorly defined. For example, to be placed in the "marked NE-like" category, S had to exhibit during the stimulus period of interest, a "marked" increase in PR and DBP, and a "drop" in HR and CO. This deficiency, in combination with the probable neglect of using a blind classification procedure could have resulted in considerable bias. Nevertheless, 31 of 47 Ss were classified as exhibiting NE-like physiological responses to pain stimulation. Less than half of the Ss exhibited a similar pattern to anger stimulation. The fear portion of the Funkenstein hypothesis received the strongest confirmation as 35 of 48 Ss exhibited E-like response patterns.

Funkenstein, King, and Drolette (1954) adopted a different approach in their examination of the differential secretion hypothesis. Instead of using external anger- and fear-inducing stimuli, they presented one set of stimuli to all Ss. In effect they relied on anticipated individual differences in mediating responses to the same stimuli. The stimulus complex consisted of the investigator reading off digits and arithmetic problems in a confusing and rapid manner while chastising S for incorrect responses. The majority of Ss were expected to either blame the experimenter for their difficulties (Anger-out) or blame themselves (Anger-in). The terms Anger-out and Anger-in are used synonymously with the terms anger and fear/anxiety. The subjective responses were assessed in an interview immediately following the stress period. A physiological classification procedure, similar in nature to the one used by Schachter (1957) was used to code responses into NE-like or E-like categories. Unfortunately, the same lack of control evident in the Schachter study was operative in this study as the same investigators were involved in both the verbal and physiological assessment procedures. This is very serious when one considers that both assessment procedures were also subjective in nature. The results, taken at face value, were in strong support of the differential secretion hypothesis. Of the 18 Ss classified as Anger-out, 14 exhibited a NE-like physiological response pattern. The results were equally supportive of the case of Anger-in since 12 of 15 Ss exhibited E-like response patterns.

A summary of the relevant portions of the Ax (1953), Schachter (1957), and Funkenstein et al. (1954) studies appears in Table 2. The Funkenstein hypothesis suggests a similarity of physiological responses during anger and fear to physiological responses elicited by the infusion of NE and E. From Table 2 it is evident that only the Funkenstein et al. (1954) study is definitive with respect to emotional responses. The results from the Ax and Schachter studies can be taken in support of differential or nondifferential response patterning. In the Ax study, for example, DBP increased 17.8 mm Hg.

TABLE 2

Summary of Portions of the Ax (1953), Schachter (1957), and Funkenstein et al. (1954) Studies

Cardiovascular Variable	Ax Fear	Ax Anger	Schachter Fear	Schachter Anger	Funkenstein et al. Fear	Funkenstein et al. Anger
SBP	20.4	19.2	22.5	21.1	19.6%	13.1%
DBP	14.5	17.8	13.7	14.5	9.7%	22.8%
HR	30.3	25.8	18.7	10.8	33.3%	7.4%
CO	-	-	6.7	3.0	61.9%	-3.2%

Note: Scores in the Ax and Schachter studies represent mean difference scores between resting level and the maximum level attained in response to stress stimulation. Scores in the Funkenstein et al. study represent percentage changes from resting level.

for anger and 14.5 mm. Hg. for fear resulting in a net mean difference of only 3.3 mm. Hg. Although statistically significant the reliability and theoretical significance of this difference remains to be demonstrated.

The conception of general physiological arousal, supportive of Cannon's (1934) principle of diffuse activation, has received considerable support from the experimental literature (Duffy, 1957; Malmo, 1959; Seyle, 1946), and cannot be ignored. Differential response patterning, if it occurs, will have to be detected over and above this general tendency. General physiological arousal may characterize all émotions, but the composite index characterizing one emotion may be different from that characterizing another emotion.

Dykman, Ackerman, Galbrecht, and Reese (1963) performed a post hoc analysis of the Funkenstein hypothesis. In the experiment proper, 40 male medical students were required to recite a list of digits backwards under continual criticism for poor performance. On the basis of a post-experimental interview, Ss were dichotomized into those who experienced predominantly fear and those who experienced predominantly anger during the stress period. Of the physiological variables employed, HR was the only one to behave in accordance with the Funkenstein hypothesis. SC and RR responses were in the opposite direction to the changes observed by Ax (1953). On the basis of this latter finding, Dykman et al. felt their results repudiated the Funkenstein hypothesis. However, the hypothesis, in its present form, does not lead to predictions with the variables of SC and RR. In fact SC is controlled by the cholinergic system and is therefore under the direct control of acetylcholine and not NE or E. Empirically, Wenger et al. (1960) found E and NE infusions to have no effect on SC and only a slight effect on RR.

Several investigators have also examined the Funkenstein hypothesis in relation to personality traits. Funkenstein, King, and Drolette (1957) found that Ss who exhibited a NE-like response pattern to the experimental stressor perceived their fathers as the chief source of authority and affection. Conversely, Ss with an E-like pattern perceived their mothers as both the chief sources of authority and affection. The NE-like Ss also placed more emphasis on the necessity of the male being dominant and assertive in familial relationships.

Berger (1964) divided 30 psychiatric patients, on the basis of their blood pressure response to methacholine injection, into NE-like and E-like groups. In addition, 22 personality scores were derived from two projective tests. Of 44 phi-coefficients computed, only five attained significance. In spite of this, Berger felt the overall self-report pattern of the NE-like group was characteristic of an "infantile personality constellation". These patients also expressed less hostility and greater resentment towards their fathers on the projective instruments. The E-like group were seen as more adequate in attachments with parents and also exhibited more fantasied hostility.

Ax, Beckett, Cohen, Frohman, Tourney, and Gottlieb (1962) have also applied the Funkenstein hypothesis to the clinical setting. They found a definite trend for schizophrenic patients to respond to the threat of electric shock with a NE-like physiological response pattern, while non-psychotic patients responded with an E-like physiological response pattern.

Due to the small sample size a definite trend could not, at this time, be incontestably established. By using a larger sample size and a group of matched controls, Ax et al. (1969) were able to corroborate their earlier finding. In this study each S was required to immerse his foot in ice water for a period of one minute. A pattern analysis based on the composite index of six physiological variables clearly differentiated the schizophrenics from the controls. The schizophrenics exhibited a definite NE-like pattern, while the controls exhibited an E-like pattern.

THEORETICAL AND METHODOLOGICAL CONSIDERATIONS

In conducting psychophysiological research, there are several issues in need of serious consideration. In terms of the present research, it is possible to categorize these issues into four general headings: (a) endocrinological-physiological relationship, (b) method of emotion-inducing manipulation, (c) measurement of verbal behavior, and (d) measurement of physiological responses.

Endocrinological-physiological Relationship

The Funkenstein hypothesis (Funkenstein et al., 1957) is based on the assumption of differential secretion of NE and E during the emotional states of anger and fear. DBP and HR were shown to be sensitive and easily obtainable physiological indicants of the differential effects of these catecholamines. More importantly both DBP and HR have proved to be the most promising variables in differentiating the emotions of anger and fear. Several investigators, however, have challenged the proposed relationship between physiological and endocrinological systems on the basis that the effector organs respond too quickly to threatening stimuli for the adrenal medulla to be involved (Buss, 1961; Dykman et al., 1960). In response to this challenge, it has been found that both NE and E are available at the sympathetic nerve endings for immediate action. Formerly it was believed NE only was available, but a recent review (Wurtman, 1965) suggests both hormones are available at this site.

This issue is certainly less controversial than the preceding argument implies. In recognition of this point, Ax et al. (1969) comment:

> "Following Funkenstein et al., we have used the terms 'epinephrine-like' and 'norepinephrine-like' to describe the physiologic patterns that tend to be more like one or the other of these two states; this is not to imply that the subjects necessarily have higher epinephrine or norepinephrine concentrations in the blood, rather it is implied that these terms represent the combined neurologic and hormonal states. (Ax et al., 1969, p. 354)."

The current state of psychophysiological theory precludes the formulation of exact identities between physiological and endocrinological processes. At present the utility of such identities resides only at a descriptive level.

<u>Method of Emotion-inducing Manipulation</u>

Theoretically, there are at least two opposing approaches to the induction of emotional states. First, the stimulus situation can be arranged in such a manner that factors within the external situation are the major determiners of the emotional reactions. Second, the stimulus situation can be arranged such that factors within the Ss, rather than the external stimulus array, play the major role in determining the emotion experienced. It is probably not possible to completely isolate these methods as any response is the result of both external and internal stimuli. The first approach is exemplified by the Ax (1953) and Schachter (1957) studies wherein the emotions of anger and fear were identified strictly in terms of the external stimulus situation. The study by Funkenstein et al. (1954) exemplifies the second approach as the resonses of the Ss were used to define the nature of the emotion experienced.

The major difficulty with an a priori definition of the emotional stimulus is simply the identifying of a suitable stimulus. Anger and fear are learned responses to innumerable stimuli, both internal and external, which makes it extremely difficult to specify a stimulus which will elicit the same responses across a group of Ss. Shontz (1965) has discussed this problem with references to the Ax (1953) study:

> "The validity of this investigation depends to a large extent upon the degree to which the investigator was successful in actually producing the emotional states intended. The real independent variables were not the stimulus situations that presumably produced these states but the subjects' probable responses to these situations. (Shontz, 1965, p. 202)"

This may account for the large individual differences found in the Schachter (1957) study, as only one-half of the Ss exhibited a NE-like response pattern to the anger stimulus. Although other explanations are certainly plausible, the other Ss may have simply reacted with an emotional response unrelated to anger. In his recent book on psychological stress, Lazarus (1966) has reiterated the difficulty of a purely external stimuli approach:

> "...stress cannot be defined exclusively by situations because the capacity of any situation to produce stress reaction depends on the characteristics of the individuals. (Lazarus, 1966, p. 5)"

By attempting to define emotions solely in terms of the external situation, the investigator must face, in addition to individual differences in appraisal, the problem of differences in the physical characteristics of the respective situations. Not only does the physiological response depend on the S's appraisal, but it also depends on the physical parameters of the stimulus situation. This problem is of paramount importance in stress research as a variety of distractors such as white noise, electric shock, and physical abuse have been applied differentially in the elicitation of emotional behavior. Averill and Opton (1968) in discussing this problem, point out that the mean differences found between the fear and anger stimuli in the Ax (1953) study may not have reflected differences in emotional states, but simply differences in the physical parameters of the stimulus situations. If the same external stimulus situation is used across all Ss, the problem is not removed but now it will be possible to detect physiological responses occurring during emotional states over and above the common responses occurring to the physical parameters of the stimulus situation. In the present investigation, the same external stimulus complex was presented to all Ss and individual differences along the dimension of anger and fear were anticipated in response to these stimuli.

Measurement of the Verbal Behavior

By adopting the approach which defines the emotion experienced in terms of the S's actual response, it followed that the assessment of verbal behavior must be accorded the same importance as the assessment of the physiological behavior. Although the postexperimental interview has been used quite extensively in the past, its use is no longer recommended. The subjective interview, besides being difficult to conduct, suffers from lack of standardization and objective scoring thereby making impossible cross-study comparisons of relevant research. Often the interviewer will not accept at face value the S's interpretation of his experience and begin to probe for what he believes the S "really" experienced. If emotional research is to advance, objective techniques must be implemented to scale the subjective as well as the physiological behavior.

In the past few years various adjective check lists have been devised to circumvent the problems inherent in the interview, the most popular being the Nowlis Mood Adjective Check List (Nowlis, 1965). The Mood Adjective Check List (MACL), in its complete form, consists of 49 self-descriptive adjectives on which S reports his perception of feelings at the moment of taking the test. Each adjective is rated on a four-point scale ranging from "definitely feel" to "definitely do not feel" and the entire test takes only a few minutes to complete. The responses have been factor analyzed several times and have yielded 10 independent dimensions. This makes it possible to use only the mood factors of interest, thereby shortening the time of administration to two or three minutes. Nowlis also sites several articles in support of his claim that the MACL is maximally sensitive to mood and minimally sensitive to other determinants of verbal behavior such as social desirability. Taken as a whole, however, he recognizes the limitations of the MACL in that only a few adjectives are being employed to assess very complex emotional states. This limitation notwithstanding, the MACL constitutes an improvement over the unstructured interview by virtue of its standardization and objectivity.

Measurement of the Physiological Responses

For the purpose of facilitating discussion, this category can be further subdivided into: (i) recording of the physiological responses,

(ii) analysis of the physiological data, and (iii) derivation of the Intrasympathetic Balance Score (ISB).

Recording of the physiological responses. One difficulty more prevalent with the earlier psychophysiological studies was the manner in which the physiological variables were recorded. For instance, Funkenstein et al. (1954) only recorded responses prior to and immediately following the stress period. This approach may misrepresent what has taken place since one summary measure does not describe the entire experimental procedure. In agreement with this position, Mordkoff (1964) has proposed that stress periods may not operate in a unitary fashion in that some periods may elicit different responses than other periods. This is precisely what he found when using the "Subincision" film of Lazarus and his colleagues (Lazarus, Speisman, Mordkoff, and Davidson, 1962) as the film proved to be much more disrupting physiologically at the beginning than at the end.

One assumption behind the use of only pre- and post-stimulation measures is that once the sympathetic system is aroused, it will remain aroused for some period of time. However, Wurtman (1965) disagrees with this position and proposes instead that the sympathetic system responds in short "spurts" with equally short durations of response. Mason (1968) has also adopted a similar position:

> "The extreme lability of the sympathetic-adrenal medullary system which responds so rapidly that levels may show a tenfold change in the human or monkey in 2 min. or may, on the other hand, drop from a peak of 10 ug./L/ or more to less than 1 ug./L. in a few minutes, places heavy technical demands upon the physiological investigator working with the conscious subject. (Mason, 1968, p. 644)"

Regardless of the actual temporal mechanism involved, it was advocated that as many as possible readings be taken from the various stimulus periods.

This was easily achieved with HR as the cardiotachometer permits a continuous record of the R-R intervals which can be converted to beats per minute (bpm). In addition, Opton, Rankin, and Lazarus (1966) have simplified the scoring of cardiotachometer data by proposing only the peak rate reached during prescribed intervals be scored. In addition to saving considerable time, the method offers some control over variation due to the sinus arrythmia. It was more difficult to obtain numerous DBP readings in that the ausculatory method required the inflation and deflation of a cuff for each reading. It was still possible, however, to obtain a number of readings during the experimental session.

Analysis of the physiological data. The statistical analysis of physiological data is most difficult as a linear relationship between the magnitude of psychological response and the magnitude of physiological response cannot always be assumed. Instead a negative relationship often appears between the amount of change evidenced by a physiological variable and the initial level of the same physiological variable. This relationship between initial level and response to stimulation has become known as the "Law of Initial Value" (Wilder, 1958). The law states that the lower the initial level the greater the change in response to a stimulus associated with an increase in activity; the higher the initial level the greater the change in response to a stimulus associated with a decrease in activity. The problem for psychophysiology may be exemplified by considering two hypothetical Ss with initial HR scores of 60 and 90 bpm, respectively. An increase of 10 bpm by both, it would be argued, cannot have the same meaning. The S with the higher initial HR would experience the greater reaction because his increase occurred nearer the upper limit of the cardiovascular system where opposing homeostatic forces are much greater. To have reflected the same reaction as the S with the initial level of 60 bpm, his HR increase should have been more than 10 bpm. Some investigators believe this negative relationship must be removed if meaningful relationships are to be uncovered (Benjamin, 1963; Lacey, 1956).

The most frequently used statistical method used to correct for this dependence on initial level is Lacey's (1956) Autonomic Lability Score (ALS). The ALS is similar to the analysis of covariance in that the effects of initial level are statistically removed. Considerable opposition has been voiced both against the Law of Initial Value (LIV) and Lacey's proposed method of correction. Steinchneider and Lipton (1965) consider the LIV as barely a semi-quantitative law as there is no specific mathematical function relating initial level to the amount of change. The nature of the relationship has also been found to vary across Ss (Sternbach, 1966) and across variables (Shapiro, 1960). On the theoretical side, Lykken (1968) has disagreed with the "blind" removal of the negative correlation of initial level with amount of change. The relationship, he feels, is an empirical fact and therefore may have theoretical value.

At present there is no established precedent for the appropriate analysis. Heath and Oken (1965) have offered an alternative to the ALS which is more conservative as it does not result in a score which is independent of initial level. The method simply involves the standardization of pre- and postscores and then computing the difference. Although not free of the influence of initial level, the resultant standardized difference score (ZDS) is proposed to be a direct measure of change whereas the ALS is not. In addition, there is some evidence that blood pressure is not influenced by the LIV (Shapiro, 1960). In such cases the ZDS has been demonstrated to more clearly reflect the magnitude of change than does the LIV (Heath & Oken, 1965). The present investigation adopted the ZDS approach throughout the data analysis.

Derivation of the Intrasympathetic Balance Score. The Funkenstein hypothesis proposes a relationship between the emotional states, anger and fear, and the catecholamines NE and E. A review of the relevant research suggested DBP and HR to be the most promising variables for differentiating anger and fear within the framework of this hypothesis. This is not to imply the simple equation of HR with fear and DBP with anger as previous research indicated an interaction of both physiological variables with each psychological state. Since both physiological variables are predominantly under the control of the sympathetic nervous system, the Intrasympathetic Balance Score or ISB was proposed as a means of reflecting this interaction on a single continuum. Simply stated, the ISB reflected the standardized difference (mean of 50 and sigma of 10) between S's relative standing on DBP minus his relative standing on HR. A high ISB score therefore reflected a high DBP score relative to a HR score. Conversely, a low ISB score reflected high HR scores relative to DBP scores. In a very narrow sense, the pattern approach of Ax (1953) was retained in this study. In addition, the pattern was directly quantified and expressed on a single continuum.

The ISB scores were derived in a much more specific nature than is implied in the preceding paragraph. In order to adequately summarize the physiological data, it was proposed two kinds of ISB scores be derived, one reflecting pre- and poststimulus or tension data and the other reflecting change or lability data. This was the result of a distinction made by Lacey:

> "Autonomic tension and autonomic lability are simply names for level of function and magnitude of changes, respectively. By autonomic tension, then, is meant simply the direct evaluation of the current status of each physiological function in the units of measurement appropriate to that function...Autonomic lability is a measure of momentary displacement of level as a function of some imposed stimulus. (Lacey, 1959, p. 179)".

