BLOOD PRESSURE REACTIONS TO EXPRESSED AND UNEXPRESSED ANGER IN LOW GUILT AND HIGH GUILT SUBJECTS

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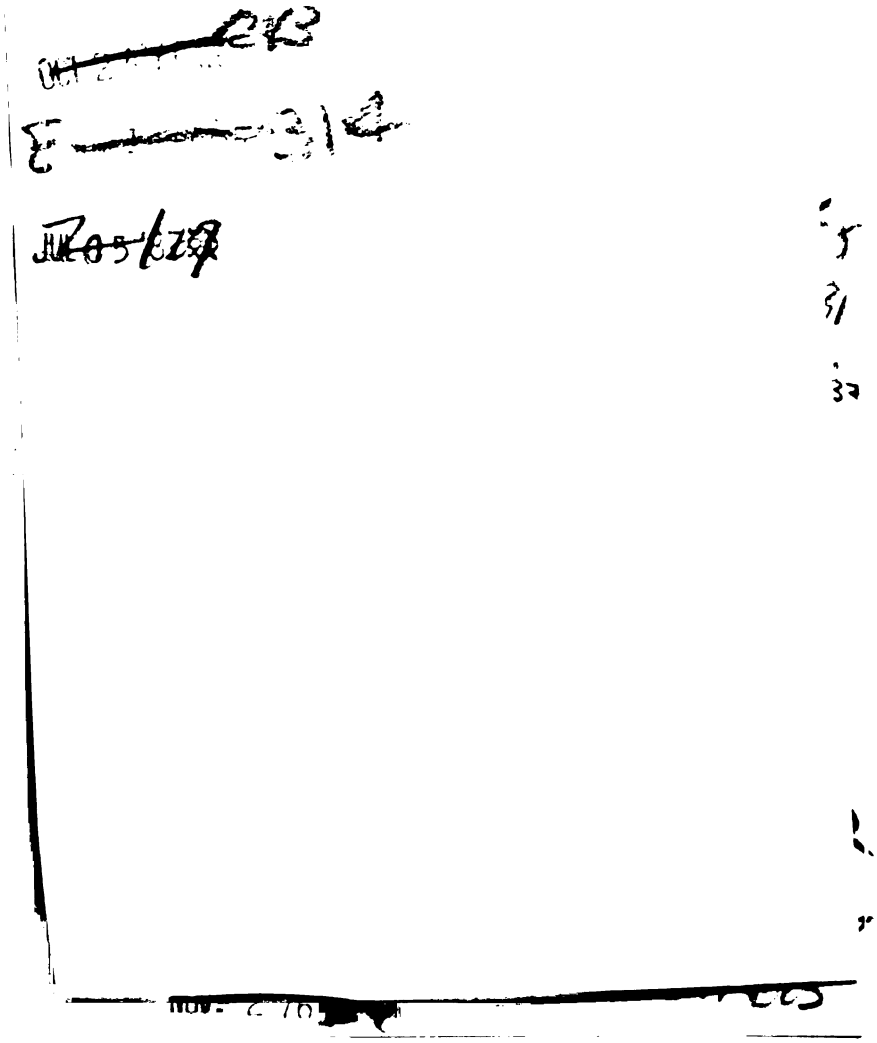

ABSTRACT

BLOOD PRESSURE REACTIONS TO EXPRESSED AND UNEXPRESSED ANGER IN LOW GUILT AND HIGH GUILT SUBJECTS

By Salvatore Gambaro

The psychosomatic theory of essential hypertension involves the following major postulates: Inhibition of anger instigated aggression raises diastolic blood pressure and, by implication, the expression of aggression under these conditions lowers diastolic blood pressure. In an effort to experimentally investigate these postulates, basically two questions were considered in this research: "What effect do psychological stimuli, designed to arouse anger, have on blood pressure; and what is the effect on blood pressure of directly and indirectly expressing anger following these stimuli?" Also considered in this research was the variable of "aggression guilt" as it relates to blood pressure reactions in the expression and non-expression of anger following the experimental manipulations.

Subjects were randomly divided into four groups with twenty subjects in each group. Group I subjects went through a "frustration sequence" and were allowed "direct expression" of anger by shocking the frustrator (the experimenter's assistant). Group II subjects went through the "frustration sequence" and were allowed "indirect expression" by shocking the experimenter. Group III subjects went through the "frustration sequence" but were allowed "no expression" through the

shock apparatus. Group IV subjects did not go through the "frustration sequence." They were allowed to complete the presented task and in the "expression" phase they were engaged in "fill-in" activities.

Blood pressure was measured indirectly in the subject's left arm by means of an E and M Physiograph, utilizing an Electrosphygmograph transducer. Resting blood pressures were recorded for all subjects. Post "frustration" and post "expression" recordings were also obtained. Subjective ratings of anger were also made at the end of the "frustration sequence." At the end of the experimental procedure, the Mosher Incomplete Sentence Test was administered and scored for aggression-guilt. Subjects were categorized as High Guilt or Low Guilt on the basis of the median guilt score for all 80 subjects.

Subjects who underwent the "frustration sequence" rated themselves as significantly more angry than control subjects. Diastolic blood pressure was significantly elevated as a result of our experimental procedure. In the post "expression" phase for Groups I and II and post "fill-in" phase for Groups III and IV, a comparison of the mean diastolic decreases of subjects in the High Guilt and Low Guilt categories was made. Across all conditions of "expression" and "non-expression," the "low guilt" subjects exhibited a significantly greater decrease of diastolic blood pressure. "Direct expression," shocking the frustrator, resulted in a significantly greater diastolic decrease than was measured in the "no expression" group. "Indirect expression" did not result in a significantly greater diastolic decrease than was measured in the "no expression" group. However, when the variable of aggression-guilt was taken into account, a different picture emerged.

"High guilt" and "low guilt" subjects did not differ in their diastolic and systolic elevations in anger; almost all subjects showed blood pressure increases in this phase. In the "expression phase" both the High Guilt and Low Guilt sub-groups in the "direct expression" group exhibited significant mean diastolic decreases. In the "indirect expression" group, we found that the group as a whole did not differ significantly from the "no expression" group in mean diastolic decrease. But, when the High Guilt and Low Guilt sub-groups were compared in the "indirect expression" phase, we found that the Low Guilt group had a diastolic decrease significantly greater than the High Guilt group had and the Low Guilt group's decrease was as great as that shown by the total "direct expression" group. The "high guilt," "indirect expression" subjects were actually showing a slight mean increase after "expression"!

The results were seen as supporting those aspects of the psychosomatic theory of hypertension which were put to an experimental test and also as introducing the importance of the aggression-guilt variable into the theory.

Approved _____
Committee Chairman

Date 7/15/66

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By

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CHAPTER I

INTRODUCTION

AIMS OF THIS RESEARCH

The primary purpose of this investigation was to study the interrelationship of a psychological state (anger) and a concommitant physiological change (blood pressure), with the intention of contributing to the understanding of the clinical syndrome of essential hypertension. Further, in a more exploratory fashion, the variables of guilt and defense preference, as they relate to blood pressure changes under certain conditions, were investigated.

HYPERTENSION: A RELATED PROBLEM

There is a clinical syndrome which is known as "essential hypertension." The use of the term "essential" is to distinguish between two major types of arterial hypertension. In one type, called primary, or essential hypertension, the condition occurs unpreceded by known pathological changes in the kidneys, the vascular system or other organs, and in which emotional factors are believed to play an important role. Essential hypertension, therefore, may cause but is not itself the result of kidney disease. In the other form, i.e. renal hypertension, the hypertension is a consequence of chronic kidney disease (Best and Taylor, 1958).

The clinical syndrome of hypertension appears in the form of chronically elevated <u>diastolic</u> blood pressure. Usually the systolic pressure is also raised, but it need not be. Also, systolic hypertension

may occur without a diastolic pressure elevation. Systolic hypertension alone is not believed to be clinically important unless very high levels threaten the integrity of the blood vessels. In the more important diastolic hypertension, the chronic, abnormally high pressure is due to spasms of the arterioles. This condition leads to serious consequences; it throws extra work upon the heart and subjects the arterial system to undue strain (Best and Taylor, 1961). Most of the damage caused by the persistence of high blood pressure can be summed up in one word--sclerosis. This scarring of the walls of the arterioles and arteries ultimately leads to closure of some of these vessels (Page, 1951).

The organic tradition in medicine has generally favored a purely physical view of the etiology, pathogenesis and treatment of essential hypertension. There is a psychosomatic approach, on the other hand, which does not ignore the physical problems involved but includes a consideration of the role of experience and emotions. It emphasizes the multiple factors involved in etiology and pathogenesis. Briefly stated, the psychosomatic theory is as follows: During the early phase of hypertension marked lability of the blood pressure is common. This lability makes it probable that no permanent structural vasoconstriction or sclerosis exists. The transient blood pressure elevations in the prehypertensive are easily induced by psychic factors. When the emotions causing the transient hypertension are prolonged over long periods, permanent vasospasm and hypertension occur. The theory supposes that long, continued excitation of the mediating mechanisms causes sclerosis and permanent hypertension (Alexander, 1939).

One of the most energetic "schools" of research on hypertension is that which promotes a "repressed-hostility" hypothesis. Beginning with Alexander's (1939) theoretical discussion, this hypothesis asserts that hypertension develops as a result of the chronic repression of feelings of anger. This repressed anger or tension is somatically expressed in increased blood pressure, which, over time, leads to the permanent vascular changes associated with hypertension. Alexander's speculations were based on the psychoanalysis of hypertensive patients. A number of other clinical observers have also worked along the line of Alexander's repressed hostility hypothesis (Binger, Ackerman, Cohn, Schroeder and Steel, 1945; Milton, 1961; Saul, 1939; Schwarts, 1940; Weiss, 1942). Their general conclusions seem to be that although all varieties of character and neurotic disturbances occur in hypertensive individuals, a common problem seems to be the presence of "emotional tension" due to "chronically repressed hostility." These investigators feel that their findings are consistent with this sort of causal sequence:

1) S inhibits impulses to action (in situations where others would aggress),

2) thereby raising his blood pressure.

3) Such frequent inhibitions result in heightened blood pressure outlasting the inhibition period; and

4) eventually, S's blood pressure remains at a high level. He is always under stress.

Their method is that of interpreting the data obtained during psychotherapy. Disregarding for a moment the question of the method itself, these observers could not avoid errors due to preselection of the material which they studied. It will remain an open question as to how representative of the general population of hypertensives are those in psychotherapy;

it is quite likely that they are a small and select part of the population. However, the observations of such a large group of keen clinical observers cannot easily be dismissed, regardless of their methodology, and in this case they led to a series of primarily correlational studies.

Relevant Research

One of the most creative tests of the hostility hypothesis was done by Saul, Sheppard, Selby, Sachs and Master (1954). They asked 17 chronic hypertensives and 16 non-hypertensive patients to report their dreams. The Ss did not know the experimental hypothesis. Over a two month period 78 dreams were collected. These were rated for hostility by two judges who did not know the hypothesis being investigated and did not know the S's blood pressures. Dreams of hypertensives had content rated significantly higher for hostility than did dreams of the non-hypertensive patients.

In a similar study, Kaplan, Gottschalk, Magliocco, Rohobit and Ross (1961) compared a group of 10 hypertensive patients with 10 non-hypertensive patients on measurements of hostile content in samples of five-minute verbal productions and hypnotic dreams. Their results showed a striking difference. The hypertensive group's productions showed a greater mean amount of hostility ($p < .002$) as measured by this method.

Milton (1961) investigated the relationships over time among blood pressure, personality dynamics discussed during therapy, and overt behaviors for a single hypertensive patient. A 38 year old, white, male hypertensive served as the S. Over a nine month period, interrelations among 15 variables were factor analyzed and an approximate simple structure was achieved. Five factors were isolated. Two of these

factors were related to blood pressure and they involve hostility and identification conflict. In all three of the above experiments, however, the possibility that the hostile verbal content might be due to elevation of blood pressure, rather than vice versa, or that both might be dependent variables of some other critical factor, cannot be discounted.

A study which attempted to get at this question (Gottschalk, Gleser, D'Zmura and Hanenson, 1964) reported the relationship between blood pressure and hostility and also the changes that would occur in this relationship following continuous administration of a diuretic agent, such as hydrochlorothiazide, which is capable of significantly reducing the blood pressure of hypertensive patients. (It was hoped that this experimental aspect of the study might provide some clues as to whether the hostility might be a result, in part, of pathophysiological factors rather than simply a causal factor in the elevated blood pressure). Twelve hypertensive female patients with an absence of known renal or hormonal pathology were observed. Taped five minute speeches in response to standardized instructions from the same examiner were rated for levels of "hostility inward" and "hostility outward."

Their results report that statistically significant positive correlations ($p < .05$) were found between hostility inward levels and average systolic and diastolic blood pressures. Significant negative correlations ($p < .05$) were found between hostility outward levels and blood pressure. No significant changes in hostility levels occurred while women were taking hydrochlorothiazide even though there were significant decreases in blood pressure during this time.

Not all studies present results which support the repressed hostility hypothesis. A study which presents ambiguous results, at best, is that by Matarazzo (1954). He had Ss, well matched for age, sex and socio-economic status, but with either hypertensive or normal blood pressure, tell stories to TAT pictures. As they were telling the stories, their performance was criticized by the investigator. Pre-test indices of aggressiveness were obtained from the Rosenzweig Picture-Frustration Study and the Allport Ascendance-Submission Scale. TAT stories were coded for aggressive content before and after the criticism, which began after several stories had been told. There were no differences between hypertensive and normal blood pressure Ss on either pre or post-test aggressiveness using these variables. However, 12 out of 40 of the non-hypertensive Ss refused to continue telling TAT stories when criticism began while only 1 out of the 40 hypertensive Ss quit. Matarazzo interprets quitting as aggressivity toward E and notes that the hypertensives, who are at least theorized to be less openly aggressive, generally did not quit.

Neiberg (1957) gave a multiple choice form of the Rosenzweig P-F Study to a group of hypertensive Ss and non-hypertensive Ss before and after a criticism experience. Subjects were criticized while going through the Wisconsin Card Sort. Verbalized aggression by S following stress was recorded. He found no differences in pre or post-stress aggressivity between the hypertensive and the non-hypertensive Ss.

PROSPECTUS

In an effort to experimentally investigate those aspects of the psychosomatic theory of hypertension which state that the inhibition of

aggression will raise blood pressure and which imply that the expression of aggression will lower blood pressure, basically two questions are considered in this research: "What effect do psychological stimuli, designed to arouse anger, have on blood pressure; and what is the effect on blood pressure of directly and indirectly expressing anger following these stimuli?" Also considered in this research, but in a more exploratory manner, are the variables of "defense preference" and "aggression-guilt" as they relate to blood pressure reactions in the expression and non-expression of anger following the experimental manipulations.

HEMODYNAMICS BRIEFLY CONSIDERED

Arterial blood pressure is the result of the discharge by the heart into the arterial system of a volume of blood which cannot all escape through the peripheral vessels into the venous system much before the next heart beat occurs. The arterial system during life is at all times overfilled. That is, the elastic arterial walls are always more or less stretched. The height of the blood pressure is therefore dependent upon two main factors: the output of the heart, and the caliber of the peripheral resistance (Best and Taylor, 1958). The small vessels at the periphery--the arterioles and the capillaries--but especially the arterioles, offer resistance to the passage of blood from the arterial system into the veins. Within the closed circulatory system, illustrated in Figure 1, we can see that the dilation or contraction of the arterioles can control circulation and pressure in the whole system.

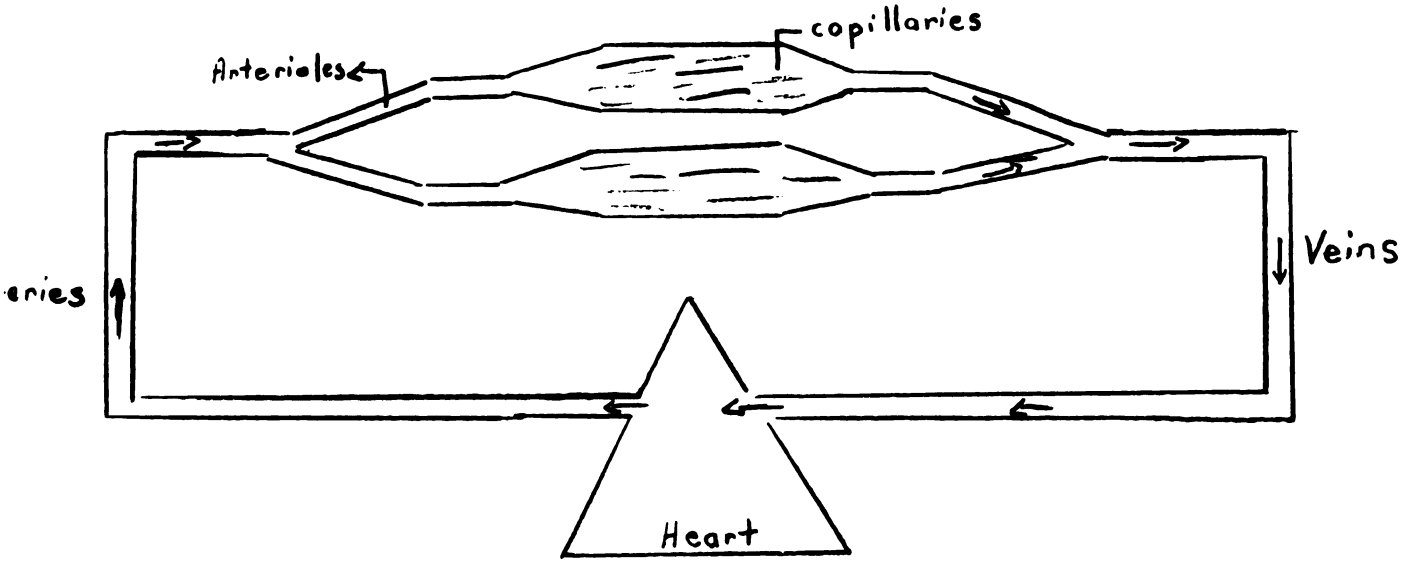

Fig. 1. Schema to demonstrate the main features of the circulatory system

The arterioles in the body represent stopcocks through which, by alterations in their caliber, the volume of blood flow entering the capillaries is metered. The arterioles are supplied with nerves which, by bringing about contraction or relaxation of the rings of smooth muscle, control their calibers. Constriction of the peripheral vessels reduces, temporarily, the outflow from the arterial system and a rise in arterial pressure occurs, provided the minute volume of the heart is not at the same time reduced. The arterial system must, therefore, contain more blood than formerly, and the arterial walls are more forcibly stretched. The pressure then rises to the point at which the quantity of blood leaving the arterial system again equals that which is pumped into the heart; no further rise in pressure then occurs (Best and Taylor, 1958). We can see in the illustration of Figure 2 that within the vascular system a large part of the ventricular contraction is expended in overcoming the resistance offered by the small calibered

arterioles. If the output of the heart remains unchanged, any constriction of the arterioles would further increase blood pressure.

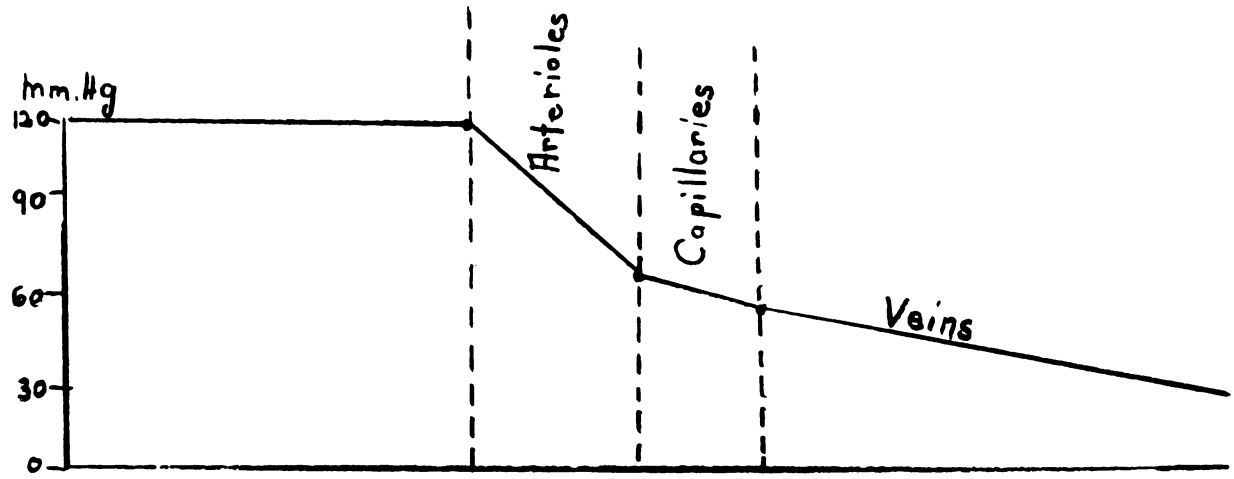

Fig. 2. Curve of blood pressure throughout the circulation from left ventricle to right auricle (Best and Taylor, 1958, p. 130)

The velocity of the blood also varies in different parts of the vascular system but it does not, like blood pressure, show a continuously progressive diminution from the aorta to the right ventricle (see Figure 3).

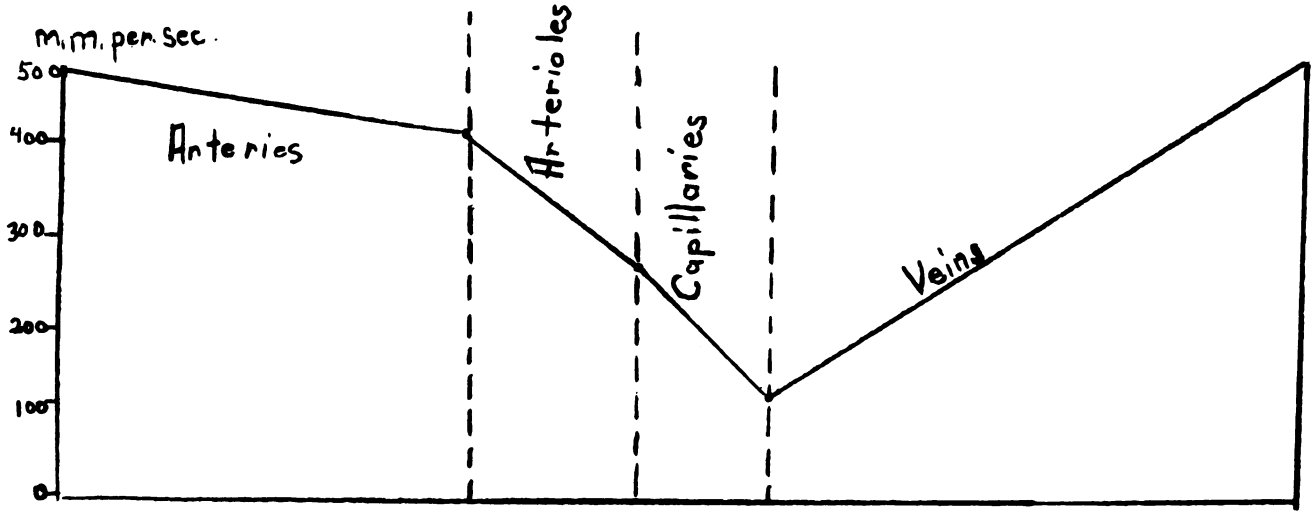

Fig. 3. Curve of velocity throughout the circulation - from left ventricle to right auricle (Best and Taylor, 1958, p. 136)

Each ventricular systole forces blood into an already filled and stretched aorta, partly by further distention of the aorta and its branches. During diastole the gradual recoil of the elastic walls causes the flow of blood to continue out of the arterial system through arterioles into capillaries. The steady flow through capillaries is thus achieved by the compression chamber function of the aorta, and the volume of capillary flow is determined by vasomotor changes in arterioles which act as stopcocks of the circulatory system (Wiggers, 1952). In Figure 4 we can see how the elastic recoil of the arterial wall acts as a pump to keep the blood moving forward.