Lacey feels the distinction is quite important in that the tension and lability scores have different statistical properties and different relationships to other modes of behavior, both of which were examined in this paper.

By way of illustrating the use of tension and lability scores in the present research, consider an individual with a resting HR of 60 bpm and a resting DBP of 50 mm. Hg. Assume, upon stimulation, his HR rises to 80 bpm and his DBP to 55 mm. Hg. Next the four distributions containing these tension scores are converted into standardized T-scores, with mean equal to 50 and sigma equal to 10. By subtracting the standardized base HR score from the corresponding DBP score, and restandardizing the difference, a specific Tension-ISB score is computed. Similarly, the difference between the tension scores attained under stimulation would constitute another Tension-ISB score. The Lability-ISB score was computed in an identical fashion, except it was based on change scores concomitant with stimulation. Using the standardized tension data, the respective increases shown by HR and DBP were first derived. The differences were then standardized and subtracted from one another, yielding the Lability-ISB score.

PRELIMINARY INVESTIGATION

An extensive preliminary investigation was conducted prior to the present study. The major interest of the preliminary study concerned the stability of the Tension and Lability-ISB scores. Specifically, the degree to which the ISB and its component scores under various conditions were replicable across two successive days was scrutinized. A number of related issues were also examined. Firstly, the reliabilities of ISB scores derived from mean peak scores and simply the peak score were compared. Secondly, the experimental session was divided into several identifiable periods and the physiological responses obtained during these periods were compared. The main division was made on the basis of whether physical or psychological stimuli were predominant. Thirdly, time to recovery following stimulation was examined. This temporal variable has generally been neglected in psychophysiological research. Finally, the relationship of these numerous physiological scores to several self-report inventories were examined.

Procedure and Results

Psychological and physiological data were collected from 50 male Ss enrolled in the introductory psychology class at the University of Manitoba. Upon entering the laboratory, S was seated in a comfortable reclining chair and the physiological apparatus was attached. Following a 20 minute base period S was required to complete the Thayer Affect Adjective Check List (Thayer, 1967), a self-report measure of general activation. Upon completion of the check list, the instructions listed in Appendix A were verbally presented. The experiment was described as a study of the cardiovascular reactions associated with the attentive process. The task was presented to Ss in terms of solving extremely difficult anagrams under the distraction of white noise, with the additional manipulation of harassment by the investigator (E). The underlying purpose of the task was, in actuality, to elicit the emotional responses requisite for the examination of the issues in question. Immediately following the last anagram/noise trial, the adjective check list was readministered. A recovery period of 20 minutes completed the experimental session. Except for minor variations in the instructions and the use of different anagrams, the same procedure was adopted on the following day. In a third and final testing session, self-report inventory data pertaining to anger and fear were collected. A total of three inventories were used, the first being constructed by the E to separate "feel-like" responses from "actual" responses to potential anger-eliciting social stimuli. The Activity Preference Questionnaire (Lykken, and Katzenmeyer, 1967) was used to assess anxiety and Valin's (1967) Nervousness and Anger Questionnaire completed the self-report battery.

The psychophysiological data analysis utilized various subscales of the check list and inventory self-report data in conjunction with the physiological index and component scores obtained during the experimental stress session. Physiological scores were also derived from several identifiable periods of the experimental session: (a) initial rest period, (b) check list period, (c) anagram/noise period, (d) harassment period, and (e) final rest period. Because of incomplete automation, DBP was sampled only intermittently, readings being obtained only during the two rest periods and the harassment period. HR was recorded continuously and scored according to the mean peak method proposed by Opton, Rankin, and Lazarus (1966). In addition, the single maximal rate attained during the various stimulus periods was treated as a separate variable.

The physiological test-retest reliability coefficients and the psychophysiological relationships were statistically evaluated with the Pearson product-moment coefficient of correlation. The main question of this analysis concerned the reliability of the ISB score, taken by itself, and in relation to the component scores from which it was derived. The reliability coefficients are presented in Table 3. The median and range were used to summarize the coefficients for similar scores obtained during different periods. The substantial range exhibited by the various physiological scores attests to the difference of the stimulus periods in eliciting similar responses across consecutive days. In ascending order of reliability were the interval period, the check list period, the initial base period, and the anagram/noise period. An inspection of the polygraph tracing suggested HR to be very stabile during the latter period. However, during the interval separating the anagram/noise trials, there was considerable variation in HR. Lacey and Lacey (1962) have suggested that each S has a maximum level which is reached upon stimulation. This notion is certainly supported by the HR responses to anagram/noise stimulation found in this study. Additional support is provided by the finding that a single peak score obtained during the anagram/noise period was as reliable as the average of a number of peak scores. This suggested

TABLE 3

Twenty-four Hour Reliability Coefficients of the ISB,

Component and Recovery Scores

Score	Median	Range
Lability-ISB	.33	.18 - .54
Tension-ISB	.58	.51 - .69
Lability HR-component	.31	.20 - .57
Lability DBP-component	.50	.45 - .54
Tension HR-component	.76	.56 - .84
Tension DBP-component	.63	.61 - .65
Recovery HR	.30	-
Recovery DBP	.40	-

Note: Lability refers to change scores from base; Tension refers to pre- and post-stress response levels. ISB represents stanardized difference between DBP and HR component measures.

HR did indeed reach a maximum and then level off at the maximum rate. A similar approach was adopted with DBP in that three scores were derived for each period of interest: mean level which was based on all the readings, peak which was the highest level attained, and a mean based on the two highest readings. The latter measure proved to be the most reliable.

As indicated in Table 3, physiological scores derived from lability data were generally considerably less reliable than physiological scores derived from tension data. In actual fact a paradox exists between the reliabilities of change and tension scores (Bereiter, 1967; McNemar, 1962).

Although the reliability of a lability score varies directly with the reliability of tension scores, it also varies inversely with the correlation between tension scores. Therefore the reliability of a change score can only be increased by increasing the reliability of the tension scores, but this also increases the correlation between the latter resulting in a decrease in the reliability of the change score.

The data summarized in Table 3 demonstrates that the derived ISB scores were generally less reliable over time than the component scores. In fact the more the ISB score deviated from the component scores, the more the reliability decreased. This ruled out the possibility of a derived score, comprised of HR and DBP in synergetic or correlated relationship, being a more reliable index than the component scores taken by themselves.

The correlational analysis revealed very few significant relationships between the physiological variables and the self-report data. The intercorrelation matrix was comprised of 240 measures, many of which were dependent. In order to facilitate interpretation, a factor analysis was performed, separately for both days, on the physiological and check list data taken together with the self-report data from the third session. Thus the physiological and check list data of the first day was factor analyzed with the self-report inventory data. The same procedure was followed for the physiological and check list data collected for the second day. A total of 132 variables were factor analyzed for each day. Because of the high degree of experimental dependence among many of the measures, this analysis was intended only as a summary device.

The data were factor analyzed on a computer using a principal-components solution. All factors corresponding to eigenvalues greater than one were retained and rotated to Varimax criterion. Twenty-three factors were retained for rotation on Day 1 and 22 factors were retained on Day 2. On account of the large dependency of many of the measures, no importance could be attributed to the proportion of variance accounted for by each factor. However, on both days, the first five factors appeared to summarize the important aspects of this study. A summary of these factors is presented in Table 4 for Day 1 and Table 5 for Day 2. In the case where a number of similar scores were derived from different periods, the median and range were used to simplify description.

On both Days 1 and 2, Factor I was defined by the high positive leadings of the Lability-ISB scores. The DBP and HR lability component scores also loaded on this factor. In support of Lacey's (1959) distinction between lability and tension physiological scores, the Tension-ISB scores and their components loaded on Factor II. Factor III was described as a general sympathetic change factor as both HR and DBP lability scores loaded equally on this factor. The loadings were also in the same direction thus negating expectations of a possible bipolar factor. The intercorrelations between the DBP and HR lability scores ranged from .27 to .48 across the two days. Factor IV an Day I and Factor V on Day 2 were both defined by the Lability-ISB scores derived from the initial check list period. Inspection of Tables IV and V does not make this evident since Lability scores were summarized under a single classification. The emergence of this specific Lability factor on two consecutive days offers some support for a

TABLE 4

Factor Loadings on the Factors Obtained on Day 1

Variable		Factor I	Factor II	Factor III
Lability-ISB	Med	.87	-.01	.00
	Range	.59 to .93	-.02 to .13	-.07 to .14
Tension-ISB	Med	.15	.68	-.01
	Range	-.23 to .29	.64 to .72	-.10 to .12
Lability-HR	Med	-.32	.04	-.74
	Range	-.03 to -.54	-.14 to .09	-.59 to -.80
Lability-DBP	Med	.68	.00	-.64
	Range	.64 to .69	-.02 to .01	-.63 to -.67
Tension-HR	Med	.07	-.90	-.13
	Range	-.23 to .21	-.86 to -.95	-.32 to .37
Tension-DBP	Med	.27	.01	-.05
	Range	-.11 to .35	.00 to .02	-.10 to .35
Recovery-HR		-.03	-.04	-.19
Recovery-DBP		.11	-.09	-.32
Thayer Check List	Med	.02	.05	.01
	Range	-.21 to .21	-.34 to .33	-.06 to .04
Valins: Anger		.01	.05	.16
Nervousness		.06	.01	-.01
APQ: Social Anxiety		-.06	.01	-.23
Physical Anxiety		.10	-.23	-.07
Ego Threat		-.28	.12	-.06

Note: The median and range were used to summarize identical scores derived from different stimulus periods. Lability-ISB represents scores based on the difference between standardized DBP and HR lability scores. Tension-ISB scores represent the difference between standardized DBP and HR tension scores. Lability-HR and Lability-DBP refer to change scores from prestimulus or base level. Tension-HR refers to pre- and poststimulus standardized HR scores, while Tension-DBP refers to pre- and poststimulus DBP scores. Recovery scores refer to the time in minutes taken to return to prestimulus levels.

TABLE 4 (CONTINUED)

Variable		Factor IV	Factor V
Lability-ISB	Med	.10	.13
	Range	-.01 to .75	-.09 to .22
Tension-ISB	Med	.02	.66
	Range	-.05 to .20	.64 to .69
Lability-HR	Med	-.05	-.15
	Range	-.54 to .02	-.07 to -.21
Lability-DBP	Med	.05	.09
	Range	.04 to .15	-.09 to .09
Tension-HR	Med	.09	-.04
	Range	-.43 to .13	-.09 to .08
Tension-DBP	Med	.05	.91
	Range	.03 to .07	.90 to .94
Recovery-HR		.06	.05
Recovery-DBP		.26	.13
Thayer Check List	Med	-.01	.01
	Range	-.19 to .14	-.16 to .06
Valins: Anger		.03	.19
Nervousness		-.05	-.13
APQ: Social Anxiety		-.19	-.03
Physical Anxiety		-.25	.03
Ego Threat		-.02	-.03

TABLE 5

Factor Loadings on the Factors Obtained on Day 2

Variable		Factor I	II	III
Lability-ISB	Med	.88	.01	-.07
	Range	.66 to .96	-.07 to .09	-.22 to .22
Tension-ISB	Med	.20	.57	.05
	Range	-.30 to .29	.54 to .62	-.12 to .08
Lability-HR	Med	-.38	-.03	.75
	Range	-.48 to -.21	-.10 to .03	-.54 to .86
Lability-DBP	Med	.68	.00	.67
	Range	.66 to .73	-.02 to .00	-.59 to .69
Tension-HR	Med	-.05	-.93	.09
	Range	-.12 to .13	-.86 to -.97	-.30 to .12
Tension-DBP	Med	.20	-.17	.08
	Range	-.20 to .27	-.16 to -.18	-.30 to .12
Recovery-HR		-.14	.04	.39
Recovery-DBP		.35	-.21	.25
Thayer Check List	Med	.01	.07	.01
	Range	-.17 to .28	-.30 to .17	-.20 to .17
Valins: Anger		-.04	-.12	-.09
Nervousness		-.12	.01	.06
APQ: Social Anxiety		-.27	.07	.34
Physical Anxiety		-.12	.14	.18
Ego Threat		-.40	.18	.36

TABLE 5 (CONTINUED)

Variable		Factor IV	Factor V
Lability-ISB	Med	-.04	-.01
	Range	-.17 to .12	-.65 to .05
Tension-ISB	Med	-.75	.05
	Range	-.72 to -.77	-.22 to .07
Lability-HR	Med	.00	-.03
	Range	-.07 to .17	-.06 to .83
Lability-DBP	Med	-.04	-.81
	Range	-.05 to -.106	-.02 to .00
Tension-HR	Med	.07	-.09
	Range	-.01 to .12	-.10 to .28
Tension-DBP	Med	-.93	.00
	Range	-.91 to -.95	-.01 to -.01
Recovery-HR		-.01	-.19
Recovery-DBP		-.40	-.13
Thayer Check List	Med	.02	.06
	Range	-.11 to .25	-.28 to .27
Valins: Anger		-.05	.10
Nervousness		.06	.09
APQ: Social Anxiety		.16	-.12
Physical Anxiety		.27	-.22
Ego Threat		.18	-.44

differentiation tack in analyzing experimental stress periods. Factor V on Day 1 and Factor IV on Day 2 were defined by the Tension-DBP scores, with the Tension-ISB scores also loading moderately on this factor. Contrary to the lability scores, HR and DBP tension scores did not intercorrelate significantly.

The general failure of the inventory self-report measures to correlate with the physiological scores was substantiated by their similar failure to load on the physiological factors. However, the Ego Threat subscale of the APQ did load on the Lability-ISB factors on Day 2, although it failed to do so on Day 1. The correlation accounting for this loading were quite respectable ranging from an infrequent low of -.01 to a moderately frequent high of -.44. The Anger and Nervousness scales exhibited near zero correlations with the various physiological measures. The two scales did intercorrelate .60 which supports a similar correlation of .67 found by Valins (1964). This relationship led Valins to conclude that Ss who are more or less anxious to potential anxiety-eliciting stimuli are also more or less angry to potential anger-eliciting stimuli. In any case, the scales were not successful in differentiating individuals along the proposed anger-fear continuum.

The principle finding of the preliminary investigation was comprised of supportive data confirming the reliability and specificity of the physiological factors. Although the lability component scores for HR and DBP appeared as a common factor, the corresponding physiological tension scores did load on distinct factors. In addition, the correlations between HR and DBP tension scores, although nonsignificant, were generally negative and thus partially supportive of the proposed synergetic relationship between these cardiovascular variables.

The theoretical value of these physiological factors remains questionable since their relationship to other behavioral modes was not firmly established. In the preliminary investigation, the physiological factors, taken by themselves, reflect the commonly found failure of physiological indices to intercorrelate, (Lacey, 1956; Malmstrom, Opton, & Lazarus, 1965). This is not to degrade the value of physiological factors however. The value of these or other physiological factors can only come from demonstrated empirical relationships with other behavioral measures.

STATEMENT OF THE PROBLEM

This investigation was concerned with the physiological specificity of the emotional states of anger and fear. In spite of the current interest in psychophysiology, this important topic has received only peripheral attention. The possibility of such a distinction has been discussed in several recent texts and review articles (Averill and Opton, 1968; Buss, 1961; Sternbach, 1966), but unfortunately, such discussions have been limited to reviewing (and re-reviewing) the few "classic" studies available. The paucity of data is exemplified by the fact that very few studies (Ax, 1953; Funkenstein, et al., 1954; Schachter, 1957) have been offered in support of the specificity hypothesis. Although these studies were published over a decade ago, no serious attempt has been made to replicate or extend their findings. When this fact is considered along with the methodological deficiencies of these studies, it is not surprising reviewers have been reluctant to concede that the physiological differentiation of anger and fear has in fact been demonstrated.

Unlike most psychophysiological research, the physiological specificity of anger and fear hypothesis is actually the outgrowth of a similar hypothesis at the endocrine level. Specifically it has been proposed that anger and fear lead to differential secretion of NE and E from the adrenal medulla (Funkenstein et al., 1954). This proposed relationship, commonly known as the "Funkenstein hypothesis", has received some support from studies which have examined the effects of stress on urinary catecholamine content (Elmadjian et al., 1957; Cohen and Silverman, 1959), as well as from a study which compared medullary NE and E concentrations of aggressive and timid animals. However, reviewers of the endocrine research (Mason, 1968; Schildkraut and Kety, 1967) have exhibited the same caution as their physiological counterparts. Again this is the result of too few studies with too many deficiencies. Endocrine researchers have grossly neglected quantification of results, control of bias, and operationistic approaches in defining anger and fear.

In view of these methodological limitations, the Funkenstein hypothesis remains largely speculative in nature. The present research attempted to ameliorate this neglect of methodology by focusing primarily on the operationalizing of anger and fear psychophysiological responses. This approach permitted comparisons on a quantitative level, between the self-report and physiological data.

The Intrasympathetic Balance Score (IBS) was proposed as a means of directly quantifying, along a single continuum, the physiological responses of HR and DBP elicited in the experimental session. The preliminary investigation failed to establish the utility of the index, since it did not relate to the other behavioral measures employed. It was re-examined in the present study in relation to a number of other self-report measures, which in general were more specific to the anger-fear construct than the self-report materials used in the preliminary investigation. The usefulness of the ISB score rests on the supposition that it relates more robustly to the self-report measures than either HR or DBP taken alone.

It was considered peremptory by the nature of the subject matter, and most useful in this context, to employ a correlational approach to the investigation of the psychophysiological relationships under study. Since the relationships to date have been multi faceted and highly speculative, it was considered premature to adopt the conventional null hypothesis decision procedure. Instead a strictly exploratory approach was adopted in the expectation that systemic relationships between the variables under study might emerge.

CHAPTER II

METHOD

Subjects (Ss)

Physiological and psychological data were collected from 100 male introductory psychology students at the University of Manitoba. Participation was required for partial fulfillment of the introductory course requirement. The mean age of the Ss was 19 with a range of 17-25 years.