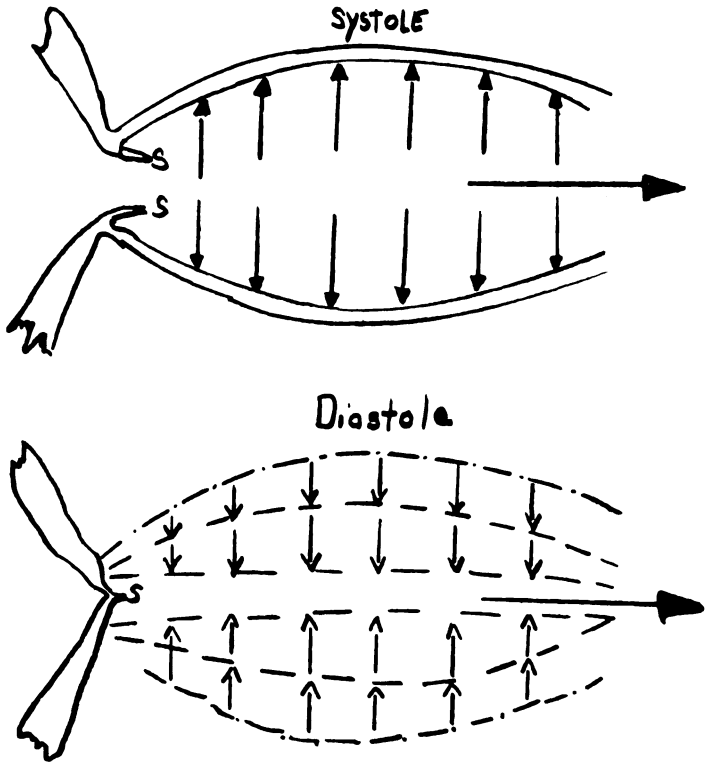

Fig. 4. Diagram to illustrate the storing of energy of the heart's contraction in the elastic arterial walls (at root of aorta) during systole and its release during diastole. Small arrows indicate the direction of movement of the arterial walls and of the force exerted during the two phases. Large arrows indicate direction of the blood flow (Best and Taylor, 1958, p. 150).

The whole pressure curve is designated the "pressure pulse." The maximal pressure reached during systole is the systolic pressure; the minimal pressure realized at the end of diastole is the diastolic pressure, and the numerical difference between these represents the pulse pressure. The expansion of the vessels which the pressure pulse produces in any part of the arterial system is the pulse (Wiggers, 1952).

Although blood pressure has been measured for more than half a century, there is still little agreement on what constitutes "normal" blood pressure (McGinn, 1962). This is due, in good part, to the fact that arterial blood pressure is influenced by a number of physiological and psychological conditions--age, muscular exercise, digestion, emotion, etc. In the newborn baby, the systolic pressure averages 40 mm. Hg, but reaches a value of around 80 mm. by the end of the first month. It rises more gradually throughout childhood, attaining a level of about 100 mm. by the twelfth year and 120 or so by the seventeenth. It remains around this level for the next five to eight years. After about the twenty-fifth year, the renewed increase in systolic pressure averages about 0.5 mm. Hg per year (Best and Taylor, 1958). From "blood pressure by age norms" (Fishberg, 1939), general guidelines have been established for what to consider high or "abnormal" blood pressure. As a practical criterion, the physician assumes that normal systolic blood pressure, taken after the subject has had a short rest, is in the range of 100 plus his age in years. The rule for diastolic is a little more than one-third less than the systolic pressure.

The systolic level of blood pressure is mainly determined by the activity of the heart, whereas the diastolic level is a tonic function of the peripheral arteries (Page, 1951). The diastolic level is the more important of the two in hypertension (Best and Taylor, 1961) and the one we will be most concerned with in this experiment. It is the "run off" pressure from the great vessels into the tissues, and is the pressure which must be developed by the heart before it can even begin to eject blood into the vessels (Page, 1951).

ANGER

Anger is considered to be an emotional reaction with prominent skeletal-facial components. It may be conceptualized as a drive state; like anxiety in this respect (Buss, 1961). Because the expressions and characteristics of anger undergo modification during socialization, the skeletal and facial aspects of anger are best seen in children. Children can be taught to modulate the expression of anger; a scowl and a threatening position of the arms can be punished, and with continued punishment these expressions can be inhibited. However, while the postural features of anger may be suppressed, physical aspects are not changed by socialization (Buss, 1961). Society is concerned mainly with responses that have interpersonal consequences, and both overt anger and attacking responses are shaped and inhibited by society. However, the heightened level of physiological activity is less public, and there are no taboos concerning such physiological arousal. Furthermore, it is difficult to control autonomic responses; though they may be conditioned in the laboratory (Razran, 1961), it is extremely difficult to modulate or inhibit them in everyday situations.

Thus, the autonomic aspects of anger remain intact while the postural and facial aspects are modulated and inhibited.

The pattern of autonomic arousal that occurs in anger constitutes a physiological tension state (Buss, 1961). The individual is aware of this tension state because interoceptors are sensitive to these internal stimuli, but it is difficult to verbalize precisely what the tension state is like. The subject typically reports being stirred up, aroused, tense, excited, tight, etc. (Buss, 1961). The tension state is sufficiently different from the resting state to be discriminated but too diffuse to be described in detail. Folklore has frequently associated this tension state with blood pressure changes occurring with increases or decreases of anger. Note how often we have heard the expression to an angered person, "Now watch your blood pressure!" Folklore also holds that an angered person often feels better after striking at the source of his annoyance, either directly through physical actions or indirectly through verbal responses.

These thoughts, essentially, contain the notions of Dollard, Doob, Miller, Mower and Sears (1939) on the "catharsis hypothesis." Specifically, the catharsis hypothesis reads: "The occurrence of any act of aggression is assumed to reduce the instigation to aggression" (p. 50). Extrapolating from their notions concerning the joint operation of displacement and catharsis, we are led to believe that displaced aggression, even though forced, might also lead to some degree of arousal reduction. Thus we might expect a reduction in tension level, as measured by blood pressure, in a person who not only aggresses against his frustrator but also in one who aggresses against a

"non-frustrator." The response is a displaced one, however, and in relation to anger at least, we would not expect as great a reduction in "arousal level" as we would if the response was direct.

The bodily and chemical changes that occur in anger are by no means clear. In recent years adrenaline and noradrenaline have been assigned central roles in attempts to account for physiological changes in both fear and anger (Goldenberg, Pines, Baldwin, Green and Roh, 1948). These investigators found that injections of adrenaline caused a sharp drop in peripheral blood vessel resistance and "striking increases" in cardiac output. Injections of noradrenaline caused "striking increases" in peripheral resistance with little or no change in cardiac output. In a review of this, and other studies which comprise only a paucity of knowledge about bodily changes in human anger, Buss (1961) summarizes the following account of human anger:

> . . . An anger stimulus impinges on a receptor, which initiates an afferent neural impulse to the cerebral cortex. The cortex in turn stimulates the hypothalamus, the amygdala, and related structures in the rhinencephalon (which are evidently necessary for an integrated rage pattern). The hypothalamus relays impulses in two directions. First as the "head ganglion" of an autonomic nervous system, it initiates or relays impulses to the sympathetic nervous system. The action of the sympathetic nervous system is only moderate in anger, there being only slight increases in heart rate, galvanic skin response, etc. The hypothalamus also stimulates the adrenal medulla to secrete both noradrenaline and adrenaline, with the major component being noradrenaline. Noradrenaline in overflow quantities may also be produced at sympathetic nerve endings, and its effect is a large increase in peripheral vascular resistance, a rise in both systolic and diastolic blood pressure, and a diminution in the activity of the stomach and intestines. The changes are different from these in fear, but there is an overlap in the physiology of fear and anger (p. 105).

It may be that the actual carrying out of an aggressive response is accompanied by the release of adrenaline. Adrenaline elevates

cardiac output so that more blood is delivered; and it acts as a vasodilator, allowing the blood to reach skeletal muscles and decreasing peripheral resistance. In decreasing the peripheral resistance the diastolic blood pressure level would also be decreased.

EMOTION AND TRANSIENT RISES OF BLOOD PRESSURE

It seems necessary, before getting into our problem area, that we should supply a sampling of evidence that the vascular system is responsive to emotional stimuli and conditioning, resulting in at least a transient rise in blood pressure.

That transitory blood pressure changes might follow changes in mood or stimulation was systematically noted as early as 1773 by Stephen Hales (Hamilton, 1942). However, although it has long been well known that changes in circulatory dynamics may occur as part of the total response to physical and psychological stress, many details of the interrelationships between the emotional and circulatory phenomena so evoked are still unclear. In fact, the problem that plagues the cardiologist even today (Ackner, 1956) is that he sees evidence daily of the influence of emotion on the circulation, but has at hand no extensive body of data that might illuminate his clinical observations.

Relevant Research

Wilhelmj, McGuire, McDonough, Waldmann and McCarthy (1953) took continuous blood pressure readings from trained dogs and demonstrated that many trivial factors such as strangers in the laboratory, noise and confusion in the kennels, changes in the daily experimental routine,

an unexpected change of experimenters or the presence of a female dog in estrus may cause pronounced and sudden elevations of blood pressure.

A Russian experimenter, Andreev (1952), demonstrated, with dogs as subjects, that it was possible to develop conditioned-reflex heightening of blood pressure to sound. He reports that ". . . the conditioned increase in blood pressure is maintained for months without reinforcement and is accompanied by changes in the physiochemical properties of the blood serum as well as by an increase in the amount of vaso-constrictive substances in the blood."

In an earlier study by Menzies (1937), very interesting for its implications, vasoconstriction was elicited by immersing one hand in ice water; warm water was used to produce vasodilation. The vaso-constriction was successfully conditioned to: (a) the sound of a bell; (b) to the sound of a buzzer and to the subject's whispered repetition of a nonsense word; (c) to movements and postures of various parts of the subject's body; (d) to a pattern of light. The frequency and the extent of both the original and the vasomotor changes were determined by taking continuous records of skin temperature from one hand. A thermopile and high sensitivity galvanometer provided a means of measuring slight changes of temperature. This experiment is highly interesting for its demonstration that changes in the blood vessels can be controlled by verbal processes. It indicates that autonomic responses may become linked to symbolic activities such as bodily attitudes, gestures, implicit speech and imagery. The experimenter himself concludes:

> It has been found to be relatively easy to establish a sympathetic conditioned reflex in man. Using the vasoconstriction

> due to dipping the hand in water as the unconditioned response, and appropriately coupling it with a conditioned stimulus (buzzer, light, or verbal stimulus), the conditioned stimulus soon becomes effective in evoking vasoconstriction. It is of particular interest that the intensity of the conditioned response was greater 30-60 days after the conditioning than it was immediately after the conditioning period, although no reinforcement was employed during the interval. In this work even recalling or thinking of the conditioned visual stimulus sufficed to evoke the vasoconstrictor effect in some subjects. This suggests that any factor associated with an emotional situation may evoke sympathetic discharges long after the crucial event (p. 115).

There seems to be little or no disagreement as to the importance of emotional factors in causing circulatory changes. But the problem of how important such factors are is difficult to answer quantitatively and accurately. Subjects can be exposed to comparable stimuli or environmental factors, but the emotional significance of a given factor to the individual determines the occurrence and to a large extent the severity of the bodily response to it. Characterizing the feelings experienced by subjects is difficult, nor is there any certainty that such feelings as they describe retrospectively may have been present at the time of examination. In summary (and in reference to the present proposal), it is recognized that psychological stress is not just something external which can be applied; for its occurrence depends on factors of emotional reaction inherent and conditioned within the individual. Only the external factors producing stress can be clearly defined.

THE PROBLEM OF SPECIFICITY

Cannon's classic work (1932) describing the physiological preparation for "fight or flight" in animals has been taken as the basis for attractive hypotheses concerning the possible role of acute and

chronic emotional states in the genesis of various psychosomatic disorders in man. Yet Cannon's data do not supply clues as to any differentiation of physiologic responses in association with specifically different emotions. In fact, his work suggested that emotion was a generic term to apply to an emergency pattern of physiologic changes regardless of the psychological components, i.e. anger or fear. In his description of the bodily changes in reaction to stress, considerable emphasis is laid upon the diffuse character of the reaction. This diffuseness was said to be related to the widespread effects of sympathetic stimulation and the release of adrenalin into the blood stream (Cannon, 1932).

Efforts to clarify the mechanisms and specificity of emotionally induced circulatory changes have led to conflicting results. Some investigators have advanced data to support the notion that patterns of circulatory response are specific for each individual and that a single person will react similarly regardless of the implications or nature of the stimulus for emotional experience (Lacey, 1952; Lacey, Bateman and Van Lehn, 1953; Malmo and Shagass, 1949). Other workers submit evidence in support of the opposite thesis: that the pattern of circulatory activity is specifically related to the nature of the emotional response evoked in the subject and that a single individual will exhibit consistent and different circulatory responses to different emotional states (Ax, 1953; Funkenstein, 1953; Wolf and Wolff, 1946). In line with this later general hypothesis, we would expect distinct patterns for anger and fear across individuals despite individual differences. Thus we would say that anger tends to increase blood pressure; in one

subject the increase might be small and in another subject it might be large, but both subjects should show an increase. According to this formulation the direction of blood pressure change is always up, regardless of individual differences in extent of change. However, the prevailing view until recently has been the hypothesis put forth by Cannon (1932) that emotions cannot be differentiated on the basis of physiological changes that accompany them. The physiological components of anger and fear were believed to be the same and were treated under the heading of "emotion."

The first definitive study to challenge this view was offered by Ax (1953). Forty-three subjects were stimulated in the laboratory to "fear" and "anger." 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, and then exclaimed with alarm that this was a dangerous high-voltage short circuit. The anger stimulus was provided by an assistant who entered the room stating that he must check the wiring because some of the calibrations might be off. He then turned off a radio, criticized a nearby nurse and told the subject sarcastically that it would have helped if he had been on time. He checked the electrodes, roughly adjusted the subject and criticized him for moving, non-cooperation and other behavior. The stimulation periods of fear and anger were alternated so that 22 subjects received the fear stimulation first and 21 subjects received the anger stimulation first. During these states the

following physiological reactions were recorded: (1) heart rate, (2) face temperature, (3) ballistocardiogram, (4) respiration rate, (5) hand temperature, (6) skin conductance, (7) integrated muscle potential, (8) systolic and diastolic blood pressures. The scores used were the maximum rise and maximum fall from the preceding resting level and the number of responses of a critical value per unit of time.

Of the scores thus obtained, 7 showed significant discrimination between anger and fear. Diastolic blood pressure rises, heart rate falls, number of rises in skin conductance and average intensity of muscle potential increases, were greater for anger than for fear, whereas skin conductance increases, frequency of muscle potential increases and respiration rate increases were greater for fear than for anger.

Similarly, Schachter (1957) exposed subjects to situations intended to produce emotions of pain, fear and anger in that order. For the pain experience subjects kept their hands in a bucket of ice water (3 degrees centigrade for 1 minute). The anger and fear situations were similar to those used by Ax. Subjects responded to these stimulus conditions with a significant increase in diastolic blood pressure to the pain and anger conditions and a significant systolic increase to the fear condition. Another experiment along this line (Funkenstein, King and Drolette, 1957) used frustrating tasks to induce anger. The results were similar to Schachter's.

Buss (1961) compared the results of the above three studies in terms of blood pressure changes. He asserts that in general these experiments support the notion that physiological emotion is not as

Cannon hypothesized, that is, all the same emergency pattern. He also concludes that for fear (or anxiety) stimuli there appears to be a consistent blood pressure pattern of response: a rise in systolic blood pressure (and also heart rate) and little or no increase in diastolic pressure. For anger there appears to be a consistent rise in diastolic pressure.

Although these results could be taken as a refutation of Cannon's hypothesis of a unitary visceral excitement reaction, it could still be argued that there is universal visceral excitement but with different organs reacting in intensity according to the type of emotion experienced.

THE CONSTRUCTS OF GUILT AND DEFENSE PREFERENCE

Guilt

As stated, the exploratory aspect of this research is concerned with the variables of aggression-guilt and modes of defense. Do people who score high on a measure of guilt differ from people who score low on a measure of guilt in their blood pressure reactions to expressed or unexpressed anger? Is a person's defense preference a variable which is related to the blood pressure reactions elicited by an anger provoking situation?

Historically, the guilt construct has played an important role in psychoanalytic theory. Guilt and the superego are seen as intimately related conceptualizations (Fenichel, 1945). The superego--the incorporated moral standards of society--is the structural component of personality concerned with coercing the ego, or reality oriented aspect

of the psyche, into considering its moral, ethical or religious standards of proper behavior. The superego, which is said to develop with the passing or partial resolution of the oedipus complex (Fenichel, 1945), influences the ego through the medium of guilt feelings. In psychoanalytic conceptions of guilt, several important considerations become apparent. Guilt refers to painful feelings of self blame, self criticism and self remorse which arise from internalized standards of proper behavior. The violation may be real or imagined. Guilt may result from failure to attain goals and to live in accordance with ideals, as well as by transgressions of internalized standards of proper behavior. Some investigations have evaluated guilt as an inhibitor (Mackinnon, 1938; Clark, 1952; Rader, 1957). Collectively, the studies of Mackinnon, Clark and Rader provide evidence supporting the hypothesis that guilt serves to inhibit morally tabooed behavior, such as cheating, the expression of verbal aggression and the telling of sexual stories to TAT cards. Alexander (1938) also stresses the inhibitory effect of guilt:

> As a form of anxiety, the fearful expectation of an inevitable and deserved suffering, the sense of guilt is primarily an inhibitory phenomenon. Under its pressure the individual is apt to avoid the expression of those impulses which have evoked and contributed to his guilt feelings (p. 43).

From the psychoanalytic viewpoint, a possible transgression of taboos circumscribing aggressive impulses would arouse guilt. Thus we might expect the inhibitory phenomenon of guilt to reflect itself somatically in a situation where a person is angered or called upon to aggress.

Defense Preference

It was after psychoanalysis shifted the emphasis of psychiatric thinking to the irrational aspects of man's thinking that a dynamic view of human functioning was formed and the notion of defense mechanisms evolved. Thus the concept of defense mechanisms also originated from psychoanalytic theory (Freud, 1936). Freud (1936) used the term "defense" to mean a protection of the ego against the instinctual demands of the id. Since that time the meaning of "defense" has been considerably enlarged by the Ego Psychologists and the origin of defense preferences is usually seen from one of four points of view. (Thelen, 1964, gives an overview of the literature covering these four perspectives.) Since the present study is concerned only with the relationship between type of defense most used in aggression-defined situations and blood pressure reactions, and not with the origin of defenses, we will avoid this broader issue.

In general the Ego Psychologists' position on defenses is that defenses involve a type of "perceptual maneuvering" to escape experiencing anxiety. For example, in the book The Ego and the Mechanisms of Defense (1937), Anna Freud expanded the meaning of "defense" to include dealings with external reality and danger. From her initial expansion of the concept the broader definition was arrived at which generally accepted the meaning of defenses as being any behavior designed, usually unconsciously, to protect an individual from the discomfort aroused by an anxiety provoking situation. In relation to hostility, defenses can change one's perception of a hostile situation, thereby rendering it innocuous. For purposes of this study, the broader definition is accepted.

Our exploratory concern with defenses here is with their differential relationship with one aspect of physiological functioning. For example, do blood pressure changes in an anger-provoking or anger expressing situation vary according to the typical mode of defense used in aggression situations? Is the degree of change related to the degree of use of, say, "reaction formation?" "intellectualization?" "avoidance?" "regression?" "projection?"

CHAPTER II

PROBLEM AND HYPOTHESES

As stated, basically two questions were considered in this research: "What effect do psychological stimuli, designed to arouse anger, have on blood pressure; and what is the effect of directly and indirectly expressing anger following these stimuli?" In line with these questions the following hypotheses were tested:

1. The stimulation to anger of experimental subjects will significantly raise mean diastolic blood pressure readings.
2. The direct expression of anger following a period of frustration will significantly lower mean diastolic blood pressure readings below that of a group not allowed expression of anger following frustration.
3. The indirect expression of anger (not at source of frustration), following a period of frustration, will significantly lower mean diastolic blood pressure readings below that of a group not allowed expression of anger following frustration but will not lower it as much as direct expression will.

In addition to investigating these main hypotheses, this research explored the relation of aggression-guilt and psychological defenses to the degree of blood pressure changes in the expression and non-expression of anger.

CHAPTER III

METHOD

A. Subjects

Subjects used in this study were 80 male undergraduates attending Michigan State University who were required to serve as research subjects as part of the requirements of enrollment in introductory psychology courses.

The data on sex differences in anger are certainly not conclusive, but there is evidence that men tend to become angrier than women and tend to ventilate their anger more (Buss, 1961). Use of men and women may tend to obscure otherwise consistent physiological patterns. Men and women may even have different physiological patterns in anger.

B. Instruments and Apparatus

1. Blood Pressure Measurement

Blood pressure was measured indirectly in the subject's left arm by means of an E and M Physiograph, utilizing an Electrosphygmograph transducer. The Electrosphygmograph is a transducer-preamplifier for the recording of indirect systolic and diastolic blood pressures of humans and many animals. The Electrosphygmograph combines a pressure transducer and an amplifier to produce single channel recordings of occluding cuff pressure and superimposed Korotkoff sounds.[1]

[1] These are the sounds heard over an artery with a mechanical listening device. As the air pressure in a cuff which circles the subject's arm is gradually decreased and the blood resumes its flow through the once occluded artery, faint tapping sounds are heard which are synchronous with the heart beats.

The method of blood pressure measurement with this instrument can be best illustrated by the description of another, more common technique. This method is the one used in clinical medical practice in which an instrument called a sphygmomanometer is used. The method of measuring blood pressure with this instrument is called the auscultatory technique because the examiner employs a listening device, a stethoscope, in order to make his measurements. To take a blood pressure reading the examiner encircles the subject's upper arm (usually his left arm) with a rubber tube that can be inflated with air. The amount of air pressure in the cuff is measured by a column of mercury. Hence, blood pressure readings are usually stated in millimeters (mm.) of mercury (Hg). The examiner inflates the cuff so as to completely stop the flow in the main, or brachial, artery of the arm. He then releases pressure in the cuff until he can hear a beating sound through his stethoscope which is applied to the artery below the cuff. The height of the mercury column at the time when he first hears the sound is the systolic blood pressure. The examiner then releases more air from the cuff until he can no longer hear the beating sound. The height of the mercury at that somewhat indeterminate time when the beating sound can no longer be heard is the diastolic blood pressure.

The automatic device used in this experiment works in a similar fashion, except that the sounds marking the systolic and diastolic readings are recorded automatically.

2. Aggression-Guilt Measurement

The Mosher Incomplete Sentences Test (MIST) was our instrument for the measurement of aggression-guilt. The test is a 50 stem sentence

completion blank which was developed and validated as a measure of guilt by Mosher (1961). The responses to the test can be quantitatively scored for guilt. The scoring of the sentence completions incorporates the referents for guilt which have been suggested by psychoanalytic theory. The MIST can be scored to obtain a total guilt score and three subscale scores: hostile guilt, sex guilt and morality conscious guilt. For purposes of this study, only the hostile guilt stems and score were used. The MIST was devised to measure manifest and relatively covert admission of moralistic standards and feelings of self blame, self remorse and self criticism for failing to live in accordance with internalized moral ideals. Responses are rated on a "guilt continuum," from '5' to '0', with high guilt being given a high number. Numerous examples for each scoring category are provided. The responses were scored independently by two judges so that an inter-rater reliability check could be made.

Reliability

The inter-rater reliability found in this study was .86. This figure is comparable to the inter-rater reliability of .90 Mosher (1961) reports for the scoring of his hostile-guilt stems.

Construction of the MIST

To construct his sentence completion test, Mosher collected 200 sentence stems from three psychologists. The stems were those the psychologists thought would be related to guilt on the basis of notions contained in psychoanalytic theory. The stems were then divided into two comparable sentence completion forms and administered to 38 hospitalized patients in a V. A. hospital.

The patients' responses to each stem were listed on a card and two clinical psychologists independently selected the stems which they felt best elicited information on the guilt dimension. Stems which yielded stereotyped responses or extremely brief responses were eliminated. Those stems which elicited a wide range of "guilt-no guilt" responses and on which both raters agreed, were chosen.

The psychologists then independently rated the remaining stems into three classes: hostile, sex, and morality conscious guilt. The stems they agreed upon for each category were retained as part of the sentence completion test. Finally, the test was administered to 51 males and 60 females in an introductory psychology course. Their responses formed the basis of the scoring examples which make up the scoring manual. Separate scoring norms were made up for males and females.

Construct Validity of the MIST

To investigate the construct validity of the MIST, Mosher used responses to it as the operational definition of guilt in an experimental test of a hypothesis generated by theoretical discussion of guilt. Guilt was defined as a generalized expectancy for self-mediated punishment for violating, anticipating the violation of, or failure to attain internalized standards of proper behavior. As part of his dissertation, Mosher (1961) examined the relationship of guilt to verbal conditioning. He predicted that subjects high on hostile guilt would condition less readily to hostile content than subjects scoring low on hostile guilt. The rationale for this hypothesis stemmed from the psychoanalytic notion that guilt over hostility should be aroused by the hostile content and

lead to a tendency to inhibit the use of the hostile content or to a disruption of the learning process due to the evocation of irrelevant responses related to the guilt motivated inhibitory response. The hypothesis was clearly supported.

Criteria for High and Low Guilt

For purposes of this study the median guilt score was calculated. Subjects scoring above this cutoff point were categorized as having high hostile guilt. Subjects scoring below this cutoff point were categorized as having low hostile guilt.

3. Defense Preference Measurement

The measure of defenses utilized in this study was the Defense Preference Inquiry (DPI). This is a test which uses the original Blacky Test Cartoons (Blum, 1956) to arouse feelings associated with psychosexual conflict. Only the cards (i.e., cartoons II, III, IV, VII and VIII) which Blum identified as hostility situations were used.