Physiological Apparatus

Heart rate was recorded from a Grass Model 5 polygraph. The electrocardiogram (ECG) was recorded from silver-disc electrodes affixed to the sternum and fifth intercostal space. HR was derived from the R-R interval of the ECG by a cardiotachometer. DBP was recorded indirectly with a Model Har-6 Blood Pressure Monitor.[1] This device has a pressure transducer located in the cuff which converts the sounds of Korotkoff into an electrical signal. It also has a fixed bleed rate of 3-4 mm. Hg per second at a HR of 80 bpm, and a locking device which is activated with the disappearance of the Korotkoff sounds. The inflatable cuff was firmly attached just above the anticubital fossa (Wiggers, Conner, Hamilton, Kerr, and Bordley, 1951). Since SBP was not relevant to the present study, it was possible to record only DBP. This procedure minimized discomfort resulting from cuff inflation and facilitated the acquisition of numerous DBP readings.

Self-report Materials (Appendix D)

Mood Adjective Check List. A modified version of the Nowlis Mood

[1] Harco Electronics Ltd., Winnipeg, Canada.

Adjective Check List (Nowlis, 1966) was used to assess the verbal responses to the experimental stress stimuli. The specific mood factors considered relevant to the present study were: Hostility, Anxiety, and Skepticism; Hostility and Anxiety were considered synonymous with anger and fear, respectively. Skepticism was included to assess the Ss suspicions regarding the nature of the experimental task (Schultz, 1969). In addition, the Skepticism factor score was combined with Hostility as a means of differentiating Anger-out from Anger-in verbal responses (Funkenstein et al., 1954). The adjectives representing these moods were buffered with several non-directional adjectives from the Thayer Adjective Check List (Thayer, 1967).

Post Experimental Questionnaire. This questionnaire was devised by E to obtain information on the subjective reactions to the stress stimuli, as well as to assess the effects of smoking and time of last meal on the physiological responses. The variable of birth order was also included since this variable has been found to yield individual differences in response to frustrating stimuli (Glass et al., 1963).

Activity Preference Questionnaire. Devised by Lykken and Katzenmeyer (1967), the Activity Preference Questionnaire (APQ) is a 100-item forced choice anxiety questionnaire which requires the respondent to choose between one of two unpleasant activities. Although each pair of alternatives is matched for degree of unpleasantness, one alternative is noxious because it is distasteful or tedious, while the other is embarrassing or anxiety arousing. It is assumed the anxious S will endorse the noxious or distasteful alternative when asked to indicate a preference. One proposed advantage of the APQ is that it minimizes the operation of inventory contaminants such as social desirability and response sets by not requiring the respondent to admit to psychiatric and somatic symptoms. Lykken and Katzenmeyer derived, by inspection, three factors to represent responses to the total inventory: Physical Anxiety (fear of physical danger), Social Anxiety (fear of social stress and embarrassment), and Ego Threat (anxiety over situations involving guilt, shame, and failure). The inventory also incorporates two lie scales which were derived by pairing anxiety with anxiety items and noxious with noxious items. An honest and deliberate response would simply involve endorsement of the less intense alternative.

Buss-Durkee Hostility Inventory. The Buss-Durkee Hostility scale (Buss and Durkee, 1957) is a 75-item true-false questionnaire. It consists of seven subscales designed to measure different aspects of the construct "Hostility-Aggression" and one additional subscale designed to measure guilt over the expression of aggression. Buss (1961) has factor analyzed the subscales and found two clusters, corresponding to his theoretical distinction between aggression and hostility. The subscales are: Assault, Indirect, Irritability, Negativism, Resentment, Suspicion, Verbal, and Guilt.

Fenz Anxiety Scale. The Fenz Anxiety scale is a 53-item inventory composed of items from the Taylor Manifest Anxiety Scale. It requires the respondent to indicate the degree of applicability of each item on a 5-point scale ranging from "never" to "almost always". Fenz (1967) has identified three factors to account for the total score and in support of his response specificity hypothesis has found relationships with other measures to be specific to each factor. The three factors are: Autonomic Arousal, Striated

Muscle Tension, and Feelings of Insecurity.

Cattell Factors U.I. 18 and U.I. 20. These factors were selected from the Cattell 12 Objective-Analytic Battery (Cattell et al., 1955) on the basis of a previously demonstrated relationship with NE and E levels (Fine and Sweeney, 1968). The establishment of a similar relationship between the Cattell factors and the ISB score was attempted since there is the suggestion of a relationship between the physiological score and hormonal secretion (Funkenstein et al., 1954).

Although Cattell et al. (1955) preferred to avoid the ambiguity attendant upon premature labeling, their operationalistically derived factors nonetheless have accompanying adjectival descriptions. Factor U.I. 18 is also called Hypomanic Overcompensation, a high score reflecting excessive self-criticism accompanied by strong compensatory tendencies. Factor U.I. 20 or Social Willingness is proposed to reflect honesty and social conformity. Low scores are suggested as being characteristic of psychopathic and criminal personalities. The tests comprising these two factors were too numerous and lengthy to be included in Appendix D.

Stimulus Materials

The external stimulus-complex consisted of 5-letter anagrams, white noise, and verbal harassment. The words behind the anagrams were selected from the Thorndike and Lorge (1944) word list. The anagrams (Appendix C) were constructed from words of low frequency of occurrence and maximum letter order difficulty to minimize their mastery (Mayzner and Tressault, 1958). White noise (90 decibels) was administered binaurally via headphones. The comments selected for verbal harassment are presented in

Appendix B and were modeled after those used by Funkenstein et al. (1954) and Dykman et al. (1963).

Control of Extraneous Variables

Wenger and Cullen (1962) have stressed the importance of extraneous variables known to affect autonomic activity. In the present study age and sex were restricted by using only male Ss under the age of 26. The physiological measures were examined for time of day. Elliott and Thysell's (1968) suggestion that Ss be instructed not to smoke for at least an hour prior to the experiment was also adopted. Thermal constriction and dilatation was kept minimal by maintaining the laboratory froom temperature between 74 F $\pm$ 2 F (Wood, 1968).

Procedure

No advance information was given to the Ss concerning the nature of the experiment. Upon arrival at the lab, S was seated in a comfortable reclining chair facing a bare wall used as a screen for slide presentation. The room was semi-darkened and the fans from the slide projector and polygraph provided a constant background noise of 45-50 decibels. The actual experimental sequence is presented in Table 6.

Baseline period. During this period, S, seated in the comfortable chair, remained quiet and motionless with his head leaning back on the chair, eyes open, and under the instructions to relax as much as possible. HR was recorded continuously for 20 minutes at a paper speed of 1.5 mm. per second. After five minutes of elapsed time the blood pressure cuff was inflated and deflated once to minimize reflex vasoconstriction. The last two minutes of this period were used to obtain the base HR values to be

TABLE 6

Experimental Sequence for All Subjects

Period		Duration in Minutes
Baseline or rest period		20.0
Check list period		3.0
Instructions		4.0
Anticipation period		1.5
Anagram/noise and intervals		15.0
Check list period		2.0
Recovery period		20.0
	Total	65.5

used in comparison with the effects of the stress stimuli. Resting DBP was determined from six readings taken at 90-second intervals during the last 10 minutes of this period.

<u>Check list period</u>. Following the completion of the base period, S was required to complete the Mood Adjective Check List for the first time. It was simply handed to the S on a clip-board with the instructions to read and complete. This required between three and four minutes to complete.

<u>Instructions</u>. The instruction period was used to convey the ostensible nature of the experiment and the task required of the S. The experiment was described as a study of the attentional process. Specifically the S's task was to develop a "narrow attentional span" by ignoring the white noise and solving the anagrams. Only two Ss were able to solve over 40 per

cent of the anagrams to make it impracticable to administer the critical comments. The data from these Ss were not used in the analysis. The actual instructions are contained in Appendix A, and were presented by means of a tape recorder.

Anticipation period. This was simply a 90-second period immediately following the instructions and the S's acknowledgement that he was ready to proceed. HR was recorded continuously throughout this period and a single DBP reading was also obtained near the end of the period.

Stress period. The stress period consisted of the presentation, by means of a slide projector, of seven series of anagrams, separated by 90-second intervals. Each series contained eight anagrams with a visual duration of 10 seconds for each anagram. White noise was administered only during the anagram periods. During the interval periods, S was chastised for poor performance. The entire sequence was controlled electronically and an event marker was used to delineate the various periods on the Grass recorder. DBP was sampled once during each of the anagram and interval periods. The interval readings always followed the critical comment.

Check list period. At the end of the last anagram/noise series, the headphones were immediately removed and S was requested to recomplete the MACL.

Recovery period. A 20-minute recovery period followed the completion of the check list. Similar to the initial rest period, S was instructed to relax, with eyes open and head towards the front. Conversation during this period was forbidden.

Post experimental questionnaire. Immediately following the recovery session and while in the recliner, S was required to complete a short questionnaire dealing with his reactions to the experiment. The variable of birth order was also administered as part of this questionnaire. Upon completion of the questionnaire, S was disconnected from the apparatus and assured that his performance on the anagrams was quite satisfactory. Ss were also requested not to discuss the experiment with their fellow introductory students.

Personality Inventory Sessions. All Ss were required to return at a later date and complete the Activity Preference Questionnaire (Lykken and Katzenmeyer, 1967), the Fenz Anxiety Scale (Fenz, 1967), the Buss-Durkee Hostility Inventory (Buss and Durkee, 1957), and the numerous tests which comprise Factors U.I. 18 and 20 from the Cattell battery (Cattell et al., 1955). Two separate sessions of approximately one hour each were required to complete this material. The stress and psychometric sessions were divorced from one another by having another E collect the psychometric data.

Physiological Analysis

Heart rate. Separate HR scores were derived from the base, anticipation, anagram/noise, interval, and recovery periods. For each of these periods HR was derived according to the peak rate method proposed by Opton et al. (1966). The method greatly simplifies the scoring of cardiotachometer data by requiring the computation of only the peak rate attained during a prescribed period, which in this study was every 10 seconds. The score used to represent a specific period was the average of the peak rates for all the 10-second segments of that period. Artifacts were kept minimal by only scoring as a "peak" a deflection preceded and succeeded by deflections within 10 mm. of the deflection of interest.

Diastolic blood pressure. Although much more difficult to record than HR, separate DBP scores were also derived for the same periods as HR scores were derived. Only one reading was obtained during the anticipation period. Seven readings were obtained during the anagram/noise series, one reading from each series. Similarly, a single reading was obtained from each of the intervals separating the anagram/noise series. In addition to deriving the average DBP score, another score based on the average of the two highest readings obtained during a period of interest was computed.

Lability Intrasympathetic Balance Score. The L-ISB represented the difference between relative HR and DBP change or lability component scores. It was derived by first standardizing the pre- and posttension scores for each cardiovascular variable. The relative difference exhibited by each variable was then determined by subtracting the pre- from posttension scores. The differences were then standardized and the difference of the differences computed. L-ISB scores were derived to represent the anticipation, anagram/noise, and interval periods.

Tension Intrasympathetic Balance Score. The T-ISB simply represented the difference between DBP and HR standardized tension scores. T-ISB scores were derived for the base, anticipation, anagram/noise, and interval periods.

Recovery scores. HR recovery was defined as the time elapsed into the recovery period before the rate was within four bpm of the base level. DBP recovery time was defined as the time elapsed in 90-second intervals prior to two successive readings which were within four mm. Hg of the average base level.

Resting autonomic activity. A number of investigators in studying continuous recordings of autonomic functioning of Ss at rest have observed short "bursts" in their recordings. Lacey and Lacey (1958) found a score representing this "spontaneous autonomic activity" to have a fairly high 48-hour reliability and to be unrelated to other measures derived from the same variable. As a descriptive device, they proposed that Ss exhibiting a high degree of spontaneous or background activity be called "labiles" and those at the other end of the continuum be called "stabiles". Labiles have been found to be more impulsive as measured by perceptual speed tasks (Boyle, Dykman, and Ackerman, 1965; Lacey and Lacey, 1958). Wilson and Dykman (1960) found the variable of background activity as derived from HR to be unrelated to the Taylor Manifest Anxiety Scale, and positively related to a measure of defensiveness.

In the present investigation a background activity score was derived from HR both during the initial base period and the final recovery period. A procedure similar to that used by Boyle et al. (1965) was used to compute the background activity score. The base and recovery periods were divided into 10-second segments and a background interval (BI) was scored if the maximal rate in a 10-second segment was at least six bpm higher than the maximal rate in the preceding interval. Although the intervals were longer than those employed by Boyle et al. there was less chance of scoring atypical fluctuations from the sinus arrythmia.

CHAPTER III

RESULTS

The effectiveness of the psychological stress session in eliciting physiological changes was assessed by examining the absolute mean change scores for DBP and HR. These change scores are presented in Table 7. The largest DBP changes occurred during the interval periods in which Ss were being criticized while the largest HR changes occurred during the anagram/noise periods.

TABLE 7

Absolute Mean and Standard Deviations for Diastolic Blood Pressure (DBP) and Heart Rate (HR) Change Scores Across Psychological Stress Periods

Physiological Measure	Stimulus Period		
	Anticipation	Anagram/Noise	Interval
DBP Peak Change (mm.Hg)			
M	-	13.6	14.7
SD	-	6.2	5.4
DBP Mean Change (mm.Hg.)			
M	5.1	8.7	11.3
SD	3.9	5.4	4.8
HR Mean Change (b.p.m.)			
M	7.2	16.2	9.1
SD	6.3	7.7	5.8

Note: DBP peak change score represented the average of the two highest readings obtained during the stimulus period of interest.

R-TECHNIQUE CORRELATIONAL ANALYSIS

A total of 33 physiological measures were derived from the HR and DBP data, consisting of recovery scores and the ISB index and component scores which were computed separately for the base, anticipation, anagram/noise, and interval periods. Similarly 46 self-report scores resulted from the separate treatment of the various personality and check list subscales. Seven additional measures were obtained from the postexperimental questionnaire. The physiological and self-report postexperimental, check list, and personality inventory data were analyzed with the Pearson product-moment coefficient of correlation. The complete matrix of correlations and accompanying definitions of the measures are presented in Appendix E.

Physiological postexperimental

The postexperimental questionnaire was designed to investigate birth order, subjective reactions to the intellectual stress session, and the potentially confounding variables of smoking, time of last meal, and time of testing. Birth order bore no significant relationship to the psychophysiological indices used in the present study. Of the three items designed to examine subjective responses to the stress situation, only one correlated significantly with other variables. This item called for a response from Ss regarding the frequency with which they reflected upon the adequacy of their performance during the stress session. The expectation that high anxiety Ss would receive the highest score on this item was supported in part since the item correlated .33[2] with posttest Anxiety from the MACL. The strength of this relationship is attenuated, however, by virtue of a higher correlation between posttest MACL Hostility and this item (r = .40).

Smokers manifested a noticeably higher HR than non-smokers only during the anagram/noise period, the correlation being .32. Time of last meal correlated .23 to .28 with the various DBP scores, indicating a low relationship between duration since eating and level of DBP. Time of testing (i.e., whether A.M. or P.M.) did not relate to any of the physiological measures.

With the scoring of the physiological data, another contaminating variable presented itself. From the experiment taken in toto, it appeared that Ss run during the latter stages manifested less autonomic arousal than earlier Ss exposed to the same manipulation. Evidence for this came from specific measures, the maximum strength of relationship being with HR lability derived during the anticipation period (r = -.39). This trend was maintained with DBP as well but the relationships were of a lesser magnitude (r = -.16 to -.26). The relationships between the order in which Ss were run during the entire experiment and their verbal responses to the MACL adjectives were not as manifest as those involving the physiological variables; however, data suggestive of this phenomenon did exist. A significant correlation was obtained with posttest Anxiety (r = -.21). Taken as a whole these

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[2]An N of 100 was used for the complete matrix of correlations. Therefore, $p < .05$, r = .20 $p < .01$, r = .26.

data suggest that the order in which Ss were run in the experiment is a factor meriting consideration.

Physiological-MACL Check List

Pre, post, and change scores were derived for each of the Hostility, Anxiety, and Skepticism factors of the MACL. In addition, a combined Hostility plus Skepticism score was computed for the purpose of correlation with physiological variables, since it was considered that this might yield higher relationships than either mood factor alone. The pretest Anxiety score correlated .33 with the HR tension score derived from the base period. This score also correlated from .37 to .39 with HR tension scores from the anticipation, anagram/noise, and interval periods. However, the posttest and change Anxiety scores failed to correlate significantly with the physiological measures. In addition, the proposed synergetic relationship between HR and DBP was not supported since the other mood factors failed to relate to either HR or DBP. Thus the present study established few relationships between mood states and physiological responses to the stress situation.

Physiological-Personality Inventory

A similar lack of relationship was apparent with the personality trait measures and the physiological scores. No significant relationships emerged between the physiological measures and the Cattell factors U.I. 18 and U.I. 20. The six scales derived from the two anxiety inventories yielded only one coefficient beyond .20, the Muscle Tension subscale correlated .22 with DBP tension derived from the interval periods in which Ss were being chastised. Evidence for some relationship between the personality factors Hostility and Aggression, measured by the Buss-Durkee Hostility Inventory, and DBP was obtained; however, it is more instructive to consider this relationship in terms of the constituent subscales. The aggression subscale Indirect correlated -.21 with HR tension score derived from the base period. The Hostility subscales Resentment and Suspicion correlated .22 and .28 with the DBP tension score derived from the criticism periods. The relationships, it appears, are specific to certain subscales and to certain portions of the stress periods, the most useful period being that in which Ss were being criticized. There is the implication of some qualified support for the Funkenstein hypothesis in as much as the Buss-Durkee scale at least tends to relate to DBP.

The relationships between the personality data and the MACL check list factors defied interpretation a propos of the Funkenstein hypothesis. For example, the inventory subscales Autonomic Arousal and Feelings of Insecurity correlated .26 and .34 with posttest Hostility, while the Aggression subscale of Irritability correlated .26 with posttest Hostility and .27 with posttest Anxiety.

The anxiety inventories employed bore little relationship to one another since near zero correlations were obtained between the APQ and Fenz subscales. No relationship was found between the Cattell factors U.I. 18 and 20, the Buss-Durkee, and the APQ subscales. Some slight relationship was found between the Fenz subscales and the Buss-Durkee factors, since Autonomic Arousal and Muscle Tension correlated .32 and .38 with the Hostility factor of the Buss-Durkee inventory. In addition, the subscale Feelings of Insecurity correlated .55 with Hostility and .38 with Agression.