In administration, the subject is given five statements with each cartoon and is asked to rank the five statements in terms of how well they fit the situation. (A copy of the instructions and test can be found in the Appendix.) Each statement represents an operational definition of one of the five defensive modes; namely, intellectualization, regression, projection, reaction formation and avoidance (the generic term for the repression-denial family).

Scoring

Objectivity of scoring is achieved by having the subject simply rank order a given set of statements. The total score for each defensive mode is arrived at by simply adding the ranks for each individual statement.

Reliability

Blum (1956), using the test-retest technique, obtained reliability coefficients of .45 and .46. Intervals of three to four weeks between test-retest were used.

Construct Validity of the DPI

Blum (1956) feels that the successful employment of the DPI in a variety of research situations (i.e., the hypotheses were confirmed), lends support to the validity of the defense construct and his instrument for its measurement.

Goldstein (1952), in the first use of this instrument, explored the consistency of defense preferences among a mixed group of male and female undergraduates. He found that subjects who tended to employ the same type of defense with "a number of cartoons" manifested more disturbance in their spontaneous stories to the test than those subjects with more flexible defense preference. Shire (1954) also reported that these "general defenders" manifested significantly more maladjustment as measured by the Munro Inspection Technique (with the Rorschach) and on spontaneous stories of the Blacky Test. His measure of the "general defenders" was the DPI. More recently, Thelen (1964), using the DPI, found that male adolescents were significantly more similar to their fathers in defense preferences than to non-related adult males.

4. Subjective Rating of Anger Measurement

Subjective ratings of anger were obtained from all subjects participating in the experiment. The rating scale consists of six items (see Appendix) to which the subject is instructed to respond by placing a check mark at an appropriate point along the line, i.e.,

"Please check one. Which most honestly expresses your feelings during the past part of the experiment": Very Pleased ___; Pleased ___; Indifferent ___; Mildly Annoyed ___; Angry ___; Very Angry ___. The responses are weighted from one to six, with the highest rating indicative of the highest subjective perception of anger.

C. Procedure

The procedure used was essentially that designed by Hokanson (1961), which not only submits the subjects to a frustrating condition but also gives them an opportunity to overtly aggress by administering an electric shock. This overt aggression is what we will call "the expression of anger." The presence of anger is thus determined by operational definition--the presence of an anger inducing situation. Earlier use of this technique (Hokanson, 1959), indicates that subjective feelings of anger are markedly increased in the process, as reported by the experimental subjects.

The experiment was introduced to each subject as one involving blood pressure responses to routine intellectual tasks and a brief ESP guessing experiment. (See Appendix for the instructions given at each stage of the investigation.) Following this, the subject was given a ten minute adaptation period, during which he was sitting at rest and usually engaging in conversation with the experimenter. After ten minutes, the first and resting blood pressure recording was taken.

Groups

For purposes of the experiment the subjects were randomly divided into four groups, with 20 subjects in each group. Group I went through the frustration sequence and was allowed "direct expression" by shocking

the frustrator. Group II went through the frustration sequence and was allowed "indirect expression" by shocking the experimenter. Group III went through the frustration sequence but was allowed "no expression" by not allowing them to administer shock. Group IV did not go through the frustration sequence and did not administer shock.

Frustration Sequence (Groups I, II and III)

A crucial role in the "anger manipulation" is played by an accomplice of the experimenter. If the experimenter himself is the frustrating agent he has the dual burden of trying to maintain his subject's interest in the experiment as well as provoking the desired affect. An accomplice can better play the provocative role because he can more easily assume a peer role and would not have to interact with the subject on a friendly level. The technique involves putting the assistant in some disrepute. He is described to the subject as not the regular assistant but as one who had been fired for incompetence and arrogance, but due to the illness of the regular assistant he had to be employed for that day. Thus he is labeled as a suitable target for anger for the subject. This technique attempts to solve the artificiality problem by making the attack appear to be an incidental, unrelated aspect of the laboratory situation.

After the first blood pressure reading, the subject was told that the experimenter wanted to see what effect counting would have on his blood pressure. He was then asked to count backwards from 99 to 1 by two's as quickly as possible. When each subject in the three "frustration groups" reached a count in the sixties, the assistant entered the room and gruffly told the experimenter that he should not have begun before he (the assistant) arrived. He then turned to the subject and

said, "Stop! I'll tell you when to start again!" In an annoyed tone the experimenter told the assistant to watch the counting carefully, and then occupied himself with another piece of apparatus. The assistant then told the subject to begin again. During the counting the assistant stopped the subject two more times and criticized the subject for counting too slowly. After the third interruption, the experimenter, again sounding annoyed, told the assistant that he was "fouling things up again" and demanded that he go busy himself with another piece of apparatus. The experimenter then took another blood pressure recording and immediately administered the subjective rating of anger scale.

No Frustration Sequence (Group IV)

Subjects in the "no frustration condition," Group IV, were allowed to count backward from 99 to 1 without any interference. After completing the counting sequence blood pressure recordings were taken and the subjects were administered the subjective rating of anger scale.

The Expression of Aggression Phase (Groups I and II)

Immediately following the ratings, Group I subjects (direct expression) were given an opportunity to aggress physically against the frustrator (the assistant) by administering electric shocks to him. Group II subjects (indirect expression) were given an opportunity to aggress physically against the experimenter who took no direct part in the frustration. Group III and Group IV subjects were not given the same opportunity to aggress.

The situation was structured as follows: Subjects were told that the next task involved a brief experiment in extrasensory perception in which they were to think of a number from 1 to 10, following which the

experimenter/assistant was going to try to guess the number. (The instructions and conditions were identical for Group I and Group II except that the assistant read the instructions and received the shock from Group I while the experimenter read the instructions and received the shock from Group II.) They were told that if the experimenter's/assistant's guess was wrong, they were to signal this error by pressing a button on their panel. The pressing of this button, they were told, would turn on a light on the experimenter's/assistant's panel and give him a shock via the two leads attached to his fingers. The subject was told that the shock was being used so that the effect of pain on his subsequent guesses could be studied. For credibility, each subject was given a sample of the shock he thought he would be administering (20-30 volts, .5 amps). However, after this the experimenter surreptitiously turned a potentiometer which reduced the voltage to a much lower level. The shock received by the experimenter and assistant was very small and felt like a tickle but they responded as though it hurt. The subjects were further told that if the experimenter's/assistant's guess was correct, they (the subjects) were to do nothing. Each subject was allowed to administer five shocks. Blood pressure was again recorded at the end of this phase.

Control Procedure (Groups III and IV)

Subjects in Group III and Group IV went through the same procedure except that the signaling of the experimenter's errors was done by simply flashing the light instead of also administering shock. To control for the condition in which subjects in Group I and Group II were given a shock for credibility, subjects in Group III and Group IV were

asked to feel the same shock. They were told that we would also be looking for the effect of this shock on their blood pressure changes. After five incorrect guesses (five light flashes) this phase of the experiment was ended and blood pressure recordings were taken.

Sentence Completion Task for Guilt

After the final (third) blood pressure recording was taken, all subjects were given a sheet of paper with the 15 sentence stems on it and told: "Complete this as quickly as possible and let me know when you are through."

Defense Preference Task

For the defense preference task, each subject was given the five Blacky Pictures along with the appropriate sentences for each and the instructions were first read verbatum (see Appendix) and then explained further if necessary. This was administered after the sentence completion task for guilt.

The total time spent with each subject was approximately 45 minutes. All 80 subjects were seen within a period of three weeks. Throughout the experiment, all but five of the 80 subjects made their appointments. These five were later replaced by others. This high rate of cooperation was, no doubt, due to the procedure involved in reminding subjects of their appointments. Several days before their appointments each subject was sent a letter of reminder and a campus map with the location of the experiment circled. This information was sent in envelopes bearing the official heading of the Department of Psychology.

D. Treatment of the Data

1. To test our hypothesis that stimulation to anger will significantly raise mean blood pressure readings, a test of mean differences was required. We wanted to know whether or not the mean blood pressure increase was greater for the "anger group" than for the "non-anger" group. For this phase of the experiment, Groups I, II and III, which went through the frustration sequence but were not allowed expression of anger, comprised the experimental group. Group IV, the group that did not go through the frustration sequence, was the control. (The control group was similar to the experimental group except that the control group was allowed to finish the counting sequence.) At the beginning and end of the counting and "manipulation to anger" sequence, blood pressure readings were taken for both groups.

It was hypothesized that the experimental group, Groups I, II and III, would show a significantly higher mean change in blood pressure readings than the control group, Group IV. A "t" test of the mean differences of change was used here with the application of a one tailed test, since the direction of change was also predicted.

2. To determine the effects on blood pressure of direct, indirect and no expression of aggression after arousal, a two way analysis of variance was employed. The other variable involved here was aggression-guilt. The population sample was dichotomized into a High Guilt and a Low Guilt group on the basis of the median guilt score for the 80 subjects. In this manner we were also able to determine the interaction effects of guilt and type of expression. Graphically we had:

	Direct Expression	Indirect Expression	No Expression	No Arousal
High Guilt	Mean Change in B.P.			
Low Guilt				

We were then able to examine the effects of the type of expression and the interaction when "guilt" was considered to be a variable. The results were examined with and without "guilt" considered as a variable.

3. The subjective ratings of anger were scored in such a way that the "highest anger" response was scored "6" and the item at the extreme other end of the continuum was scored "1." Each item is separated by a score of "1." The mean "anger score" for the three groups subjected to the "anger manipulation" was compared with the mean "anger score" of the group not stimulated to anger. We hypothesized that the "stimulated group" would give a higher mean rating for subjective feelings of anger. A "t" test of mean differences was applicable here. The level of significance used was ($p < .05$) with the application of a one tailed test, since the direction of the difference was also predicted.

4. Although we were primarily interested in diastolic pressure because of its greater importance in the clinical syndrome of hypertension, all of the above statistical tests involving blood pressure measures were repeated for the systolic measures.

5. To determine the relationship between degree of blood pressure change in anger, expression and type of defense utilized, a product moment correlational analysis was run. The degree of blood pressure change in each experimental condition was correlated with each of the five defensive modes.

Table 1. Summary of operational design

Steps in Procedure	Groups (20 subjects per group) I	II	III	IV
1.	Subjects were told that they would be participants in an experiment to determine blood pressure reactions to intellectual activities.	Same	Same	Same
2.	After a ten minute rest, systolic and diastolic blood pressure recordings were made.	Same	Same	Same
3.	Subjects were given a counting task. They were interrupted four times while counting, treated gruffly and not allowed to complete the task.	Same	Same	Subjects were allowed to count all the way back without the interference the other groups received.
4.	Blood pressure recordings were taken.	Same	Same	Same
5.	Subjective ratings of anger were obtained.	Same	Same	Same
6.	Subjects were allowed to "express anger" through a shock apparatus. This group aggressed directly at the source of frustration (the assistant). Shock was administered as a result of the experimenter's inaccurate guess	This group aggressed indirectly (shock to experimenter).	This group went through the same procedure except that their efforts would only turn on a light and not administer shock.	This group went through the same procedure except that their efforts would only turn on a light and not administer shock.

(continued)

Table 1, continued

Steps in Procedure	Groups (20 subjects per group) I	II	III	IV
6. (cont'd.)	during the "interpersonal guessing game." Each subject was allowed to shock exactly five times.			
7.	Blood pressure recordings were taken at the end of this phase of the experiment.	Same	Same	Same
8.	The sentence completion task to be scored for guilt (MIST) and the Defense Preference Inquiry (DPI) were administered.	Same	Same	Same

CHAPTER IV

RESULTS

HYPOTHESIS I:

The stimulation to anger of experimental subjects will significantly raise mean diastolic blood pressure readings.

It was hypothesized that if our experimental procedure was effective in arousing anger, we would see this manifested in elevated diastolic blood pressure recordings for our three experimental groups involved in the frustration sequence. As well as predicting a diastolic blood pressure rise in these groups, we expected that the change would be greater than that seen in the control group which did not experience the frustration sequence. To make this initial comparison, mean diastolic recordings for our three experimental groups (Groups I, II and III) were taken before and after the frustration sequence. The post-frustration mean of 87.34 was compared with the pre-frustration mean of 79.38 (Table 2). Using a one tailed test of significance, the post-frustration mean was found to be significantly greater ($p < .02$). This mean increase of 7.96 mm. was then compared with the mean increase in blood pressure of our control group, the group which was allowed to complete the counting sequence. The mean blood pressure of the control group actually dropped slightly, resulting in an average change of -.2 mm. When compared to our average increase of +7.96 mm. in the experimental groups, we found the difference of these differences to be

significant beyond the .001 level. A one tailed test was used again, since the direction of the difference was predicted.

Table 2. Diastolic blood pressure increases in anger

	Experimental Groups (N = 60)	Control Group (N = 20)
Mean Resting Level	79.38	82.35
Post Experimental Procedure	87.34	82.15
Difference	+7.96	-.2
	$p < .02$	Non Significant
Difference of Differences	7.98	
	$p < .001$	

To investigate the possibility of a sampling bias among our groups, a single classification analysis of variance was used and the resting blood pressures of all four groups were compared. The analysis indicated no significant differences among the four means.

The Guilt Variable and Diastolic Increases:

All of our subjects were administered the sentence completion task for aggression-guilt. After the sentence completions were scored, the median guilt score was calculated and those subjects scoring above that point were categorized as High Guilt while those scoring below were categorized as Low Guilt. The three experimental groups (I, II and III) were then dichotomized into High Guilt and Low Guilt and their diastolic changes were compared (Table 3). We found that the Low Guilt sub-group

had a mean diastolic increase of 8.09 mm. while the High Guilt sub-group had a mean diastolic increase of 7.38 mm. The difference of .71 mm. was not found to be statistically significant. An examination of the mean base scores of the High Guilt and Low Guilt groups revealed a non-significant difference of .6.

Table 3. High Guilt and Low Guilt sub-group diastolic increases in the three anger stimulated groups

Group	N	Mean Base Score	Mean Diastolic Increase
High Guilt	29	79.7	7.38
Low Guilt	31	79.1	8.09
Difference		.6 Non Significant	.71 Non Significant

Subjective Ratings of Anger:

To evaluate the effectiveness of our experimental procedure to arouse anger, the subjective rating of anger scale was administered and scored for all subjects. The higher the score on this scale, the higher the subjective rating of one's anger. Subjects in the control or "no frustration" condition obtained a mean anger rating of 2.65 while those in the experimental groups obtained a mean anger rating of 3.43. The difference, while not seemingly great, is actually enormous in light of the small variance involved (Pooled variance of .512). The difference is significant beyond the .001 level, with the experimental groups reporting significantly greater feelings of anger.

HYPOTHESIS II:

The direct expression of anger following a period of frustration will significantly lower mean diastolic blood pressure readings below that of a group not allowed expression of anger following frustration.

HYPOTHESIS III:

The indirect expression of anger (not at the source of frustration), following a period of frustration, will significantly lower mean diastolic blood pressure readings below that of a group not allowed expression of anger following frustration but will not lower it as much as direct expression will.

In the investigation of these hypotheses, we also dichotomized our groups into High Guilt and Low Guilt sub-groups on the basis of the median guilt score for all 80 subjects. Utilizing a double classification analysis of variance, we were then able to investigate the effects on diastolic blood pressure of type of anger expression, guilt, and the joint effects of these two variables.

The F tests for both the row effects (guilt variable) and the column effects (type of expression) were significant ($p < .05$), indicating that diastolic pressure was differentially decreased by "type of expression" and that the decrease across all groups was different for "high guilt" and "low guilt" subjects. Table 4 summarizes our results:

Table 4. Diastolic blood pressure changes after the expression of anger or fill-in activity

	Direct Expression Group I	Indirect Expression Group II	No Expression Group III	No Expression No Anger Group IV	Total
(High Guilt)	n = 9	n = 11	n = 9	n = 12	n = 41
	-4.78	+.45	-1.33	+1.27	-.88
(Low Guilt)	n = 11	n = 9	n = 11	n = 8	n = 39
	-5.63	-4.77	-1.90	-1.37	-3.51
(Total Group)	n = 20	n = 20	n = 20	n = 20	
	-5.25	-1.90	-1.65	+.15	

The values in each cell represent the average decrease (-) or increase (+) in diastolic blood pressure immediately following the "expression of anger" phase of the experiment for Groups I and II. For Groups III and IV the blood pressures were taken after the "fill-in" or control activity.

The Guilt Variable Across Groups:

One of the most pertinent comparisons, after the significant F test findings, involved the "high guilt" and "low guilt" subjects. A comparison of the mean diastolic decreases of subjects in the High Guilt and Low Guilt categories revealed that across all conditions of expression or non-expression, the "low guilt" subjects exhibited a significantly greater decrease in diastolic blood pressure ($p < .05$).

Direct Expression and Diastolic Decreases:

When we examined the effect of "direct expression" we found that it was associated with a significant decrease in diastolic blood pressure ($p < .01$). That is, we found the difference between the mean decrease after "direct expression" (-5.25 mm.) to be significantly greater than the mean decrease after "no expression" (-1.65). The difference of 3.60 is statistically significant at the .01 level.

The diastolic decrease of the "direct expression" group was also found to be significantly greater than the diastolic decrease of the "indirect expression" group ($p < .025$).

High Guilt and Low Guilt Sub-Groups Within the Direct Expression Group:

An examination of the mean decreases of the High Guilt and Low Guilt sub-groups within the "direct expression" group revealed a non-significant difference. The mean decrease of the Low Guilt group is slightly greater (see Table 4) but the difference does not approach statistical significance at the .05 level.

Indirect Expression and Diastolic Decreases:

When we examined the over-all effect of indirect expression, we found that it was not associated with a significant decrease in diastolic pressure. The difference between the mean decrease after "indirect expression" (-1.90) was not significantly greater than the mean decrease after "no expression" (-1.65). Our third hypothesis was not confirmed for the "indirect expression" group as a whole.

High Guilt and Low Guilt Sub-Groups Within the Indirect Expression Group:

The "indirect expression" group showed interesting and meaningful sub-group differences. While the over-all mean diastolic decrease of the "indirect expression" group is not statistically significant, an examination of the High Guilt and Low Guilt sub-groups revealed a marked difference.

The High Guilt group actually had a slight average increase in diastolic pressure after having shocked the experimenter (+.45 mm.). The Low Guilt group showed a diastolic decrease (-4.77 mm.) which is not significantly different from the drop found in the over-all "direct expression" group (-5.25 mm.). The difference between the mean diastolic changes in the High Guilt and Low Guilt sub-groups in the "indirect expression" condition was found to be significant at the .025 level.

Table 5 summarizes the comparisons made and the statistical findings:

Table 5. Summary of diastolic decreases of the several groups and Low Guilt, High Guilt sub-groups

Groups Compared	Diastolic Change	t	D.F.	Significance Level
1. Direct Expression (Group I)	-5.25			
No Expression (Group III)	-1.65			
Difference	3.60	2.43	38	$p < .01$
2. Indirect Expression (Group II)	-1.90			
No Expression (Group III)	-1.65			
Difference	.25	.17	38	Non Significant
3. Direct Expression (Group I)	-5.25			
Indirect Expression (Group III)	-1.90			
Difference	3.35	2.26	38	$p < .025$
4. Low Guilt, All Groups Combined	-3.51			
High Guilt, All Groups Combined	- .88			
Difference	2.63	6.88[a]	1	$p < .05$
5. Low Guilt, Direct Expression	-5.63			
High Guilt, Direct Expression	-4.75			
Difference	.85	.41	18	Non Significant
6. Low Guilt, Indirect Expression	-4.77			
High Guilt, Indirect Expression	.45			
Difference	5.22	2.49	18	$p < .025$
7. Low Guilt, Indirect Expression	-4.77			
No Expression (Group III)	-1.65			
Difference	3.12	2.25	27	$p < .025$
8. Low Guilt, Indirect Expression	-4.77			
Direct Expression (Group I)	-5.25			
Difference	.48	.22	27	Non Significant

[a] F test, Analysis of variance data.

Summarizing these diastolic changes, we found: across all groups the "low guilt" subjects, while not increasing significantly more than the "high guilt" subjects during the "anger phase," had significantly greater mean diastolic decreases during the "expression phase." When the type of expression or non-expression was examined, we found that as a group only the "direct expression" subjects had a significant mean diastolic decrease after expression. However, when we looked at the Low Guilt and High Guilt sub-groups within the "indirect expression" group, some further differences were discovered. The Low Guilt sub-group in this group had significantly greater diastolic decreases than the High Guilt sub-group. The High Guilt sub-group even manifested a slight diastolic increase on the average. The Low Guilt sub-group manifested a mean diastolic decrease which was not significantly different from the decrease found in the total "direct expression" group. Also, the Low Guilt sub-group's diastolic decrease was significantly greater than the "no expression" group's decrease.

ADDITIONAL FINDINGS AND DATA FROM EXPLORATORY ASPECTS OF THE STUDY

Systolic Changes:

Although the diastolic blood pressure changes were the primary concern of this study because of the hypothesized relationship among anger, diastolic pressure and hypertension, systolic changes were also recorded.

It was found that the experimental subjects had a mean systolic blood pressure increase of 6.25 mm. after the "frustration experience"

while the "no frustration" subjects had a mean change of 1 mm. The difference is significant at the .01 level with the "frustration subjects" increasing significantly greater.

Guilt Variable and Systolic Changes:

The "high guilt" and "low guilt" subjects were also compared in terms of their systolic changes after the "frustration experience." We found that the "low guilt" subjects had a mean systolic rise of 7.29 mm. while the "high guilt" subjects had a mean systolic rise of 5.14 mm. The difference between these mean differences was not found to be statistically significant.

Systolic Changes After Expression:

Table 6 summarizes the systolic blood pressure changes after the "expression of anger" phase of the experiment.

Table 6. Systolic blood pressure changes after the expression of anger or fill-in activity

	Direct Expression Group I	Indirect Expression Group II	No Expression Group III	No Expression No Anger Group IV	Total
(High Guilt)	n = 9	n = 11	n = 9	n = 12	n = 41
	-.22	-.91	-.22	+.17	-.29
(Low Guilt)	n = 11	n = 9	n = 11	n = 8	n = 39
	-5.01	-.33	-1.09	+.25	-1.77
(Total Group)	n = 20	n = 20	n = 20	n = 20	
	-2.85	-.70	-.70	+.20	

The values in each cell represent the average decrease (-) or increase (+) in systolic blood pressure immediately after the "expression of anger" phase of the experiment. The groups were further divided into High Guilt and Low Guilt on the basis of their scores on the sentence completion task of aggression-guilt. A double classification analysis of variance was used in analyzing the data. Again, we were able to examine the effects of the "type of expression," guilt, and the joint effects of these variables, this time on systolic blood pressure changes.

A comparison of the means under the High Guilt and Low Guilt conditions across all conditions of expression or non-expression, showed no statistically significant difference between the mean systolic decreases. The "low guilt" subjects did have a greater mean decrease "after expression"; however, the difference is not statistically significant. Our analysis of variance also indicated that there were no statistically significant differences among the four major groups (expression and non-expression) in mean systolic changes after the "expression of anger" phase of the experiment.

Summarizing our systolic changes, we found: that while our "anger manipulation" procedure did elevate systolic blood pressure, we found no statistically significant different mean decrease among our four "expression" and "non-expression" groups. Neither did we find statistically significant differences between the High Guilt and the Low Guilt sub-groups across the four groups.

Defense Preference and Blood Pressure Changes:

It will be recalled that the Defense Preference Inventory was administered so that the usage of various defenses in aggression-defined

situations could be related to blood pressure changes. For this exploratory study, Group I was examined for the relationship between various defenses used and degree of blood pressure increases in anger, and also for the relationship between various defenses used and degree of blood pressure decrease after the expression of anger.

To obtain a subject's total score for each of the five defenses examined, the following procedure was used: The subject's rankings for each defense in each of the five Blacky cards were added. Since each group of statements was ranked from 1 to 5, and there were five groups of statements, each defense could only receive a maximum score of 25 or a minimum score of 5. However, since a low number indicated a defense most frequently chosen (a ranking of 1 indicates highest preference), the score obtained was subtracted from 25 so that the data for computational purposes was such that a high number indicated a high defense preference. A product-moment correlation procedure was then computed for each defense, blood pressure increases and decreases. Tables 7 and 8 summarize the correlational data for diastolic changes. All significance tests were two-tailed tests of the null hypothesis that $r = 0$.

Table 7. Correlation between defense preference and degree of diastolic increase after frustration to anger sequence

Defense	r	Significance Level
Projection	.078	Not significant
Reaction Formation	.154	Not significant
Avoidance	-.38	Significant at .10 level
Regression	.587	Significant at .01 level
Intellectualization	.041	Not significant

Table 8. Correlation between defense preference and degree of diastolic decrease after expression of anger

Defense	r	Significance Level
Projection	.054	Not significant
Reaction Formation	.005	Not significant
Avoidance	.072	Not significant
Regression	-.19	Not significant
Intellectualization	.053	Not significant

An examination of the data in Table 7 suggests that there is little or no relationship between blood pressure change and the usage of the defenses of projection, reaction formation and intellectualization. The negative correlation between avoidance and diastolic changes, while only significant at the .10 level, suggests a relationship between these variables. Since all diastolic changes were in the positive direction after the anger situation, we could not interpret the data as saying increased use of avoidance is associated with diastolic decreases in an anger situation. What we do see, however, is that usage of avoidance is associated with the least amount of diastolic increase in anger situations.