Q-TECHNIQUE CORRELATIONAL ANALYSIS

The magnitude of the nonsignificant relationships between the various subscales of the self-report inventories and the physiological measures suggested that Ss were perhaps idiosyncratic in their overall responses to the self-report data. Thus a pattern approach over several subscales might yield relationships with the physiological measures that were not discernable from the separate treatment of each subscale. To obtain information on this matter, a Q-factor analysis was performed. This technique represents one of the six basic uses of factor analysis proposed by Cattell (1952) for studying covariation in tests, persons, and occasions. It is the obverse of the more common R-technique which involves correlating tests over Ss. In the Q-factor analytic technique, Ss and tests are interchanged so that Ss are correlated over tests and then factored.

The various subscales from the APQ, the Fenz modified MAS, and the Buss-Durkee Hostility inventory constituted the tests employed in the Q-factor analysis of the present study. Factors U.I. 18 and U.I. 20 from the Cattell battery were excluded from this analysis on the basis of their not pertaining to the anger-fear dimension. Table 8 contains a list and a sample item from each of the 14 subscales. A complete list of items for each subscale appears in Appendix D.

Lykken (1967) suggests that Social Anxiety (S) deals with anxiety proneness to social situations; while Physical Anxiety (P) refers to fear of possible physical danger. Ego Threat (E) refers to symptoms characteristic of personal failure and lack of competence. Fenz (1967) too, in dealing with the constituent factors of anxiety, derived three factors from

TABLE 8

Personality Inventory Subscales Used in the Q-Factor Analysis

Subscales	Condensed Representative Items
A. Activity Preference Questionnaire	
1. Social Anxiety (S)	Being interviewed for a job
2. Physical Anxiety (P)	Jumping down 15 ft. into soft earth
3. Ego Threat (E)	Overhearing sarcastic comments
B. Fenz Anxiety Scale	
4. Autonomic Arousal (A)	Bothered with dizziness
5. Muscle Tension (M)	Troubled with backaches
6. Feelings of Insecurity (F)	Feelings easily hurt
C. Buss-Durkee Hostility Inventory	
7. Assault (As)	Will resort to physical violence
8. Indirect (I)	When mad, will slam doors
9. Irritability (Ir)	Feel like a powder ked ready to explode
10. Negativism (N)	Will do the opposite of what is asked
111. Verbal (V)	Often disagree with people
12. Resentment (R)	Don't get what is coming
13. Suspicion (Su)	People talk behind my back
14. Guilt (G)	Cheating leads to remorse

MAS responses. These were Autonomic Arousal (A) which pertains to symptoms characteristic of the autonomic nervous system; Muscle tension (M) which refers to symptoms specific to striated muscles, and Feelings of Insecurity (F) comprised of items that reflect general anxiety.

Buss (1961) applied a similar method in his treatment of aggression and hostility. In his treatment of aggression he derived five subscales each of which defines a particular kind of aggression. These scales, Assault (As), Indirect (I), Irritability (Ir), Negativism (N), and Verbal (V), taken as a whole comprise aggression. More specifically, the Assault subscale contains items reflecting physical violence against others, while Indirect refers to attack by more devious means. Irritability reflects a predisposition to attack upon mild provocation. The Negativism subscale reflects active or passive opposition, while Verbal involves negative affect expressed in speech. Similarly, Hostility was found to be comprised of Resentment (R) and Suspicion (Su) which involve attitudes characterized by hatred and jealousy. A subscale of Guilt (G) was included in the inventory to assess guilt arising from the expression of hostile and aggressive impulses.

The Q-types were derived by first standardizing, across Ss, the responses to the 14 subscales. Next the 100 x 14 standard score matrix was inverted and Ss were then standardized across tests, a procedure which renders the Pearson coefficients invariant across the direction of test scoring (Block, 1970). The double-standardized scores were intercorrelated and factored via a principal components solution and the factors rotated to Varimax criterion. The first six factors, accounting for 64.2 per cent of the variance, were used in the computation of the Q-types. The following criteria were used in the placement of Ss within a particular Q-type: Ss had to load at least .50 on the factor with the additional stipulation that the square of this loading be at least twice the square of their loadings on the remaining factors. This procedure maximized the location of "pure" rather than "mixed" types. Since these criteria were attained on all six factors by at least one positive and negative loader, the end result was the creation of 12 Q-types.

The number of Ss loading on the Q-types ranged from one to nine, making statistical comparisons with the physiological scores difficult to interpret. In lieu of statistical comparisons, therefore, an inspectional examination of the types across the physiological scores was performed. To simplify these comparisons the 31 physiological scores were first summarized by a R-factor analytic solution and factor scores for each S on the physiological factors derived. Since a high degree of experimental depandency existed between many of the measures, the use of factor scores minimized redundant comparisons. For instance, several HR tension scores were derived which intercorrelated highly and therefore defined one of the factors. By using factor scores a single comparison with the factor was possible without making comparisons on each of the HR tensions scores.

A summary of the physiological factors is presented in Table 9. These factors accounted for all of the derived scores and were also very similar to physiological factors of the preliminary investigation. Factor I is defined negatively by the DBP pre- and poststimulus tension scores, with the derived T-ISB index scores also loading negatively on this factor. Factor

TABLE 9

Summary of the Physiological Factor Loadings

Variable		Factor I	Factor II	Factor III
Lability-ISB	Med	-.02	-.56	-.10
	Range	-.04 to .01	-.62 to -.32	-.16 to -.04
Tension-ISB	Med	-.66	-.06	-.72
	Range	-.67 to -.63	-.13 to -.15	-.73 to -.67
Lability-HR	Med	-.03	-.18	.05
	Range	-.04 to .02	-.22 to -.15	.05 to .11
Lability-DBP	Med	-.06	-.91	.00
	Range	-.08 to -.01	-.97 to -.65	-.12 to .04
Tension-HR	Med	-.12	.00	.93
	Range	-.13 to .10	-.05 to .00	.90 to .96
Tension-DBP	Med	-.98	.12	.03
	Range	-.99 to -.97	-.15 to .29	-.04 to .05
Recovery-HR		.08	-.01	-.09
Recovery-DBP		-.01	-.68	.09
Background Activity-HR	Base	-.01	-.15	.11
	Recovery	.14	.08	-.45

Note: The median and range were used to summarize identidal scores derived from different stimulus periods. Lability-ISB represents scores based on the difference between standardized DBP and HR lability scores. Tension-ISB scores represent the difference between standardized DBP and HR tension scores. Lability-HR refers to HR change scores from prestimulus or base level. Lability-DBP scores were derived in a similar fashion. Tension-HR refers to pre- and poststimulus HR scores, while Tension-DBP refers to pre- and poststimulus DBP scores. Recovery scores pertain to the time in minutes taken to return to prestimulus levels. Background Activity refers to HR variability during the base and recovery periods.

TABLE 9 (CONTINUED)

Variable		Factor IV	V	VI
Lability-ISB	Med	-.72	-.20	.06
	Range	-.74 to -.54	-.72 to .07	-.01 to .10
Tension-ISB	Med	-.02	.05	.03
	Range	-.16 to .31	-.31 to .09	.00 to .05
Lability-HR	Med	.90	.04	.04
	Range	.70 to .93	.02 to .52	-.06 to .00
Lability-DBP	Med	-.01	-.24	.02
	Range	-.04 to .02	-.54 to .00	-.06 to .08
Tension-HR	Med	.06	.00	-.01
	Range	-.39 to .20	-.02 to .27	-.04 to .00
Tension-DBP	Med	.00	.05	.00
	Range	-.03 to .01	-.15 to .11	-.04 to .02
Recovery-HR		.55	-.02	.19
Recovery-DBP		.09	.24	.04
Background Activity	Base	.14	-.07	.85
	Recovery	-.22	.14	.69

II is defined negatively by the DBP change or lability scores. The L-ISB scores and the DBP recovery score loaded on this factor as well. Positively defining Factor III are the HR tension scores, while Factor IV is defined by the HR lability scores. Thus in the present study HR lability scores did not correlate significantly with DBP lability scores. However, the specificity of the physiological responses found in the preliminary investigation is partially supported in the present study since Factor V is defined by the L-ISB score derived from the 90-second anticipation period. This accounts for the single large loading in Table 9 under Lability-ISB and Factor V. The HR and DBP lability component scores derived during the anticipation period also loaded moderately on this factor. The base and recovery background activity HR scores defined Factor VI. The finding that HR variability did not load appreciably on the other physiological factors suggests it is an independent physiological dimension.

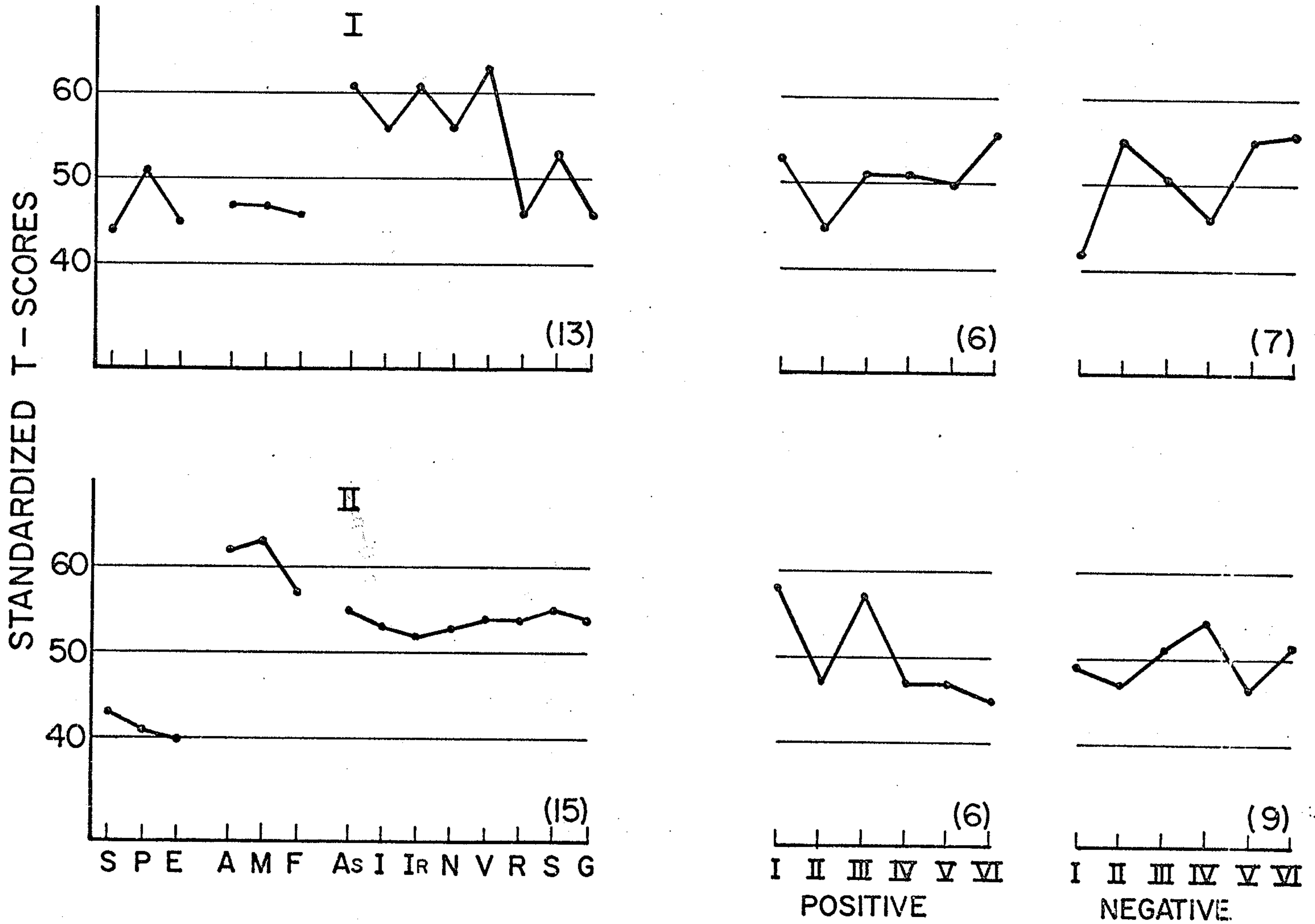
The factor scores were derived using Kaiser's (1962) method for principal-component solutions. The mean factor scores for positive and negative loaders, along with the self-report Q-profiles, are presented in Figure 1. The negatively defined physiological factors I, II, and IV were inverted in order to facilitate comparisons across all factor scores. In this way a high score on a negative factor would be plotted as a low score on the reflected positive factor.

The Q-profiles were derived by plotting the mean standard scores of Ss comprising these six factors. The mean standard scores were obtained from the original normative standard score matrix of 100 Ss across 14 subscales. There were positive and negative loaders on each of the six

Figure 1

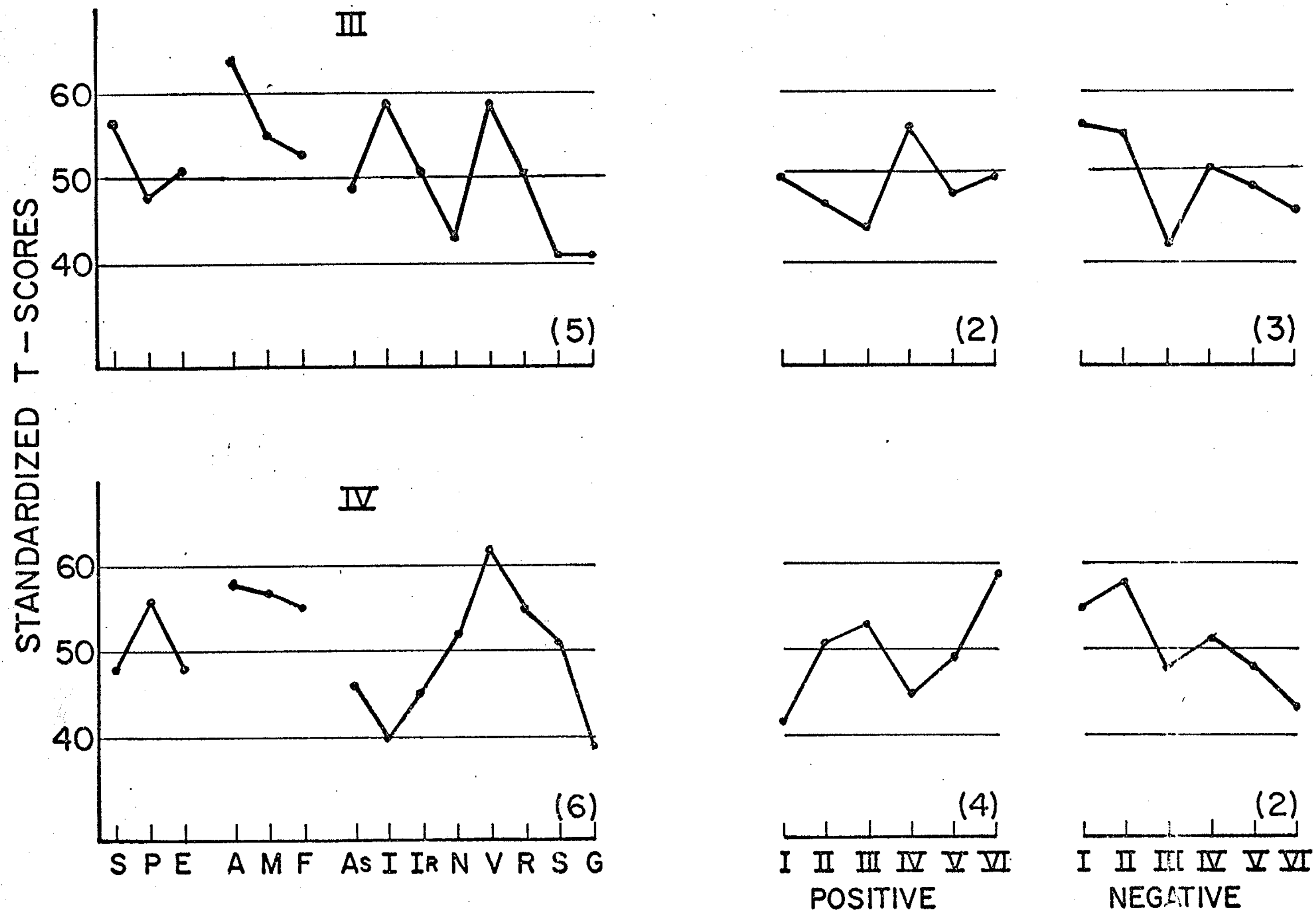
A. Q-profiles derived from APQ, Fenz, and Buss-Durkee inventory subscales. APQ subscales: S-Social Anxiety, P-Physical Anxiety, E-Ego Threat. Fenz subscales: A-Autonomic Arousal, M-Muscle Tension, F-Feelings of Insecurity. Buss-Durkee subscales: As-Assault, I-Indirect, Ir-Irritability, N-Negativism, V-Verbal, R-Resentment, S-Suspicion, G-Guilt.

B. Corresponding physiological factor scores for the positive and negative Q-profile loaders. Factor I is defined by DBP tension scores and Factor II by DBP lability scores. Factors III and IV are defined by HR tension and lability scores, respectively. Factor V is defined by the L-ISB score derived during the 90-second anticipation period. The HR background activity scores derived from the base and recovery periods defined Factor VI.