With regression the picture is quite different. Here we see a high positive relationship between the usage of regression and diastolic increases. The magnitude of blood pressure increase is seen as strongly related to the degree of "preference" of regression in aggression-defined situations.

Examining the data in Table 8 on the relationship between each of the five defenses considered and diastolic decreases after the expression of anger, we find that none of the relationships is statistically significant. However, we do see that the one correlation which indicates a trend is that between regression and diastolic decreases. The relationship is a negative one.

Systolic Changes:

An identical procedure for relating systolic changes to defense preference was followed. Tables 9 and 10 summarize the correlational data for systolic changes. Again, all significance tests were two-tailed tests of the null hypothesis that $r = 0$.

Table 9. Correlation between defense preference and degree of systolic increase after frustration to anger sequence

Defense	r	Significance Level
Projection	.104	Not significant
Reaction Formation	-.140	Not significant
Avoidance	.247	Not significant
Regression	.003	Not significant
Intellectualization	.110	Not significant

Table 10. Correlation between defense preference and degree of systolic decrease after expression of anger

Defense	r	Significance Level
Projection	.070	Not significant
Reaction Formation	-.234	Not significant
Avoidance	-.367	Not significant
Regression	.119	Not significant
Intellectualization	-.152	Not significant

None of the correlations achieved significance; however, the data is suggestive of possible relationships between systolic increases in anger and the defense preference of "avoidance." Similarly, there is a suggested negative relationship between systolic decreases after the expression of anger and the defense preference of avoidance.

CHAPTER V

DISCUSSION

Blood Pressure Changes and Our Experimental Procedure

Judging by the results reported on our subjects concerning their subjective feelings of anger, i.e., that subjects undergoing the "frustration sequence" rate themselves as significantly more angry than control subjects, we have empirical support that this aspect of our experimental procedure was effective. This is a crucial factor in our conclusions, since if we had no evidence, or equivocal evidence, that our procedure was effective in arousing anger, the remainder of our data would be less useful. However, in all experiments investigating the physiological concomitants of emotion the question of whether or not the experimenter is arousing the desired affect remains a problem. An anger inducing situation is usually defined by the operations involved and seemingly has face validity. Our procedure can be said to have empirical support through the subjective ratings as well as face validity.

Diastolic Changes in Anger

The results of our study clearly indicate that anger, as aroused by our anger inducing procedure, does produce a diastolic blood pressure rise. Since our sample was restricted to males, our conclusions are also necessarily restricted to males. Furthermore the use of college students as subjects necessitates comment. The bulk of college

populations come from the middle and upper classes. It is possible that middle and upper class subjects perceive aggression or anger-inducing situations in a different manner than lower class subjects and hence respond in a different manner physiologically. As Allinsmith (1954) has demonstrated, middle-class parents typically use psychological punishment, while the punishment of lower-class parents is predominantly physical. He also noted that physical aggression led to direct aggression against authority while psychological punishment led to indirect aggression against authority. We might speculate then that lower-class subjects, who are used to physical punishment and direct aggression, would be psychologically and physiologically oriented for "combat" in an anger producing situation. Middle and upper-class subjects, on the other hand, might be physiologically and psychologically oriented for "defense" in an anger producing situation.

Among the subjects in this study who were stimulated to anger, there were no significant differences between the High Guilt and Low Guilt groups in their diastolic increases in an anger inducing situation. In the expression of aggression, however, we do have differences between these two groups. We saw that among all the subjects, whether they were in the "direct expression," "indirect expression," "no expression" or "no anger" group, the "low guilt" subjects dissipated physiological tension, expressed in the form of a diastolic decrease, faster than "high guilt" subjects. The word "faster" is used here because within a given amount of time the "low guilt" subjects dropped much closer to resting level than the "high guilt" subjects. Aroused physiological processes do tend to recover over time, and given

sufficient time, all blood pressures should have returned to a resting level. The data here indicates that the "high guilt" subjects have a longer latency period to recovery than the "low guilt" subjects have.

When we examine the diastolic decreases in the "type of expression" groups, we also see interesting changes involving the guilt variable. The group aggressing directly against the person who previously was responsible for frustrating them shows a significant diastolic decrease. That is, their diastolic decrease is significantly greater than the diastolic decrease of subjects not allowed to aggress. (It will be recalled that all conditions for these two groups were the same except that the "aggression group" had the understanding that when they pushed the button somebody would get shocked.) Within the "direct aggression" group the "high guilt" and "low guilt" subjects do not differ significantly in their diastolic decrease. In other words, whether or not the subjects tended to feel guilty about expressing aggression, their diastolic blood pressure dropped when they aggressed against the person who frustrated them. Interpreting this drop as "tension reduction" we can say that both "high guilt" and "low guilt" subjects obtained "tension reduction" by aggressing directly at the source of their frustration.

The results are quite different for the "indirect expression" group. Over-all the "indirect expression" group does not exhibit a diastolic decrease significantly different from that shown by the group not allowed to aggress. (The "indirect expression" group was not shocking the person who had frustrated them but they were shocking a substitute target, the experimenter.) Although this over-all group shows no "tension reduction," a breakdown of the group into "high guilt"

and "low guilt" subjects is highly revealing. The "high guilt" subjects actually have a slight diastolic increase after aggressing! The "low guilt" subjects exhibit a diastolic drop which is significantly greater than that exhibited by the "no expression" group. Furthermore, the diastolic drop of the Low Guilt, "indirect aggression" group is not significantly different from the diastolic drop exhibited by the entire "direct aggression" group. What we see here is that "tension reduction" occurs in the "direct aggression" mode regardless of whether or not the subject tends to feel guilty about aggression but in the "indirect expression" mode we have "tension reduction" only if the subject tends to feel "low guilt" about aggression. If he has a tendency to feel "high guilt" about aggression, "indirect expression" is actually "tension creating" to some degree.

Systolic Changes in Anger

Although not predicted, we found that our anger-inducing procedure also elevated systolic pressure. There was no significant difference found between the "high guilt" and the "low guilt" subjects in their mean systolic elevations in the anger situation but the frustrated group did show elevations significantly greater than those exhibited by the control group. In the "aggression phase" we do see results which parallel the changes seen in diastolic pressure but none of the results achieve statistical significance. The data suggests that the "low guilt" subjects, across all groups, "dissipate faster." They have the greatest systolic drop in the given time, but the difference between the Low Guilt and High Guilt groups is not significant. Among the various "expression groups" we also failed to find a significant difference in

the degree of systolic decrease after expression. The data indicates that "direct expression" of aggression is the most effective in reducing systolic blood pressure elevations but again the difference is not significant.

What we see in the data then is that while systolic pressure is elevated in anger, it is the more important diastolic pressure which is affected by the expression of anger. The systolic pressure dissipates at a more or less even rate across all groups whether or not the subjects are aggressing. The diastolic pressure, which we predicted to be more closely associated with anger and expression, is differentially affected by the type of expression. The elevations we see in the systolic blood pressures could even be interpreted as resulting indirectly, being influenced by the elevated diastolic pressures which were in turn elevated by the anger responses.

Defense Preference and Blood Pressure Change

As far as this writer has been able to determine, no previous research has been reported in which modes of defense preference have been related to physiological processes. Not in the sense, at least, of one defensive mode being more strongly related than another defensive mode with the reaction of a physiological organ or system of organs.

The present exploratory study indicates that different defensive modes may very well have differential relationships with physiological changes in emotion. Our present data shows regression to be the most highly associated defense with diastolic changes in anger and anger expression. We have a clearly significant positive relationship in which "high" regression is associated with high diastolic increases in

anger. Although none of the defensive modes show a significant correlation with diastolic decrease in an anger-expressing situation, it is noted that regression is the most highly correlated with diastolic decreases. The correlation is negative and if it is valid we would expect that as the regression score went up, diastolic blood pressure recordings after the expression of anger would go down. These findings support the notion that different defenses are related to physiological reactions differentially in anger.

Related Research and Implications

The distinct physiological pattern we found for anger was the elevated diastolic and systolic blood pressure among almost all subjects, despite individual differences. The degree of change may have differed but in almost all subjects the direction of change was in the upward direction in anger.

Do our findings have any relevance for the psychosomatic theory of hypertension? Our data definitely supports some aspects of the theory. The theory states that the inhibition or repression of anger will raise (diastolic) blood pressure. Our data supports this. The theory implies that the expression of anger in an anger producing situation will lower (diastolic) blood pressure. Our data also supports this but with some qualifications. It appears that the expression of anger directly at the source of the frustration will lower blood pressure, but if the anger is expressed indirectly the variable of "aggression-guilt" becomes important. The pre-hypertensive then, would not only be the person who is an inhibitor of anger but he might also be the indirect aggressor who feels "high guilt" about aggression situations.

The question of whether the expression of aggression leads to a reduction of "physiological arousal" or "aggressive drive" as Dollard, Doob, Miller, Mower and Sears (1939) originally suggested, presents a much more complicated task of inquiry than was previously believed. Our findings indicate that the expression of aggression in some instances could maintain blood pressure at an elevated level and perhaps even increase it. The failure of many investigators to obtain significant results in their evaluation of the "catharsis hypothesis" could be attributed to the little attention paid to other psychological variables. One of these suggested as being important in studies of this type is "aggression-guilt." Another, suggested by Hokanson (1961) is the social status of the frustrator.

Going beyond our data, the theory states that the frequent inhibitions result in heightened blood pressure outlasting the inhibition period and eventually the person's blood pressure remains at a high level. He is always under stress. Can emotional conflict lead to sustained hypertension as the theory also predicts? Farris, Yeakel and Medoff (1945) present evidence that it can in rats.

Their study attempted to determine whether repeated subjection of rats to a conflict situation (going for food and being stopped by an air blast) i.e., to recurrent inhibition of an impulse to overt action, could result in sustained hypertension. Twenty-three gray Norway rats, bred and raised under uniform conditions, were used in this experiment. At ages ranged from 119 to 177 days, they were tested

for emotionality in Hall's open field situation,[1] and an emotionality score obtained from each rat. Blood pressure determinations were then made on the animals. (The investigators do not specify systolic or diastolic pressures.) These initial blood pressure values all fell within normal range. Following these preliminary steps, eleven of the animals were randomly chosen and set aside as controls, while the remaining twelve were subjected to an air blast each time they went for food during a five minute period each day, five days a week. At the end of the period, when each rat had been blasted a minimum of 167 times, blood pressure determinations were repeated on all of the animals. Blood pressures over 160 mm. of mercury were considered hypertensive. Animals with scores from 8 to 12 were considered to be highly emotional, 4 to 7 borderline emotional, and 0 to 3 low emotional.

Following the experimental treatment, a permanent hypertension was established in ten of the twelve experimental rats, while blood pressures of all but one of the control animals were normal. All of the experimental animals with scores of 8 or more were found to be hypertensive. The only air blasted rats that failed to exhibit an increased blood pressure had emotionality scores of 6 and 3. The hypertension produced was maintained even under ether anesthesia and was therefore assumed to

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[1]Briefly, Hall's test is as follows: A rat is placed in a large, well-lighted, circular enclosure 8 feet in diameter for two minutes a day on twelve successive days. This strange environment may evoke an emotional response in the rat, including defecation and micturation. A score is obtained by noting the number of days during which the rat either defecates or urinates while in the enclosure. Animals excreting on no or few days of the test are considered to be low-emotional; rats with high scores (maximum 12) are called emotional.

be permanent in type. The investigators interpreted "emotionality" as being the predisposing factor and the environmental stress as the precipitating factor in the development of the hypertension.

The picture is far from complete, however. We have focused on how a specific emotion and its expression can affect blood pressure and have been concerned, in a sense, about stimulus, psychological make-up and response. If an investigator wants to know the pertinence of psychologically induced changes in blood pressure to the problem of hypertensive vascular disorder, its development and exacerbation, then obviously he needs to determine whether peripheral resistance has in fact changed, since this is eventually a disorder of disturbed resistance. Hypertension, like most disorders, is a protean disorder without a unitary cause but one in which numerous mechanisms are involved.

Even the study by Farris, Yeakel and Medoff (1945) raises a question for the psychosomatic theory of hypertension. Their study supports the notion that emotional conflict can lead to sustained hypertension as the theory predicts. However, the theory also claims that it is the specific affect of anger which is associated with the development of hypertension. In the above study we see (with rats at least) that a conflict situation of approach-avoidance, created by a blast of air stopping hungry rats from going for food, resulted in hypertension. Does this indicate that any intense and prolonged emotional conflict will result in hypertension?