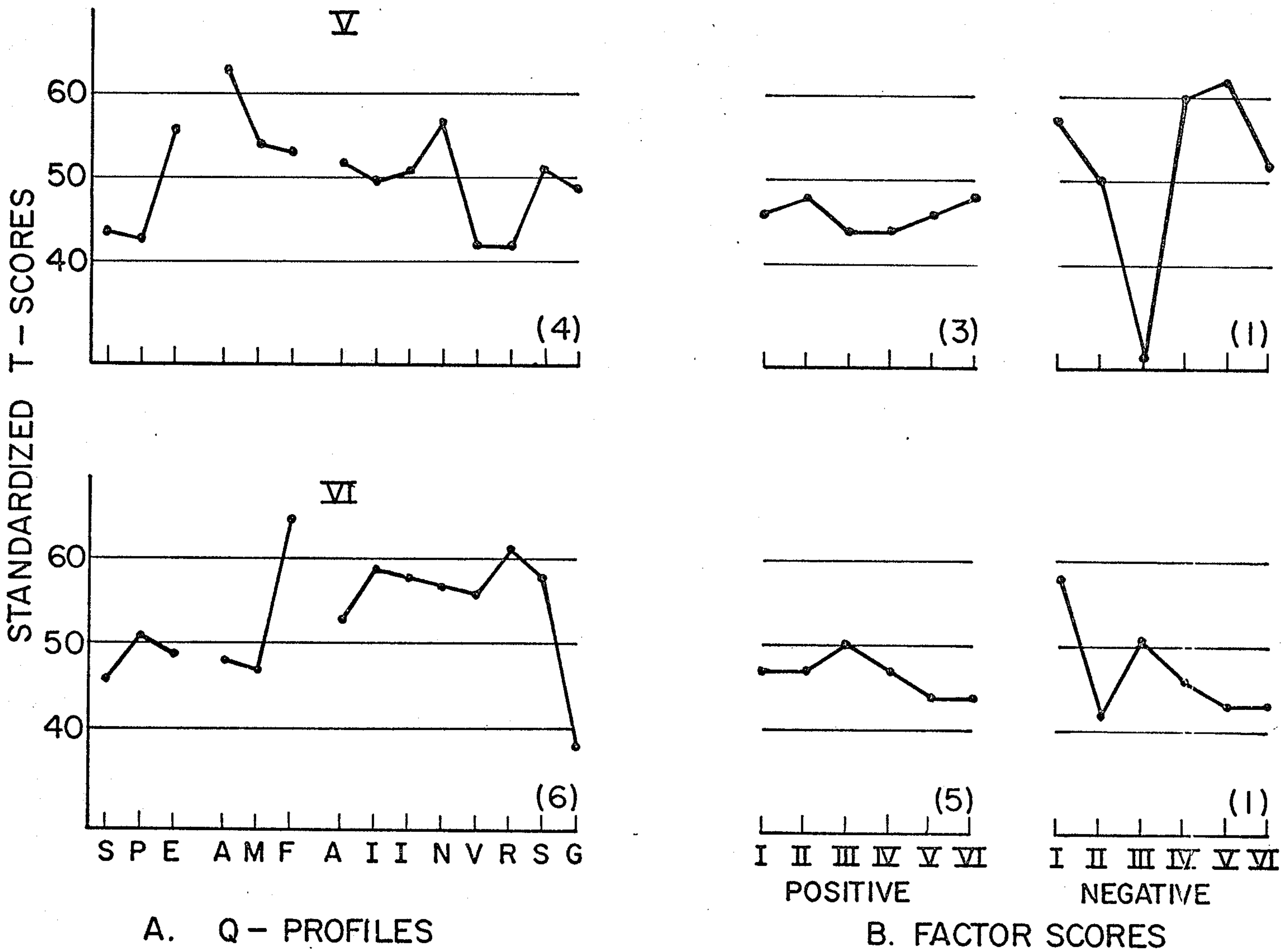


A. Q - PROFILES

B. FACTOR SCORES



A. Q - PROFILES B. FACTOR SCORES


V
VI
STANDARDIZED T-SCORES
60
50
40
(4)
(3)
(1)
(6)
(5)
(1)
S P E A M F A I I N V R S G
I II III IV V VI
POSITIVE
I II III IV V VI
NEGATIVE
A. Q-PROFILES
B. FACTOR SCORES

derived Q-factors yielding 12 Q-profiles in all. Only the positive side of the bipolar profiles is presented in Figure 1. In addition, the profiles are based on the average of the positive loaders scores and the negative loaders reflected scores. This procedure was adopted to simplify description and to avoid biasing presentation of only one end of the bipolar types. The negative profiles would correspond quite closely to the inverse of the profiles shown. The number of Ss used in the description of the Q-profiles and the number of which were positive and negative loaders is indicated in parentheses on the graphs. As indicated on the ordinate, a standard score of approximately 50 represents a median response while scores of approximately 60 and 40 represent high and low responses, respectively.

Q-type I Ss responded fairly uniformly to the anxiety subscales and exhibited distinct patterning within the Aggression-Hostility subscales. For example, positive loaders obtained moderate high to high scores on the Aggression subscales and median scores on the Hostility and Guilt subscales. Q-type II Ss were more homogeneous in their responses to the various subscales of the three inventories. However, they exhibited considerable discrepancy in their responses to the two anxiety inventories. Positive loaders obtained high scores on the Fenz subscales and low scores on the APQ subscales. The remaining four Q-profiles exhibited considerable variability in their responses to subscales within and between inventories. Q-type III positive loaders obtained a moderately high score on Social Anxiety and a high score on Autonomic Arousal. They also scored high on the Indirect and Verbal subscales and low on the Negativism, Suspicion, and Guilt subscales. Q-type IV positive loaders obtained moderately high scores on the

Fenz subscales and the Physical Anxiety subscale of the APQ. They scored low on Indirect and Guilt, and high on Verbal. Q-type V was based on 4 Ss with three positive loaders and one negative loader. Positive loaders scored moderately low on Social and Physical Anxiety and moderately high on Ego Threat. They also scored high on Autonomic Arousal. They obtained median scores on all the Aggression and Hostility subscales, except for Verbal and Resentment which were moderately low. Q-type VI positive loaders received median scores on all of the anxiety subscales, except for Feelings of Insecurity on which they scored quite high. They obtained moderately high scores on the Aggression and Hostility subscales and a low score on the Guilt subscale.

A distinct patterning of physiological responses would be expected given the Funkenstein differential secretion hypothesis. However, it will be recalled that Funkenstein et al. (1957) did not distinguish between tension and lability data, using instead only percentage change over base as the dependent variable. However, there is no reason not to expect the extension of the Funkenstein hypothesis to tenstion data. Therefore the Funkenstein hypothesis should apply to the tension and lability factors for HR and DBP. There are two other physiological factors, anticipation L-ISB and HR variability, both of which do not relate to this hypothesis because anticipation obviously does not fit this schema and both catecholamines lead to HR variability.

Funkenstein et al. (1957) postulated that a NE-like physiological response pattern would be characterized by an increase in DBP and a decrease in HR, while an E-like response pattern would be characterized by an increase in HR and a decrease in DBP. It is assumed that this would be the case with both tension and lability data. Thus high scores on Factors I and II and low scores on Factors III and IV would represent an NE-like response pattern while the reverse pattern would be characteristic of an E-like response.

Q-type I positive loaders obtained very similar HR and DBP tension scores and therefore did not conform to either a NE-like or E-like response pattern. They did, however, receive lower DBP than HR lability scores but the difference between these two indices was small in magnitude. Q-type I negative loaders obtained low DBP tension factor scores and median HR tension factor scores, which is suggestive of an E-like physiological response pattern. However, they obtained higher DBP lability factor scores than HR lability factor scores. This apparent contradiction may simply reflect the statistical dependency between tension and lability data, since the LIV dictates high tension scores yield low lability scores or low tension scores yield high lability scores. These data do suggest, however, that tension and lability data are important considerations for the Funkenstein hypothesis.

Type II positive loaders exhibited response patterns which were atypical of either NE-like or E-like physiological responses. Their responses were more characteristic of a mixed NE-E pattern since they obtained high scores on both HR and DBP tension factor scores and low scores on DBP and HR lability factor scores. Q-type II negative loaders obtained median scores on the DBP and HR tension factors and higher HR than DBP scores on the lability factors.

Although based on only two Ss, Q-type III positive loaders were differentiable as E-like responders in terms of their lability scores - obtaining higher HR than DBP factor scores. This differentiation did not apply in terms of tension scores, however, since they responded with a NE-like pattern. Q-type III negative loaders exhibited a pure NE-like physiological factor score pattern since their DBP tension and lability factor scores were both higher than their corresponding HR factor scores.

Q-type III positive loaders exhibited the same inconsistency as some of the previous types, since their tension scores corresponded to an E-like pattern and their lability scores to a NE-like pattern. However, Q-type III negative loaders obtained a pure NE-like physiological response pattern.

The positive loaders from Q-types V and VI exhibited very similar factor scores. Both groups obtained low scores on both the HR and DBP tension and lability factors. Description of the physiological data obtained from the negative loaders on types V and VI is limited by virtue of the fact that in both cases only one S met the criteria for inclusion.

CHAPTER IV

DISCUSSION

The results of the present research may be summarized, for purposes of discussion, into several distinct categories. First, the preliminary investigation established the test-retest reliability coefficients and factor structure of the numerous derived and component physiological measures. Second, data suggestive of methodological deficiencies emerged from the analysis. Third, a R-correlational analysis was used to examine the correlations between the physiological, affective, and personality trait measures. Fourth, a Q-correlational analysis revealed several distinct Q-profiles based on the personality inventory subscales. These profiles were examined in relation to their corresponding physiological factor scores.

RELIABILITY COEFFICIENTS

There has been little research investigating the reliabilities of physiological measures over time. In this respect Wenger (1948) reported the 24-hour reliabilities for HR and DBP tension scores to be .73 and .67, respectively, when Ss were at rest. The present research undertook the examination of the reliabilities of the physiological measures employed and corroborated Wenger's finding. The median 24-hour reliability coefficients for HR and DBP tension scores were .76 and .63, respectively.

The mean peak scoring method (Opton, Rankin, and Lazarus, 1966) was used in the derivation of all HR measures in the present research. The mean peak method is considerably less laborious than the technique of averaging ECG R-R intervals from specific periods, and yet proved to be as reliable, indicating the advantage gained in employing the mean peak scoring method.

Another interesting finding of the reliability study was that a single peak HR or DBP reading was often as reliable, at least for certain stimulus periods, as a measure based on a number of readings. In some measure, this finding is to be expected since Lacey and Lacey (1962) have proposed that physiological systems, in response to intense stimulation, quickly attain and maintain a maximum response level. This being the case, a single peak reading would be nearly identical to values based on a number of readings. Anagram solving within a white noise context can be considered as a form of intense stimulation and a single peak HR or DBP reading derived from this period was as reliable as measures based on a number of readings.

The reliability coefficients of the lability measures were considerably lower than those for tension scores. The median coefficients for HR and DBP lability scores were .31 and .50, respectively. As Bereiter (1967) points out, the low coefficients for lability scores reflects, in part, the paradox which exists between the reliabilities of lability and tension scores. Although the reliability of a lability score varies directly with the reliability of pre- and poststimulus tension scores, it also varies inversely with the correlation between pre- and poststimulus tension scores which increases with an increase in their reliability.

It was expected that the derived ISB score would reflect the negative relationship between DBP and HR more readily than the component scores, making it a more reliable index. This expectation was based on Funkenstein's (1955) observation that physiological responses during emotional states were similar to physiological responses resulting from the exogenous injections of NE and E. According to Funkenstein, affective anger and exogenous NE are associated with an increase in DBP and a corresponding decrease in HR, while affective fear and exogenous E are associated with the converse pattern of physiological responses. Contrary to expectation, the reliability coefficients of the ISB scores were of a smaller magnitude than those derived from the component scores, which in part was due to the failure to find a negative correlation between DBP and HR component scores. In fact in the preliminary investigation DBP and HR lability scores correlated positively while in the present study the coefficients were near zero in magnitude. These findings point out the difficulty in the equation of physiological responses during anger and fear with the responses during infusions of NE and E. Although a negative relationship between DBP and HR is demonstrable to exogenous NE and E (Wenger et al., 1960) a similar relationship during anger and fear has not been established.

The factor specific to the anticipation period appears to be reliable since it appeared in the preliminary investigation and the present research. It was identified by the L-ISB score derived from this period and also was the only factor which was specific to a definite period of the experimental stress session. There is some evidence that physiological responses occurring during anticipation of stress differ from physiological responses occurring during the actual stress period (Lazarus, 1968). The meaning of this factor remains unclear, however, since the anticipation L-ISB score failed to correlate significantly with the affective and personality inventory self-report measures.

The present research clearly supported Lacey's (1959) distinction between tension, lability, and nonspecific aspects of autonomic functioning, since these emerged as distinct physiological factors. Nonspecificity was identified by the background activity score computed during the base and recovery periods. The integrity of these factors was maintained over two distinct testing periods during the preliminary investigation and during the present research with an entirely different sample of Ss.

METHODOLOGICAL CONSIDERATIONS

The present research used deception as a means of eliciting emotional responses. The use of deception has been severely criticized on the grounds that Ss are no longer naive and in fact exhibit considerable distrust towards all psychological experiments (Kelman, 1967; Schultz, 1969). The MACL factor Skepticism was employed in the present study for the twofold purpose of seeking out relationships between the psychophysiological variables and this factor as well as the investigation of this factor alone. A check of the poststress Skepticism scores revealed 60 percent of Ss indicated some degree of suspicion. However, 74 percent of Ss, at the same time, showed a considerable rise in the poststress mood factor scores of Hostility and Anxiety. In addition, the mean change scores presented in Table 7 indicated that DBP and HR changes also occurred. These data suggest, therefore, that the manipulations were effective in the elicitation of physiological and psychological change, notwithstanding the findings obtained from the Skepticism factor. In addition, these findings mitigate against the absolute use of checks for suspicion as the criteria whereby the validity of the data are rejected or accepted.

Although the experimental manipulation was successful in eliciting changes in the affective and physiological response measures, some unexpected data suggested that the degree of change in Ss was not completely uniform across the testing sessions. A correlational analysis revealed several significant negative relationships between the order in which Ss were tested and psychophysiological change, which supported the suspicion that later-tested Ss manifested less change in the affective and physiological variables than early-tested Ss. These negative relationships may have resulted from increased sophistication of later-tested Ss toward psychological experimentation and also from communication between Ss as to the nature of the experiment. In addition, the experimenter may have changed across testing sessions in his expression of the critical comments. The negative relationships obtained, however, do not seriously impugn the validity of the deception since most of the correlations were low and specific to the anticipation period of the experimental stress session.

There is yet another difficulty that the LIV might purportedly attenuate the psychophysiological relationships found in this study. The LIV states that a negative relationship exists between the initial level of a physiological variable and the change evidenced as a result of the manipulation. In the present research, pre- and poststimulus tension scores for DBP and HR were first standardized across Ss and the respective change scores obtained from the difference between the standardized tension scores (Heath and Oken, 1965). This technique resulted in low negative correlations between initial level and change scores, the median correlations for DBP and for HR being -.23 and -.28, respectively. Lacey (1956) in compensation for the LIV has suggested a procedure whereby this statistical dependency is removed. Inherent in this procedure is the difficulty of isolating constitutional and affective factors which account for the difference in initial levels. More specifically, the statistical removal of the negative relationship between amount of change and initial level also removes from consideration the initial affective state of the Ss under investigation. It may be that initial differences are largely attributable to affective state factors. Support for this suggestion is found in a significant positive relationship between initial HR level and pretest affective Anxiety (r = .33), which suggested Ss who felt anxious in the rest period also had the highest HR resting levels. Instead of statistically removing the LIV effect, a more favorable approach might be the creation of the appropriate demand characteristics of Ss. That is to say, a greater effort should be expended at equating Ss in their expectations as to the nature of the experiment. One possibility would be to obtain the initial readings in a separate session either prior to or after the experimental stress period.

R-TECHNIQUE CORRELATIONAL ANALYSIS

Very few statistically significant relationships between the affective, personality trait, and physiological measures supportive of the Funkenstein hypothesis emerged and even these did not demonstrate great strength of association. The MACL factors of Hostility and Anxiety, which were used to assess affective anger and fear, failed to relate significantly to the appropriate physiological measures. It should be pointed out that anger and fear were assessed by only a few adjectives. This casts doubt on the ability of so few adjectives to discriminate Ss in terms of complex mood states. Evidence presented earlier demonstrated the majority of Ss responded to the psychological stress situation with an increase in affect. However, only 32 percent of Ss were clearly differentiated in terms of anger and fear, while 42 percent gave responses symptomatic of both states. It would surely prove more useful if additional corroborative measures were used for the purpose of discriminating Ss. Possibly this would best be achieved by assessing the effects of relevant dispositional and response set variables when relating physiological and affective measures. Weinstein, Averill, Opton, and Lazarus (1968), for example, have demonstrated the importance of the trait of defensiveness in relation to discrepancies between affective and physiological measures.

The failure of the affective and physiological measures to correlate significantly may also reflect a limitation of the Funkenstein hypothesis. The Funkenstein hypothesis, which served as a framework for the present research, depends on a clear differentiation of anger and fear. It is problematic, of coure, that the experimental manipulation elicited the desired responses from Ss. Additionally, in human Ss at least, it may be impossible to elicit discrete and pure emotions such as anger and fear. In agreement with this position, Plutchik (1970) has proposed that most emotional states are actually a mixture of several emotions. This may account for the lack of differentiation among Ss on the MACL factors as they tended to endorse both anger and fear adjectives. If emotional states are indeed usually a mixture of several emotions, the Funkenstein hypothesis would have to be reassessed, since the hypothesis is dependent on the clear differentiation of anger and fear.

The correlational analysis yielded virtually no statistically significant relationships between the personality trait and physiological measures. The personality measures used in this study were the APQ, the Fenz version of the MAS, the Buss-Durkee Hostility Inventory, and Factors U.I. 18 and U.I. 20 from the Cattell 12 Objective-Analytic Battery. The failure to obtain significant relationships was not improved upon by considering separately the various subscales of the inventories, since these subscales also failed to relate significantly to the physiological measures. Therefore no support was obtained for the specificity approach as a means of increasing relationships between personality and physiological variables (Fenz, 1967).

Q-TECHNIQUE CORRELATIONAL ANALYSIS

The failure of the personality and physiological measures to intercorrelate is not uncommon in psychophysiological research (Averill and Opton, 1968; Fenz, 1967). The Q-correlational analysis was offered as a means for improving upon this situation. More specifically, the data suggested Ss do not necessarily respond uniformly to the subscales which, it is assumed, comprise the traits measured by the inventory. For instance, an inspection of the Q-profiles in Figure 1 revealed that often there was little uniformity in responses to the subscales comprising the inventories. Furthermore, it was found that there is a consistency across individuals that respond in this manner.

Q-type I illustrates the importance of considering the internal relations between subscales comprising the personality inventories.

Positive loaders obtained moderately low scores on the anxiety subscales, moderately high and high scores on the aggression subscales, and moderately high and low scores on the hostility subscales. Q-type I negative loaders exhibited the reverse self-report pattern. Thus in comparison with negative loaders, positive loaders were low on anxiety and high on aggression. In terms of their physiological factor scores the two groups were differentiable only in terms of their DBP tension scores, with positive loaders obtaining considerably higher scores which is in accordance with the Funkenstein hypothesis.

The relationship between the subscales comprising the Fenz and APQ anxiety inventories identifies Q-type II Ss from Ss loading on the other profiles. Positive loaders obtained high scores on the Fenz subscales and low scores on the APQ subscales, with negative loaders exhibiting the reverse pattern. The theoretical significance of this difference is difficult to ascertain since it is not clear what kind of anxiety each inventory is measuring. The correlation between Ss scores on the APQ and the Fenz inventories was near zero ($r = .01$), suggesting that these scales do not measure the same construct in this population. The Fenz scale, it will be recalled, is actually a modified version of the MAS. Lykken and Katzenmeyer (1967) have reported several other studies which found near zero correlations between the APQ and MAS. In order to account for this lack of relationship between the scales, Lykken and Katzenmeyer have proposed that the APQ is more a measure of anxiety proneness or reactivity to a variety of situations, while the MAS is simply a measure of Ss' willingness to admit to neurotic symptoms. These authors also cite data in which a number of male

Ss, having completed the APQ and MAS, were required to describe themselves on an adjective check list. Low APQ-high MAS Ss described themselves as impulsive, immature, and lazy; while high APQ-low MAS Ss described themselves as being rigid conformists. It is not possible on the basis of such descriptions to speculate the type of physiological response pattern to be expected by Ss giving these descriptions. Q-type II positive loaders responded to the stress situation with a mixed NE-E-like pattern since they obtained quite high DBP and HR tension scores. Their corresponding DBP and HR lability scores were quite low, which suggests they may have responded with maximal arousal upon entering the laboratory and remained so until the completion of the experiment. Although not exhibiting extreme factor scores, negative loaders did respond with an E-like lability pattern since their HR lability scores were higher than their DBP lability scores. In considering the results for the positive and negative loaders together, it appears low APQ-high Fenz Ss might have reacted with immediate and sustained general arousal, while high APQ-low Fenz Ss might have low physiological levels initially and responded to portions of the stress period with an E-like response.

The profile portraying Q-type III is extremely complicated and difficult to interpret since Ss comprising the type exhibited large variation in their responses to the subscales comprising each inventory. Positive loaders obtained high scores on the Social Anxiety and Autonomic Arousal subscales relative to their scores on the other anxiety subscales. They also scored high on two of the aggression subscales; Indirect and Verbal, both of which do not involve direct physical contact. These Ss' physiological response patterns were distinguishable only in terms of lability scores since they obtained higher HR lability than DBP lability scores which is suggestive of an E-like pattern. Negative loaders were low on the anxiety measures and possibly equally as important were higher on physical aggression (Assault) and readiness to explode upon provocation (Irritability) relative to their scores on the other aggression subscales. Their physiological factor scores corresponded to a pure NE-type pattern since both tension and lability DBP scores were higher than the corresponding HR scores. It is suggested that low anxiety in combination with a habit of physically attacking upon mild provocation may be associated with an NE-like response pattern.

The suggestion of associating specific rather than general aggressive responses with autonomic patterns is given additional support in Q-type IV. Positive loaders were high on several of the anxiety subscales and low on Assault relative to Verbal aggression. Their physiological response pattern was mixed, being E-like with tension data and NE-like with lability data. However, negative loaders, who were low on anxiety and high on Assault and Irritability relative to Verbal obtained a pure NE-like physiological response pattern.

Q-types V and VI were derived from extremely few Ss and therefore can be given only limited consideration. The negative profiles were based on only one S and will not be discussed. The internal relations of the two positive types, especially within the anxiety inventories are most complicated. Lykken and Katzenmeyer (1967) have suggested that the internal relations of the APQ subscales may prove eventually to have some diagnostic value since depressed patients obtain higher scores on the Ego Threat subscale relative to their scores on the other two APQ subscales. This observation is especially interesting since Q-type V positive loaders exhibited precisely the same pattern on the AQQ subscales and obtained moderately low scores on all six physiological factors. The physiological response pattern of Q-type VI positive loaders was very similar, but their APQ subscale scores differed. However, there was a similarity in pattern of response for the Fenz subscales and the APQ subscales of the Q-type V positive loaders. Q-type VI positive loaders obtained moderate scores on the Fenz specificity subscales of Autonomic Arousal and Muscle Tension and high scores on the Feelings of Insecurity subscale. Possibly, the patterning of responses to both inventories might prove useful in the classification of emotional disorders.

The Q-profile data readily lend themselves to the suggestion that personality constructs are not as unitary as was heretofore considered, since the component subscales comprising a given inventory often showed variable and diverse patterning. Since 50 percent of the sample employed loaded on one of the six Q-profiles, the diversity of response patterning was readily demonstrated. Full benefit was not derived from the Q-analysis, however, because the number of Ss loading on the types was too small to permit meaningful comparisons. To correct for this shortcoming, it is suggested that the types be derived by initially testing very large numbers of Ss from which Q-profiles of sufficiently large sample size can be attained. With this condition fulfilled, this method is proposed as a most promising technique in the establishment of relationships between personality and physiological responses.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of the present study was to examine the psychophysiology of anger and fear within the framework of the Funkenstein hypothesis. Funkenstein (1955) proposed a relationship between the catecholamines, NE and E, and the emotional responses of anger and fear. He hypothesized that NE-like responses were characteristic of anger and E-like responses were characteristic of fear or anxiety.

The literature suggested that the cardiovascular variables DBP and HR are differentially sensitive to NE and E when exogenously administered. There was also a suggestion of the differential sensitivity of DBP and HR to both anger and fear stimuli. The ISB score was proposed as a means of quantifying the responses of HR and DBP along a single continuum. The 24-hour reliability of the ISB score and its constituents was established in a preliminary investigation.

In the present study 100 male Ss were subjected to a psychological stress session which was designed to induce emotional responses along an anger-fear dimension. Relevant mood factors from the Nowlis Adjective Check List were used to assess the verbal behavior elicited in the experimental session. In addition, a number of physiological index and constituent scores were derived from identifiable periods of the stress session. Personality inventory data pertaining to anger and fear was collected in two additional sessions. The inventories used were the Activity Preference Questionnaire, the Fenz version of the Manifest Anxiety Scale, the Buss-

Durkee Hostility Inventory, and Factors U.I. 18 and U.I. 20 from the Cattell 12 O-A Battery.

The principal findings of the present research were as follows:

1. The 24-hour median reliability coefficients of the HR and DBP tension scores were .76 and .63, respectively, which corroborated the coefficients reported by Wenger (1948). These coefficients also served to extend the utility of the mean peak scoring method which was used in the derivation of the HR measures. The reliability coefficients of the lability measures were considerably less than the coefficients found for the tension measures.

2. Lacey's (1962) distinction between tension, lability, and nonspecific aspects of autonomic functioning was strongly supported since these emerged as distinct factors over three testing periods and across two different samples of Ss.

3. The ISB score was formulated to quantify the synergy of HR and DBP along a single continuum. Since a negative relationship between these measures was not obtained, both the utility of the ISB score in particular and the Funkenstein hypothesis in general were impugned. Moreover, the reliability coefficients obtained for the composite scores comprising the ISB scores were higher than the reliabilities obtained for the ISB scores.

4. The R-correlational analysis revealed very few statistically significant relationships between the self-report and physiological measures. This was discussed in terms of methodological limitations, such as the effectiveness of the experimental manipulation and the gross level upon which psychophysiological relationships are treated by the Funkenstein

hypothesis.

5. A Q-correlational analysis was found to be more useful than a R-correlational analysis. The Q-correlational analysis illustrated that a patterning approach to inventory data is more useful than the single unitary correspondances normally considered in this type of research. Six Q-profiles were identified through factor analysis and comparisons were made with their physiological factor scores. It was proposed that in future research the Q-profiles be derived from a very large sample of Ss in order to render possible statistical comparisons on the physiological variables of interest.

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APPENDIX A

Instructions for Anagram Task

INSTRUCTIONS TO THE SUBJECTS

"In this experiment we will be examining the psychological process of attention. Attention can be conceived as a mechanism which somehow rejects some signals and accepts others for further analysis. I am sure that you have at one time noticed an individual intently concentrating on a task while appearing somewhat oblivious to a variety of potentially distracting stimuli. Such a situation is nicely exemplified by trying to read a reference paper in the university library. In this instance the paper is the task-relevant stimulus, and the surrounding noise, the task-irrelevant stimulus. The focusing of attention solely on the relevant stimulus is the result of what we call a "narrow attentional span or band width." If the individual is unable to read the paper because of the interference of the surrounding noise, he has what we call a "wide attentional span or band width." From this example we can understand the following principle: the narrower the attentional span, the greater the concentration to a specific task and hence the faster the mastery of the task. Conversely, the wider the span the slower the task mastery.

Now in this experiment you will be confronted, simultaneously, with a task-relevant stimulus and a task-irrelevant stimulus. The task-relevant stimuli will consist of a series of anagrams. An anagram is simply a number of scrambled letters which when properly re-arranged, will make a single word of the same number of letters. The task-irrelevant stimulus will be white noise of a fixed intensity which will be presented along with the anagrams. Now your task will be to develop a narrow-attentional span by ignoring the white noise and solving the anagrams. The task does not require an extensive vocabulary as a large majority of the words are quite simple and in addition all anagrams are only five letters in length. However, the task is quite short, so you must apply yourself from the beginning. As you can see, we will also be examining your heart rate and blood pressure as these variables are known to change in certain ways with changes in the attentive process. Are there any questions?"

APPENDIX B

CRITICAL COMMENTS

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Remember that this test is quite short, so that unless you try from the beginning, you will not obtain a very high score.

You will have to try harder. You should be solving more of the anagrams than you are presently doing.

What seems to be the big problem? We don't expect a perfect score but you are not even close.

Frankly, I don't think you really care about the whole thing. Remember, I said it was imperative to do your best.

Can't you answer faster. They are really not that hard.

APPENDIX C

LIST OF WORDS USED IN CONSTRUCTION OF ANAGRAMS

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Abase	Patio	Wormy
Aptly	Quair	Dozen
Basal	Rondo	Warpt
Beaux	Salty	Indue
Begin	Source	Navel
Curca	Tasty	Oriel
Clack	Abeam	Evict
Doily	Biped	Hutch
Ducat	Carom	Deist
Eerie	Elate	Clomb
Exude	Ephod	Agone
Fauna	Frond	Ultra
Godly	Irate	Waive
Icing	Joist	Facet
Kodak	Julip	Gusto
Gland	Milch	Hurry
Litre	Moldy	Gamut
Murkey	Ovoid	Plaza
Outdo	Mealy	

APPENDIX D

LIST OF SELF REPORT MATERIALS

Modified Nowlis Mood Adjective Check List

Time (please include AM or PM) ______________________________

Each of the words on the next sheet describes feelings or mood. Please use list to describe your feelings <u>at this moment</u>.

If the word definitely describes how you feel at the moment you read it, circle the double (vv) to the right of the word. For example, if the word is relaxed, and you are definitely feeling relaxed at the moment, circle the double vv as follows: relaxed vv v ? no.

<u>This means you definitely feel relaxed at the moment</u>.

If the word only slightly applies to your feelings at the moment, circle the single check as follows: relaxed vv v ? no.

<u>This means you feel slightly relaxed at the moment</u>.

If the word is not clear to you or you cannot decide whether or not it applies to your feelings at the moment, circle the question mark as follows: relaxed vv v ? no.

<u>This means you cannot decide whether you are relaxed nor not</u>.

If you clearly decide the word does not apply to your feelings at the moment, circle the no as follows: relaxed vv v ? no.

<u>This means you are definitely not relaxed at the moment</u>.

Work rapidly. Your first reaction is best. Work down the first column, then go on to the next. Please mark all words. This should take only a few minutes.

- Now please turn the page and begin working -

vv v ? no : definitely feel

vv v ? no : slightly feel

vv v ? no : cannot decide

vv v ? no : definitely do not feel

Inactive	vv	v	?	no	snappy	vv	vv	?	no
still	vv	v	?	no	passive	vv	v	?	no
jittery	vv	v	?	no	angry	vv	v	?	no
energetic	vv	v	?	no	clutched-up	vv	v	?	no
tired	vv	v	?	no	drowsy	vv	v	?	no
annoyed	vv	v	?	no	suspiciousness	vv	v	?	no
quiet	vv	v	?	no	fearful	vv	v	?	no
dynamic	vv	v	?	no	easy	vv	v	?	no
calm	vv	v	?	no	fed-up	vv	v	?	no
defiant	vv	v	?	no	full-of-pep	vv	v	?	no
intense	vv	v	?	no	sleepy	vv	v	?	no
active	vv	v	?	no	rebellious	vv	v	?	no
grouchy	vv	v	?	no	skeptical	vv	v	?	no
lively	vv	v	?	no	quick	vv	v	?	no
at-rest	vv	v	?	no	stirred-up	vv	v	?	no
dubious	vv	v	?	no	leisurely	vv	v	?	no
activated	vv	v	?	no	wakeful	vv	v	?	no

Post Experimental Questionnaire

There are several major difficulties involved in attempting to relate physiological responses to the problem-solving process. One of these concerns the possible effects of drugs, illness, and eating habits on such responses. Another difficulty arises from the unavoidable emotional side-effects of problem-solving. Unless we can identify these effects, their control becomes virtually impossible. To assist us in this effort, would you please answer the questions below.

1. Age ___________.

2. No. of brothers and sisters ___________. Their ages to the nearest birthdate

   ___________ ___________ ___________ ___________ ___________

   ___________ ___________ ___________ ___________ ___________

3. Do you smoke? (a) ___________yes; (b) ___________no.
   If (a), when did you smoke your last cigarette (i.e., number of hours)

   ___________.

4. Please indicate when you had your last meal prior to today's test (i.e., number of hours)

   ___________.

5. Relative to other students, how well do you feel you did on the anagram task?

___________	___________	___________	___________	___________
quite well	just above average	average	just below average	quite poorly

6. How important, personally, was it for you to do well on the anagram task?

___________	___________	___________	___________	___________
very	largely	moderate	slightly	not at all

7. How often during testing did you find yourself thinking how well, or how badly you seemed to be doing?

___________	___________	___________	___________	___________
constantly	largely	moderately	infrequently	never

Lykken and Katzenmeyer Activity Preference Questionnaire

ACTIVITY PREFERENCE QUESTIONNAIRE

Form A

DIRECTIONS

Read Carefully

One way of understanding a person better is by studying the kinds of activities or experiences he likes or enjoys. This test employs the similar approach of studying the pattern of your dislikes. In each of the items on the following pages--and in the sample item below--two activities or experiences are described which most people would consider at least mildly unpleasant. Some of them are very unpleasant indeed. In some instances, you will find that similar things have actually happened to you; in the others, you can at least imagine what they would be like.

Your task is to try to imagine yourself in each of the two situations and then, pretending that either one or the other had to happen to you, to decide which one you would prefer--which of the two you would take as the 'lesser of evils'.

SAMPLE ITEM

(T) Having to work late one night. (F) Being run over by a train.

In this case there isn't much doubt that, if one of these things had to happen to you, you would prefer the alternative on the left (working late at night) as the lesser evil than the one on the right (being run over by a train). Therefore, you would make a pencil mark in the first column (the one marked with a T) on the answer sheet. DO NOT MAKE ANY MARKS ON THE TEST BOOKLET. If you would prefer the activity or experience listed on the right--if you think that one would be less unpleasant than the other alternative--fill in the second column (the one marked with an F) on the answer sheet.

Answer every item on the test. Work rapidly but consider both alternatives in each item carefully. Imagine how you would feel about each alternative, decide which of the two would seem least unpleasant, and mark your answer sheet accordingly.

- Remember: Indicate the alternative that you would prefer -

1. (T) Being interviewed for a job.

   (F) Mowing the lawn.

2. (T) Sitting through a dull movie for the second time because the person you're with hasn't seen it.

   (F) Turning on a light switch when your hand is wet and you might get a shock.

3. (T) In the midst of traffic your horn sticks and begins to blow continuously.

   (F) In school having to give a report in front of the class.

4. (T) Your group takes up a collection to buy a sick member a gift. You discover later that your donation was much smaller than any others.

   (F) On doctor's orders, you can eat nothing for two weeks but a liquid dietary product.

5. (T) Take a roller coaster ride.

   (F) Wash three storm windows on both sides.

6. (T) Copying four pages of the dictionary.

   (F) Belching in church during prayer.

7. (T) Painting a large frame house.

   (F) Shovelling the walks after a snowstorm.

8. (T) Attempting to beat a railroad train at a crossing.

   (F) Spraining your ankle so that you have to have a cast put on it.

9. (T) Cleaning out the basement.

   (F) Going to a party where no one knows you.

10. (T) Getting caught at something.

    (F) Having your empty car smashed by a runaway truck.

11. (T) Having to get out of bed an hour earlier than usual.

    (F) You pass someone on the street and say, "Hi, Charley" and then realize it isn't Charley.

12. (T) Watching an operation.

    (F) Your favorite hat is lost or stolen.

13. (T) Accidentally dialing a wrong number twice in succession.

    (F) Giving a loud, uncontrollable sneeze during a quiet moment at the symphony.

14. (T) Walking a mile when its 15 degrees below zero.

    (F) Being near where a volcano erupts.

15. (T) People at a party are telling jokes. You tell a long drawn-out story but no one laughs.

    (F) You catch a bad cold the day before a big party.

16. (T) Hitting your thumb while hammering a nail.

    (F) After eating in a restaurant, you find that you can't pay the bill.

17. (T) Taking down the Christmas tree and cleaning up after it.

    (F) Jumping down 15 feet into soft earth.

18. (T) Whitewashing a long board fence.

    (F) Washing 20 storm windows on both sides.

19. (T) It is the first day in a new class. The teacher asks each person to stand up and tell about himself.

    (F) Sweep the kitchen floor.

20. (T) You must walk around all day on a blistered foot.

    (F) Sleeping out on a camping trip in an area where rattlesnakes have been reported.

21. (T) Several people push ahead of you in line but you can't bring yourself to say anything.

    (F) Wanting to go out some night and not having any money.

22. (T) Going to the morgue to identify an acquaintance who has been killed in an accident.

    (F) Letting a large but harmless spider run up your arm.

23. (T) Breaking your shoelace while getting dressed.

    (F) Your dog has torn up the neighbor's newspaper and you have to go over and apologize.

24. (T) Find a big cockroach under your pillow.

    (F) Getting stuck in traffic when you're in a hurry.

25. (T) After a school exam, names and grades are posted on the wall. Yours is at the bottom of the list.

    (F) You find you must clean up the floor where someone has vomited.

26. (T) Having to run until your throat is sore and there's a pain in your side.

    (F) Help push a stalled car on a winter morning.

27. (T) Getting ready to watch something important on television and having the set fail.

    (F) Upsetting a glass of milk on a neighbor's carpet.

28. (T) Finding a wrecked car in the ditch with three occupants unconscious and bleeding.

    (F) You go on a two-week ocean cruise and are seasick the entire time.

29. (T) You find that you must cancel your vacation.

    (F) You are arguing with friends and get so frustrated and upset that you choke up and your eyes fill with tears.

30. (T) Having your date at a dance leave without you.

    (F) Sitting through a long lecture with a runny nose and no handkerchief.

31. (T) Asking someone to pay you money that he owes you.

    (F) Sleeping one night on the floor.

32. (T) Balancing along the top rail of a picket fence.

    (F) Walking up four flights of stairs.

33. (T) Having to stay in bed with the flu and a sick headache.

33. (F) Having your hands shake and your mouth go dry as you try to talk in front of a group.

34. (T) Having to spend half a day in a closet.

    (F) You overhear a friend say something sarcastic about your parents.

35. (T) Dispose of a dead mouse from a mousetrap.

    (F) Being caught in a bad thunderstorm.

36. (T) Being wheeled into the operating room to have your appendix removed.

    (F) A doctor has examined a sore in your throat and you are waiting to find out whether it's cancer.

37. (T) You're on stage in the school play and realize that you have forgotten your lines.

    (F) You return to your car parked downtown to find you left the lights on so that the battery is dead.

38. (T) Standing in a long line for something

    (F) Being given an electric shock as part of a medical experiment.

39. (T) Having your hair cut by an inexperienced barber.

    (F) You slip in the mud and get your new spring clothes soaked and dirty.

40. (T) Put on a shirt or a blouse and finding the button missing.

    (F) Having to ask where the bathroom is at a party.

41. (T) You're in a bank and suddenly three masked men with guns come in and make everyone raise their hands.

    (F) Sitting through a two-hour concert of bad music.

42. (T) Counting the beans needed to fill a four-quart candy jar.

    (F) At a high school picnic, they choose up sides for baseball and you are the last one picked.

43. (T) Washing a car.

    (F) Driving a car at 95 miles an hour.

44. (T) Having to ask the person behind you at the movie to stop kicking your seat.

(F) Watching a long headache-pill commercial on TV.

45. (T) You are paddling a canoe across a large Canadian lake and a storm blows up.

(F) Stumbling into an electric fan.

46. (T) You have taken a neighbor's child to the circus and realize you have lost him in the crowd.

(F) While on vacation your car breaks down and you have to wait in a small town while parts are sent for.

47. (T) You must scrub the kitchen floor on hands and knees.

(F) You must make a speech to 100 people.

48. (T) Having your car swing into a skid on an icy corner.

(F) Having to walk five miles for gas.

49. (T) Having your empty car smashed by a runaway truck.

(F) Having your grocery bag break and spill on a crowded street.

50. (T) You go to a party and find you are the only one dressed up.

(F) Wet mopping the floor of a hospital corridor.

51. (T) You're at summer camp and must do 30 minutes of stiff calesthenics each morning before breakfast.

(F) You row out in a boat to help bring in the body of a drowing victim.

52. (T) Digging a big rubbish pit.

(F) A high pressure sales clerk bullies you into buying the higher-priced pair of shoes that you did'nt really want.

53. (T) Having a doctor stick a needle in your arm for an injection.

(F) Falling out of a boat.

54. (T) Losing your wallet to a pickpocket.

(F) Having someone say loudly to you at a party, "Why don't you go home? Nobody wants you here."

55. (T) Being chased by a huge and angry bull.

(F) Spending a month in bed.

56. (T) Introducing yourself to a total stranger.

(F) Having to stand up on a bus.

57. (T) Cleaning up your house after floodwaters left it filled with mud and silt.

(F) Making a parachute jump.

58. (T) Being a restaurant dishwasher for one week.

(F) You get a chance to be interviewed on TV to advertise a charity drive but you become tongue-tied and make a poor showing.

59. (T) Finding that you have been short-changed and having to return to the store to ask for the rest.

(F) Sandpapering a wooden chair to get it ready for re-painting.

60. (T) Spending a week with nothing to eat but bread and water.

(F) Going to the hospital to have a minor operation.

61. (T) Running out of gas in the middle of a crowded downtown intersection.

(F) Waiting in line for two hours to pay a parking ticket.

62. (T) Having to give up eating desserts.

(F) Swimming in very rough ocean water.

63. (T) Just sitting around with nothing to do on a Sunday afternoon.

(F) Cutting out the spoiled parts of a bushel of potatoes.

64. (T) You must wash out a dozen of someone's else's dirty handkerchiefs by hand.

(F) Walking into a room full of people, you stumble on a footstool and sprawl on the floor.

65. (T) Having someone get mad and tell you off.

(F) Playing cards with people who are more skilled than you and then making a dumb mistake.

66. (T) Being caught on a sandbar by the rising tide.

(F) Being stranded in an off-shore lighthouse for a week by high tides.

67. (T) Being sick to your stomach for 24 hours.

(F) Finding out you've overslept and missed an important appointment

68. (T) You are introduced to a girl (man) who is so attractive and poised that you become very shy and awkward.

(F) You must find where someone else parked your car in a big lot at the state fair.

69. (T) Being in a flood.

(F) Carrying a ton of coal from the backyard into the basement.

70. (T) Spilling paint all over your shoes.

(F) Discovering your feet are dirty when you undress for a medical examination.

71. (T) Having a gabby old woman sit down next to you on the bus.

(F) Catching a bad cold the day before a big party.

72. (T) Having to walk half a mile through soaking rain without a coat.

(F) Walking near a whirling plane propeller.

73. (T) You agree to supervise a child's birthday party but the children won't mind you and race around out of control.

(F) Spendind an evening with some boring people.

74. (T) Laughing at something not meant to be funny.

(F) Clean up the popcorn and candy wrappers in the neighborhood movie theatre.

75. (T) Walking around all day in tight, uncomfortable shoes.

(F) Finding yourself in the midst of a fighting mob.

76. (T) You have spent all day preparing for a picnic but it rains just as you start to eat.

(F) You overhear someone comment on how strangely you are dressed.

77. (T) Being threatened by a much bigger and more powerful person.

(F) You're caught in a speed trap driving through a small town and must wait for an hour to pay a $20.00 fine.

78. (T) Lick stamps for 1,000 letters.

(F) Watch someone make a fool of himself on a television quiz program.

79. (T) You are given an IQ test in front of a college class as a demonstration.

(F) Having to go down to the courthouse to renew your driver's licence.

80. (T) Cleaning up the living room after the plaster has all fallen down.

(F) Standing on the very top rung of a ladder in order to wash a second floor window.

81. (T) You are broke and have to borrow money for a meal..

(F) You must distribute 1000 handbills in mailboxes from door to door.

82. (T) Having a bad head cold.

(F) Having your employer get mad about mistakes in your work.

83. (T) Looking for something in an attic storeroom on a stifling hot day.

(F) Going into a dark cellar where there may be rats.

84. (T) "Having it out" with someone.

(F) Sitting from midnight to 4:00 a.m. in a railroad station waiting for your train.

85. (T) Walking barefoot in a room where some glass has been broken.

(F) Walking barefoot across a burning hot sandy beach.

86. (T) Coming home hungry and having to eat a cold supper.

(F) Stumbling in a crowded bus and dropping your load of packages.

87. (T) Coming out of a movie in your summer shoes to find it's snowed a foot deep.

(F) Getting out of a warm bed in a room so cold that you can see your breath.

88. (T) Sorting out a pailful of nuts and bolts.

(F) While flying home from a trip you get airsick and have to dash down the ailsle to the washroom.

89. (T) Taking a long ride in a taxi and then finding you don't have enough money for a trip.

(F) Getting paint in your hair.

90. (T) While dining at home, you spill a very hot cup of coffee in your lap.

(F) You go with your date to a party but she (he) slips away later and goes home with someone else.

91. (T) Waiting in a dentist's office to have a tooth pulled.

(F) Having an earache.

92. (T) Having to go to a party with a large red pimple on the end of your nose.

(F) Losing a book that you borrowed from a teacher and which can't be replaced.

93. (T) Your family, along with three others, must spend a month underground testing a fallout shelter.

(F) You want to join a social club, but the members vote not to let you in.

94. (T) Out in the middle of a frozen lake, you realize that the ice is unsafe.

(F) You find that vandals have slashed all four tires on your car.

95. (T) Waiting for an overdue bus.

(F) Meeting a friend on the street and not being able to remember his name.

96. (T) You're in the back seat of a driverless car which suddenly starts rolling downhill.

(F) Giving blood for the blood bank.

97. (T) You go to the beach with some friends and realize that they all have a better build (figure) than you do.

(F) Washing ten storm windows on both sides.

98. (T) Run a steam presser in a laundry for a week.

(F) Being caught in a blizzard.

99. (T) Being asked for a contribution when you haven't any money.

(F) Untying a hard knot in your shoelace.

100. (T) Having to "go out" with a visiting relative.

(F) Banging your head on a cabinet door.

Buss-Durkee Hostility Inventory

ATTITUDE AND OPINION SURVEY (1)

Please do not write or mark on this booklet in any way. Your answers to the statements in this inventory are to be recorded only on the separate answer sheet.

It is necessary to print only your name in the space provided for this on the answer sheet.

Please indicate whether you agree or disagree with the statements on the following pages. If you agree with an item make a pencil mark in the column marked T on the answer sheet. If you feel that an item does not apply, make a pencil mark in the column marked F. Make certain that you answer every item in this fashion. Also be sure you write by the number for the right item that you are working on.

1. I seldom strike back, even if someone hits me first.
2. I sometimes spread gossip about people I don't like.
3. Unless somebody asks me in a nice way, I won't do what they want.
4. I lose my temper easily but get over it quickly.
5. I don't seem to get what's coming to me.
6. I know that people tend to talk about me behind my back.
7. When I disapprove of my friend's behavior, I let them knowit.
8. The few times I have cheated, I have suffered unbearable feelings of remorse.
9. Once in a while I cannot control my urge to harm others.
10. I never get mad enough to throw things.
11. Sometimes people bother me just by being around.
12. When someone makes a rule I don't like, I am tempted to break it.
13. Other people always seem to get the breaks.
14. I tend to be on my guard with people who are somewhat more friendly than I expected.
15. I often find myself disagreeing with people.
16. I sometimes have had thoughts which make me feel ashamed of myself.
17. I can think of no good reason for ever hitting anyone.
18. When I am angry, I sometimes sulk.
19. When someone is bossy, I do the opposite of what he asks.
20. I am irritated a great deal more than people are aware of
21. I don't know any people that I down-right hate.
22. There are a number of people who seem to dislike me very much.
23. I can't help getting into arguments when people disagree with me.
24. People who shirk on the job must feel very guilty.

25. If somebody hits me first, I let him have it.

26. When I am mad, I sometimes slam doors.

27. I am always patient with others.

28. Occasionally when I am mad at someone, I will give him the "silent treatment".

29. When I look back on what's happened to me, I can't help feeling mildly resentful.

30. There are a number of people who seem to be jealous of me.

31. I demand that people respect my rights.

32. It depresses me that I did not do more for my parents.

33. Whoever insults me or my family is asking for a fight.

34. I never play practical jokes.

35. It makes my blood boil to have somebody make fun of me.

36. When people are bossy, I take my time just to show them.

37. Almost every week I see someone I dislike.

38. I sometimes have the feeling that others are laughing at me.

39. Even when my anger is aroused, I don't use "strong language".

40. I am concerned about being forgiven for my sins.

41. People who continually pester you are asking for a punch in the nose.

42. I sometimes pout when I don't get my own way.

43. If somebody annoys me, I am apt to tell him what I think of him.

44. I often feel like a powder keg ready to explode.

45. Although I don't show it, I am sometimes eaten up with jeaslousy.

46. My motto is "never trust strangers".

47. When people yell at me, I yell back.

48. I do many things that make me feel remorseful afterwards.

49. When I really lose my temper, I am capable of slapping someone.

50. Since the age of ten, I have never had a temper tantrum.

51. When I get mad, I say nasty things.

52. I sometimes carry a chip on my shoulders.

53. If I let people see the way I feel, I'd be considered a hard person to get along with.

54. I commonly wonder what hidden reason another person may have for doing something nice for me.

55. I could not put someone in his place, even if he needed it.

56. Failure gives me a feeling of remorse.

57. I get into fights about as often as the next person.

58. I can remember being so angry, that I picked up the nearest thing and broke it.

59. I often make threats I don't really mean to carry out.

60. I can't help being a little rude to people I don't like.

61. At times I feel I get a raw deal out of life.

62. I used to think that most people told the truth but now I know otherwise.

63. I generally cover up my poor opinion of others.

64. When I do wrong, my conscience punishes me severely.

65. If I have to resort to physical violence to defend my rights, I will.

66. If someone doesn't treat me right, I don't let it annoy me.

67. I have no enemies who really wish to harm me.

68. When arguing I tend to raise my voice.

69. I often feel that I have not lived the right kind of life.

70. I have known people who pushed me so far that we came to blows.

71. I don't let a lot of unimportant things irritate me.

72. I seldom feel that people are trying to anger or insult me.

73. Lately, I have been kind of grouchy.

74. I would rather concede a point than get into an argument about it.

75. I sometimes show my anger by banging on the table.

Fenz Anxiety Questionnaire

ATTITUDE AND OPINION SURVEY (II)

Please do not write or mark on this booklet in any way. Your answers to the statements in this inventory are to be recorded only on the separate answer sheet.

It is necessary to print only your name in the space provided for this on the answer sheet.

The following are some statements on feelings, daydreams, attitudes, and behavior. Read each statement and decide how often it applies to you. Darken alternative "1" on the ANSWER SHEET if the statement NEVER applies to you; "5" if you experience it almost all the time; "2", "3", and "4" for in between ratings. Be sure you write by the number for the right item that you are working on. Be honest but do not spend too much time over any one statement. As a rule, first impressions are as accurate as any. If you have no questions, please turn to the items on the following pages.

Never				Almost always		
1	2	3	4	5	1.	My mouth feels dry.
1	2	3	4	5	2.	I notice my heart pounding.
1	2	3	4	5	3.	My feelings are easily hurt.
1	2	3	4	5	4.	I have pains in the back of my neck.
1	2	3	4	5	5.	I am troubled with backaches.
1	2	3	4	5	6.	My sleep is fitful and disturbed.
1	2	3	4	5	7.	I take things in stride.
1	2	3	4	5	8.	I am neither too hot or too cold and cannot get comfortable at a constant temperature setting.
1	2	3	4	5	9.	I suddenly feel hot all over, without apparent reason.
1	2	3	4	5	10.	I have periods of such restlessness that I cannot sit still.
1	2	3	4	5	11.	I have a hard time swallowing.
1	2	3	4	5	12.	I am an easy-going person.
1	2	3	4	5	13.	I am troubled by tension interfering with my speech.
1	2	3	4	5	14.	I grind my teeth in my sleep.
1	2	3	4	5	15.	I am easily frightened.
1	2	3	4	5	16.	I take things hard.
1	2	3	4	5	17.	I have enduring headaches that last over several days.
1	2	3	4	5	18.	In the absence of physical action my heart beats wildly.
1	2	3	4	5	19.	When embarrassed, I break out in a sweat which annoys me greatly.
1	2	3	4	5	20.	I am bothered with blushing.

Never				Almost always		
1	2	3	4	5	21.	I have trouble with my hand shaking while I write.
1	2	3	4	5	22.	I have frightening dreams.
1	2	3	4	5	23.	I become irritable about little things.
1	2	3	4	5	24.	I worry about little things.
1	2	3	4	5	25.	I have pounding headaches in which I feel a definite beat.
1	2	3	4	5	26.	I clench my teeth when anxious.
1	2	3	4	5	27.	I feel that I am about to go to pieces.
1	2	3	4	5	28.	I go to sleep without thoughts or ideas bothering me.
1	2	3	4	5	29.	I am troubled by discomfort in the pit of my stomach.
1	2	3	4	5	30.	I am bothered by dizziness.
1	2	3	4	5	31.	My finger tips or other extremities become cold.
1	2	3	4	5	32.	I become upset when I have to wait.
1	2	3	4	5	33.	My skin becomes painfully sensitive.
1	2	3	4	5	34.	Life is a strain for me.
1	2	3	4	5	35.	I have pressure headaches in which my head feels as if it were caught in a vise or as if there was a tight band around it.
1	2	3	4	5	36.	I have feelings of panic for no special reason.
1	2	3	4	5	37.	I am short of breath without knowing why.
1	2	3	4	5	38.	I am troubled with diarrhea.
1	2	3	4	5	39.	I have trouble getting my breath, for no special reason.
1	2	3	4	5	40.	I am afraid that I am going to blush.

Never				Almost always		
1	2	3	4	5	41.	I do not think I am as happy as others.
1	2	3	4	5	42.	My head feels tender to the point that it hurts me when I comb my hair or put on a hat.
1	2	3	4	5	43.	I break out in a sweat, which is not the result of heat or physical exertion.
1	2	3	4	5	44.	I have stomach trouble.
1	2	3	4	5	45.	I am a relaxed person.
1	2	3	4	5	46.	My hand shakes when I try to do something.
1	2	3	4	5	47.	I have sensations of burning, tingling, or crawling in certain parts of my body.
1	2	3	4	5	48.	The muscles in my neck ache as if they were tied in knots.
1	2	3	4	5	49.	I am a nervous person.
1	2	3	4	5	50.	I feel chilly at temperatures that are comfortable for others.
1	2	3	4	5	51.	I have a tendency to worry.
1	2	3	4	5	52.	I have trouble with muscles twitching and jumping.
1	2	3	4	5	53.	The top of my head feels tender.

APPENDIX E

Physiological, Affective, and Personality Trait Correlation Matrix

<u>Variables</u>

1. Heart rate during rest period
   Average of the peak rate attained during 18 10-sec intervals

2. Heart rate during anticipation period
   Average of the peak rate attained during 9 10-sec intervals

3. Heart rate during anagram/noise period
   Average of the peak rate attained during 56 10-sec intervals

4. Heart rate during criticism period
   Average of the peak rate attained during 54 10-sec intervals

5. Heart rate change during anticipation compared to rest period

6. Heart rate change during anagram/noise compared to rest period

7. Heart rate change during criticism period compared to rest period

8. Diastolic blood pressure during rest period
   Average of 6 readings botained at 90-sec intervals

9. Diastolic blood pressure during anticipation period
   Based on one reading

10. Diastolic blood pressure during anagram/noise period
    Average of seven readings

11. Peak diastolic blood pressure during anagram/noise period
    Average of two highest readings

12. Diastolic blood pressure during criticism period
    Average of six readings

13. Peak diastolic blood pressure during interval or criticism period
    Average of two highest readings

14. Diastolic blood pressure change during anticipation period

15. Diastolic blood pressure change during anagram/noise period

16. Peak diastolic blood pressure change during anagram/noise period

17. Diastolic blood pressure change during criticism period

18. Peak diastolic blood pressure change during criticism period

19. Lability-Intrasympathetic Balance Score derived from the anticipation period

Variables

20. Lability-Intrasympathetic Balance Score derived from the anagram/noise period

21. Lability-Intrasympathetic Balance Score derived from anagram/noise period using the peak diastolic blood pressure score

22. Lability-Intrasympathetic Balance Score derived from the criticism period

23. Lability-Intrasympathetic Balance Score derived from the criticism period using the peak diastolic pressure score

24. Tension-Intrasympathetic Balance Score derived from the rest period

25. Tension-Intrasympathetic Balance Score derived from the anticipation period

26. Tension-Intrasympathetic Balance Score derived from the anagram/noise period

27. Tension-Intrasympathetic Balance Score derived from the anagram/noise period using the peak diastolic blood pressure score

28. Tension-Intrasympathetic Balance Score derived from the criticism period

29. Tension-Intrasympathetic Balance Score derived from the criticism period using the peak diastolic blood pressure score

30. Background activity score derived from the rest period

31. Background activity score derived from the recovery period

32. Social Anxiety subscale of the Activity Preference Questionnaire
    High score indicative of social anxiety

33. Physical Anxiety subscale of the Activity Preference Questionnaire
    High score indicative of physical anxiety

34. Ego Threat subscale of the Activity Preference Questionnaire
    High score indicative of ego threat

35. Total score to the Activity Preference Questionnaire
    Based on the sum of Ego Threat, Social Anxiety, and Physical Anxiety

Variables

36. Ve subscale of the Activity Preference Questionnaire
    High score indicative of falsification

37. Vne subscale of the Activity Preference Questionnaire
    High score indicative of falsification

38. Assault subscale of the Buss-Durkee Hostility Inventory
    High score indicative of Assault

39. Indirect subscale of the Buss-Durkee Hostility Inventory
    High score indicative of Indirect aggression

40. Irritability subscale of the Buss-Durkee Hostility Inventory
    High score indicative of Irritability

41. Negativism subscale of the Buss-Durkee Hostility Inventory
    High score indicative of Negativism

42. Resentment subscale of the Buss-Durkee Hostility Inventory
    High score indicative of Resentment

43. Suspicion subscale of the Buss-Durkee Hostility Inventory
    High score indicative of Suspicion

44. Verbal subscale of the Buss-Durkee Hostility Inventory
    High score indicative of Verbal aggression

45. Total score on the Buss-Durkee Hostility Inventory

46. Guilt subscale of the Buss-Durkee Hostility Inventory
    High score indicative of Guilt

47. Hostility factor of the Buss-Durkee Hostility Inventory
    Sum of the Suspicion and Resentment subscales

48. Aggression factor of the Buss-Durkee Hostility Inventory
    Sum of Assault, Indirect, Irritability, Negativism, Resentment, and Verbal subscales

49. Autonomic Arousal subscale of the Fenz Anxiety Questionnaire
    High score indicative of Autonomic Arousal

50. Muscle Tension subscale of the Fenz Anxiety Questionnaire
    High score indicative of Muscle Tension

51. Feelings of Insecurity subscale of the Fenz Anxiety Questionnaire
    High score indicative of Feeling of Insecurity

Variables

52. Total score of the Fenz Anxiety Questionnaire

53. M.I. 25 subscale of the Cattell 12 O-A Battery
    Low score contributes to U.I. 18

54. M.I. 134 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 18

55. M.I. 53 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 18

56. M.I. 153 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 18

57. M.I. 266 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 18

58. M.I. 15 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 18

59. Factor U.I. 18 of the Cattell 12 O-A Battery

60. M.I. 152 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I.20

61. M.I. 38 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 20

62. M.I. 113 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 20

63. M.I. 246 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 20

64. M.I. 219 subscale of the Cattell 12 O-A Battery
    High score contributes to U.I. 20

65. Factor U.I. 20 of the Cattell 12 O-A Battery

66. Birth Order
    High score indicative of later borns

67. Smoking
    High score indicates S smoked

68. Last meal
    High score indicating number of hours last meal consumed prior to test

Variables

69. Post experimental inquiry, question 5
    High score indicates endorsement of positive end of scale

70. Post experimental inquiry, question 6
    High score indicates endorsement of positive end of scale

71. Post experimental inquiry, question 7
    High score indicates considerable reflection

72. Pretest Anxiety score on MACL
    High score indicates Anxiety

73. Pretest Anger score on MACL
    High score indicates Anger

74. Pretest Skepticism score on MACL
    High score indicates Skepticism

75. Pretest Skepticism plus Anger score on MACL

76. Posttest Anxiety score on MACL
    High score indicates Anxiety

77. Posttest Anger score on MACL
    High score indicates Anger

78. Posttest Skepticism score on MACL
    High score indicates Skepticism

79. Posttest Anger plus Skepticism score on MACL

80. Time of psychophysiological testing
    High score indicates P.M.
    Low score indicates A.M.

81. Diastolic blood pressure recovery score
    High score indicates longer recovery time

82. Heart rate recovery score
    High score indicates longer recovery time

83. Difference score between Posttest and Pretest Anxiety

84. Difference score between Posttest and Pretest Anger

85. Difference score between Posttest and Pretest Skepticism

86. Difference score between Posttest and Pretest Anger plus Skepticism

Product-Moment Correlational Matrix of Psychophysiological Variables
(decimals omitted)

	1	2	3	4	5	6	7	8	9	10
1.										
2.	846									
3.	785	864								
4.	838	899	922							
5.	-277	277	144	110						
6.	-328	028	328	129	641					
7.	-284	092	241	285	679	301				
8.	160	133	146	151	049	021	016			
9.	097	053	082	076	-078	-023	-037	928		
10.	124	107	173	144	-030	075	035	898	937	
11.	131	117	187	161	-025	086	053	896	934	990
12.	111	115	147	133	007	055	040	909	940	979
13.	116	115	154	151	-001	059	062	877	898	941
14.	-166	-209	-168	-198	-078	-004	-057	-189	191	103
15.	-080	-057	060	-016	042	214	112	-226	020	227
16.	-064	-035	090	022	052	235	150	-228	015	204
17.	-115	-043	003	-041	130	180	129	-213	029	191
18.	-089	-036	018	000	096	163	157	-247	-059	089
19.	076	-331	-212	-210	-734	-439	-501	-096	184	091
20.	198	-067	-213	-115	-477	-626	-549	-163	034	121
21.	214	-050	-192	-086	-476	-618	-526	-167	031	104
22.	129	-102	-180	-247	-416	-470	-659	-150	050	119
23.	151	-098	-172	-219	-049	-491	-649	-178	-017	042
24.	-648	-550	-493	-529	176	236	208	648	641	597
25.	-544	-688	-568	-598	-258	-037	-094	578	688	603
26.	-514	-588	-643	-605	-135	-196	-160	585	665	643
27.	-512	-586	-637	-596	-132	-190	-147	588	669	641
28.	-552	-595	-588	-658	-078	-055	-186	576	657	635
29.	-554	-601	-589	-651	-086	-053	-171	558	631	612
30.	-006	062	077	060	122	126	115	-055	-024	029
31.	-297	-381	-451	-475	-152	-234	-312	005	004	-025
32.	-091	-029	-053	-043	112	059	084	-064	-059	-091
33.	-083	-044	-113	-057	070	-466	046	-109	-116	-152
34.	-038	-057	-028	-038	-035	015	-001	032	017	-011
35.	-099	-053	-091	-061	084	013	066	-078	-083	-125
36.	-076	-088	-095	-061	-022	-029	027	-049	-095	-144
37.	-084	015	-076	-047	179	012	066	-059	-058	-031
38.	-130	-107	-082	-055	042	074	133	139	166	114
39.	-213	-207	-112	-143	011	154	123	-096	-067	-085
40.	-054	-015	-021	-008	071	051	081	078	097	036
41.	-023	031	-076	023	098	-080	082	-077	-105	-107
42.	059	140	062	130	147	006	126	114	139	121
43.	035	122	083	137	157	073	180	199	226	187

	1	2	3	4	5	6	7	8	9	10
44.	-099	-093	-125	-097	011	-039	004	024	067	001
45.	-090	-033	-055	-008	103	054	145	092	124	068
46.	-145	-119	-102	-103	047	065	073	030	062	059
47.	050	142	080	147	167	047	171	176	205	172
48.	-142	-111	-111	-079	057	049	111	037	066	008
49.	015	061	010	005	083	-008	-018	047	034	027
50.	048	020	079	050	-050	048	005	132	101	132
51.	044	073	060	088	053	025	078	-032	-053	-087
52.	042	062	058	058	036	025	029	051	026	020
53.	054	085	076	052	056	034	-003	015	-003	038
54.	029	035	001	069	012	-042	071	038	023	004
55.	002	007	069	091	010	102	158	-040	-026	-019
56.	036	018	-045	-009	-032	-124	-079	074	067	046
57.	118	010	090	070	-194	-041	-084	158	075	154
58.	-137	-106	-053	-074	056	129	110	009	-003	059
59.	039	019	054	077	-036	022	067	099	051	110
60.	-054	017	005	-021	128	091	059	-072	-071	-063
61.	101	170	162	158	124	092	100	-090	-055	-054
62.	-032	-040	-054	-026	-015	-034	011	-080	-077	-117
63.	019	-054	002	027	-131	-025	015	046	103	095
64.	-133	-072	-091	-099	111	064	061	-016	016	-030
65.	-047	009	011	018	102	089	116	-101	-040	-080
66.	-158	-116	-058	-107	076	153	090	-056	-046	-027
67.	-147	-031	064	-062	211	322	150	-023	007	051
68.	006	-062	-071	-061	-122	-117	-118	282	267	230
69.	094	166	059	092	132	-053	-003	078	031	-036
70.	018	022	030	-029	008	019	-081	-005	-027	-052
71.	-176	-110	-035	-120	120	214	099	044	-003	022
72.	326	392	396	374	120	106	085	114	043	096
73.	-024	-113	-141	-112	-160	-178	-154	-212	-214	-217
74.	172	199	180	168	049	012	-007	-265	-292	-271
75.	100	067	038	047	-059	-094	-093	-296	-315	-303
76.	114	161	179	136	085	100	039	-019	-039	-081
77.	098	099	048	073	002	-076	-044	-077	066	-120
78.	083	123	189	151	073	162	120	-152	-155	-174
79.	112	131	123	124	035	018	022	-128	-121	-171
80.	081	062	043	066	-035	-059	-026	-216	-178	-142
81.	-006	141	128	097	264	204	n180	-144	-006	032
82.	-256	-112	025	018	260	428	481	-072	-095	-072
83.	-188	-206	-192	-212	-031	-006	-041	-118	-073	-157
84.	094	163	145	142	125	079	085	104	114	074
85.	-089	-075	009	-017	025	150	127	113	138	097
86.	011	060	079	072	088	104	108	157	181	124

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12.	972									
13.	943	976								
14.	103	082	055							
15.	210	156	142	647						
16.	229	139	144	639	954					
17.	179	214	231	636	894	860				
18.	096	136	248	493	742	750	897			
19.	087	052	038	734	412	400	345	271		
20.	099	080	066	519	627	573	570	462	679	
21.	116	068	069	520	598	619	550	475	679	970
22.	096	132	128	525	592	538	660	561	641	848
23.	033	074	144	423	485	462	591	650	594	779
24.	590	616	588	-018	-113	-127	-076	-122	-132	-278
25.	595	600	569	291	056	037	052	-017	374	074
26.	625	647	612	211	129	088	146	056	236	260
27.	638	647	619	212	117	109	138	061	235	245
28.	616	659	627	213	131	089	194	103	199	149
29.	600	647	652	194	121	094	209	191	191	139
30.	051	012	-014	082	184	231	158	082	-027	046
31.	-035	-010	-027	-000	-066	-086	-034	-063	103	134
32.	-113	-087	-080	015	-059	-107	-053	-032	-066	-093
33.	-156	-130	-115	-018	-094	-102	-048	-011	-060	-038
34.	-032	-010	005	-039	-096	-140	-098	-056	-002	-088
35.	-145	-112	-097	-012	-104	-145	-078	-038	-065	-093
36.	-117	-158	-146	-121	-209	-147	-254	-195	-067	-143
37.	-027	-017	-003	003	064	070	099	113	-119	041
38.	120	152	163	069	-056	-042	031	049	019	-103
39.	-079	-059	-026	078	025	039	086	141	046	-103
40.	040	084	126	049	-094	-084	015	097	-014	-115
41.	-090	-074	-071	-073	-065	-028	009	014	-116	012
42.	124	160	219	066	016	022	108	212	-055	008
43.	190	246	281	071	-027	-019	109	165	-058	-080

	11	12	13	14	15	16	17	18	19	20
44.	021	049	041	113	-051	-006	059	035	069	-009
45.	079	127	161	084	-053	-027	084	141	-013	-085
46.	056	083	124	085	064	057	123	189	026	-001
47.	176	227	277	075	-008	-001	119	204	-062	-044
48.	021	061	082	076	-065	-035	054	090	013	-091
49.	044	072	115	-032	-043	-005	060	139	-078	-028
50.	171	153	218	-082	-000	085	049	174	-022	-038
51.	-084	-039	018	-056	-122	-114	-017	100	-073	-117
52.	042	065	130	066	-069	-021	033	159	-069	-075
53.	020	029	-005	-046	052	012	035	-040	-070	014
54.	007	-018	-025	-040	-076	-069	-131	-128	-035	-027
55.	-025	-020	-032	037	046	033	048	017	018	-044
56.	040	066	047	-019	-062	-075	-019	-054	009	050
57.	145	098	075	-217	-009	-027	-138	-167	-015	026
58.	060	039	027	-032	111	112	070	036	-060	-014
59.	096	076	034	-124	024	-006	-053	-132	-060	002
60.	-061	-039	-045	003	022	026	078	056	-085	-055
61.	-061	-046	-066	092	080	063	103	048	-022	-009
62.	-107	-124	-110	009	-082	-059	-103	-059	017	-038
63.	105	059	078	149	108	130	032	065	191	106
64.	-014	014	045	085	-029	005	072	123	-017	-074
65.	-066	-065	-047	160	046	078	086	110	039	-034
66.	-040	-000	022	028	065	036	131	158	-033	-069
67.	066	027	038	042	164	195	117	123	-115	-126
68.	229	232	239	-039	-114	-116	-117	-086	056	002
69.	-035	-013	-035	-124	-251	-247	-214	-229	-174	-158
70.	-046	-042	-017	-057	-103	-089	-085	-024	-044	-097
71.	005	031	059	-123	-049	-085	-032	031	-165	-210
72.	094	104	119	-185	-040	-042	-023	012	-207	-116
73.	-225	-217	-176	-005	-012	-030	-013	073	106	133
74.	-296	-284	-249	-071	-012	-007	-044	033	-081	-019
75.	-306	-312	-265	-050	-015	-022	-037	063	007	063
76.	-070	-059	-020	-052	-137	-112	-095	-002	-093	-188
77.	-118	-084	-052	028	-097	-090	-018	049	018	-016
78.	-177	-168	-159	-006	-047	-054	-037	-013	-054	-166
79.	-170	-141	-113	018	-094	-093	-031	031	-012	-089
80.	-142	-140	-125	098	163	160	177	183	091	177
81.	088	103	142	364	499	508	581	578	068	236
82.	-085	-068	-032	-063	-001	-030	007	079	-219	-342
83.	-146	-145	-124	119	-086	-062	-064	-012	102	-064
84.	083	102	095	026	-065	-046	-003	-018	-067	-114
85.	092	116	090	064	-035	-047	007	-046	027	-147
86.	127	160	142	063	-074	-066	006	-030	-017	-142

	21	22	23	24	25	26	27	28	29	30
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22.	815									
23.	771	940								
24.	-293	-215	-254							
25.	059	111	059	866						
26.	230	232	166	848	911					
27.	242	217	161	849	912	994				
28.	117	288	223	870	910	951	945			
29.	119	288	278	857	896	934	932	986		
30.	084	033	-025	-038	-062	-038	-021	-036	-057	
31.	119	211	192	233	280	331	326	353	344	269
32.	-134	-103	-089	021	-021	-029	-047	-033	-028	-099
33.	-045	-071	-043	-020	-052	-030	-033	-055	-044	002
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