Suggestions for Further Research

As stated above, if the present findings are to be related more firmly to hypertension, effective means of monitoring peripheral

resistance throughout the anger and "expression" phases of the experiment must be devised. Longitudinal studies with animals would also be necessary to determine how peripheral resistance is affected over long periods of stress.

The question of "latency to recovery" is also an intriguing one. Latency curves to recovery could be examined in large samples of subjects and related to different psychological variables or even diagnostic categories. Does the psychopath, for example, have physiological response patterns which reflect his low guilt? A replication of the present study using only females would also be valuable. Is there a sex difference in cardiovascular responses to anger?

Finally, what would the effect of simply increasing motor activity (such as by exercise) have on elevated diastolic pressure after anger? Would the "high guilt" subjects show a greater decrease than they did in the "indirect expression" phase? In other words, would pounding a nail, lifting weights or skipping a rope be just as effective in reducing diastolic blood pressure after anger as aggressing against the frustrator? If these neutral activities did decrease diastolic blood pressure, would we still see differential decreases between the "high guilt" and "low guilt" subjects under these conditions?

CHAPTER VI

SUMMARY AND CONCLUSIONS

An effort was made to experimentally investigate some aspects of the psychosomatic theory of essential hypertension which state that the inhibition of anger-instigated aggression will raise diastolic blood pressure, and which imply that the expression of aggression under these conditions will lower diastolic pressure. Basically two questions were considered in this research: "What effect do psychological stimuli, designed to arouse anger, have on blood pressure; and what is the effect on blood pressure of directly and indirectly expressing anger following these stimuli?" Also considered in this research were the variables of "aggression guilt" and "defense preference" as they relate to blood pressure reactions in the expression and non-expression of anger following the experimental manipulations.

Eighty male undergraduate students enrolled in introductory psychology courses at Michigan State University served as subjects. The subjects were randomly divided into four groups with twenty subjects in each group. Group I subjects went through a "frustration sequence" and were allowed "direct expression" of anger by shocking the frustrator (the experimenter's assistant). Group II subjects went through the "frustration sequence" and were allowed "indirect expression" by shocking the experimenter. Group III subjects went through the "frustration sequence" but were allowed "no expression" through the shock apparatus. Group IV subjects did not go through the "frustration sequence." They were

allowed to complete the presented task and in the "expression" phase they were engaged in "fill-in" activities.

The "frustration sequence" involved first putting the assistant in some disrepute during his brief absence from the experimental room. Subjects were told that the experimenter wanted to determine what effect counting would have on their blood pressure. They were asked to count backward from 99 to 1 by two's as quickly as possible. When each subject in the three frustration groups was approximately half way through with the counting, the assistant re-entered the room, stopped the counting and had the subject begin over again. During the counting the assistant stopped the subject from counting a total of three times, had him begin over again and criticized him for counting too slowly. Subjects in the "no frustration group," Group IV, were allowed to count backward from 99 to 1 without any interference.

At the end of the "frustration sequence," all subjects participated in a "brief experiment in extrasensory perception." For Group I, as a result of the assistant's wrong guess of a number the subject was thinking of, the subject pressed a button which administered an electric shock to the assistant's finger tips. For Group II, the experimenter's wrong guesses would result in shock administered to his finger tips. For Group III and Group IV, the experimenter's wrong guess was signaled by the subject's pressing the same button but this time no shock was administered, only a console light was lit. A total of five shocks was allowed from each subject.

Blood pressure was measured indirectly in the subject's left arm by means of an E and M Physiograph, utilizing an Electrosphygmograph

transducer. Resting blood pressures were recorded for all subjects. Post "frustration" and post "expression" recordings were also obtained. Subjective ratings of anger were also made at the end of the "frustration sequence." At the end of the experimental procedure the Mosher Incomplete Sentence Test was administered and scored for aggression-guilt. Subjects were categorized as High Guilt or Low Guilt on the basis of the median guilt score for all subjects. Blum's Defense Preference Inquiry was also administered and scored for "defense preference."

Subjects who underwent the "frustration sequence" rated themselves as significantly more angry than control subjects. Diastolic blood pressure was significantly elevated as a result of our experimental procedure, as was also systolic to a lesser extent. In the post "expression" phase for Groups I and II and post "fill-in" phase for Groups III and IV, a comparison of the mean diastolic decreases of subjects in the High Guilt and Low Guilt categories was made. Across all conditions of "expression" and "non-expression," the "low guilt" subjects exhibited a significantly greater decrease of diastolic blood pressure. "Direct expression," shocking the frustrator, resulted in a significantly greater diastolic decrease than was measured in the "no expression" group. "Indirect expression" did not result in a significantly greater diastolic decrease than was measured in the "no expression" group. However, when the variable of aggression-guilt was taken into account, a different picture emerged.

"High guilt" and "low guilt" subjects did not differ in their diastolic and systolic elevations in anger; almost all subjects showed blood pressure increases in this phase. In the "expression phase" both

the High Guilt and Low Guilt sub-groups in the "direct expression" group exhibited significant mean diastolic decreases. In the "indirect expression" group, we found that the group as a whole did not differ significantly from the "no expression" group in mean diastolic decrease. But, when the High Guilt and Low Guilt sub-groups were compared in the "indirect expression" phase, we found that the Low Guilt group had a diastolic decrease significantly greater than the High Guilt group had and the Low Guilt group's decrease was as great as that shown by the total "direct expression" group. The "high guilt," "indirect expression" subjects were actually showing a slight mean increase after "expression"! The data on defense preference in aggression-defined situations indicated that only the defense of regression was significantly associated with diastolic blood pressure changes in anger.

The above findings were discussed in terms of their relevance for some aspects of the psychosomatic theory of hypertension. The results were seen as supporting those aspects of the theory which were put to an experimental test and also as introducing the importance of the aggression-guilt variable into the theory. Further research was suggested.

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APPENDICES

APPENDIX A

ORIENTING INSTRUCTIONS GIVEN TO STUDENTS

(Subjects were welcomed in and seated comfortably in front of the apparatus.) "What we're trying to do here is to look at blood pressure changes during different activities. I'll be recording your blood pressure on this paper coming out of the machine from time to time.

Walking upstairs has an effect on your blood pressure, however, so before we begin I'd like to put this cuff around your arm and just have you relax for five minutes. When we are through with the experiment I would like to explain some of the things we did more thoroughly and answer some of the questions you might have. Just relax for now."

APPENDIX B

INSTRUCTIONS GIVEN TO THE SUBJECTS WHO WERE STIMULATED TO ANGER BY THE ASSISTANT

(The assistant left the room at a prescribed cue.)

"My regular assistant is sick and could not make it to work today. This substitute has been fouling things up left and right but I'll have to use him anyway. He was the only assistant available today. This is definitely the last day he will be hired though!"

APPENDIX C

INSTRUCTIONS FOR THE COUNTING TASK

"I want you to count backward from 99 to 1 by two's as fast as you can, like 99, 97, 95 . . . Are there any questions? Go!"

APPENDIX D

ASSISTANT'S ROLE DURING THE MANIPULATION TO ANGER PROCEDURE

For Groups I, II and III the assistant entered the room when he heard that the subject had reached a count somewhere below 51 and he said to the experimenter: "I'm supposed to help you, right! Then why don't you wait for me to help? Let's start that counting over." The assistant then stopped the subject two more times during the counting when he had reached a count in the thirties or forties and told him brusquely: "You're going too slow!" During the final interruption the assistant crumpled up a piece of paper he was writing on and said: "We can't use this data!" At that the experimenter sided with the subject and shouted at the assistant: "Can't you do anything right today?"

APPENDIX E

INSTRUCTIONS FOR THE INTERPERSONAL GUESSING GAME:

GROUPS I AND II

For Group I the assistant will read the instructions and receive the shock (direct).

For Group II the experimenter will read the instructions and receive the shock (indirect).

Now I want to see if a brief experiment in extrasensory perception will affect your blood pressure. This involves a guessing game in which you will be giving me a shock each time I guess wrong. This will allow me to see the effect shock has on the number of correct guesses.

Each time I say "Ready?" you think of a different number from one to ten and I will try to guess the number you are thinking of. If my guess is wrong, press the button on your panel; if my guess is correct, don't do anything. Pressing your button will turn on the light on my panel and at the same time give me a shock. First I would like you to feel the amount of shock you will be administering. . . . "Ready?"

APPENDIX F

INSTRUCTIONS FOR THE INTERPERSONAL GUESSING GAME:

GROUPS III AND IV

"Now I want to see if a brief experiment in extrasensory perception will have an effect on your blood pressure. Think of a number from one to ten. I will try to guess the number you are thinking of. Each time I guess wrong you are to press the button on your panel. If I guess correctly, don't do anything. Before we begin, however, I would like you to feel a mild shock, since I will also be looking to see how your blood pressure responds to that. . . . Ready?"

APPENDIX G

SUBJECTIVE RATING OF ANGER SCALE

Please check one. Which most honestly expresses your feelings during the past part of the experiment?

Very Pleased ___

Pleased ___

Indifferent ___

Mildly Annoyed ___

Angry ___

Very Angry ___

APPENDIX H

AGGRESSION-GUILT ITEMS OF THE MOSHER INCOMPLETE SENTENCE TEST

Directions: Complete all sentences as quickly as you can.

1. The idea of murder is . . . . . .
2. When someone swears at me . . . . . .
3. After a childhood fight, I felt . . . . . .
4. After an argument . . . . . .
5. To kill in war . . . . . .
6. Arguments leave me feeling . . . . . .
7. If I robbed a bank . . . . . .
8. When anger builds inside me . . . . . .
9. If I felt like murdering someone . . . . . .
10. I hate . . . . . .
11. After an outburst of anger . . . . . .
12. When I was younger, fighting . . . . . .
13. Capital punishment . . . . . .
14. If I hated my parents . . . . . .
15. If I killed someone in self-defense, I . . . . . .

APPENDIX I

INSTRUCTIONS FOR THE BLACKY TEST AND THE DESCRIPTIVE STATEMENTS TO BE RANKED FOR EACH CARD

Only those cartoons Blum identified as hostility situations were used.

"I am going to show you a series of pictures about a dog named Blacky. These are like the cartoons you see in the funny papers. Look at each cartoon for as long as you feel you need to. Then rank the five statements about the cartoon from one to five. There are five different statements for each cartoon. Place the number one beside the statement which fits best, a two beside the statement which fits next best, and so on. Place a five beside the statement which fits least well. Please work as rapidly as possible. Are there any questions before starting the test?"

Rank all of the following statements according to how well they seem to fit the situation:

1 - fits best
2 - fits second best
3 - fits third best
4 - fits fourth best
5 - fits worst

Cartoon II

_____A. When Blacky gets angry, he often throws a temper tantrum like he did in his earlier days.

_____B. Blacky tries to pretend that he's ferocious, but when Mama is around he is sure to be overly gentle, calm, and well-behaved.

_____C. Blacky is a firm believer in the idea of releasing one's aggressions, so he feels justified in ripping Mama's collar here.

_____D. Blacky is so intent on chewing the collar to pieces that he doesn't even realize it belongs to Mama.

_____E. In Blacky's own way of thinking, his family has been treating him so unfairly that he feels entitled to chew up the collar.

Cartoon III

_____A. It may look like Blacky is relieving himself between his parent's houses, but possibly he's just digging a hole to bury a bone.

_____B. Blacky knows Mama and Papa are not going to like the spot he chose, but to his way of thinking a dog's physical well-being is extremely important.

_____C. The consequences of Blacky's relieving himself there might very well make him wish that he were a young pup again.

_____D. Blacky thinks his behavior here is perfectly all right because he senses that Mama and Papa have been unreasonably irritated with him, even though their actions didn't show it.

_____E. Blacky figures that Mama and Papa will be pleased to find him so clean and neat about covering his mess.

- -

Cartoon IV

_____A. Blacky is feeling irritable, but he'll cheer up when he realizes that Mama and Papa love each other so much.

_____B. Though Blacky is the one behind the bushes, he's still upset by the thought that his parents are hiding their love-making from him in order to keep him out of the group.

_____C. At the moment Blacky is upset watching his parents together, but he'll soon forget his anger as he starts playing again.

_____D. As Blacky watches, he works himself into a fit of anger and helpless rage which will force Mama to take care of him again.

_____E. Blacky feels justified in getting angry here because he wants his parents to enjoy the other activities they had planned.

Cartoon VII

_____A. Blacky is so perplexed and frustrated by the toy that he may lose control of his temper the way he did when he was a pup.

_____B. Blacky wants to mind his own business but he figures the toy dog is trying to start a fight by blocking his path.

_____C. Blacky has eagerly called the family's attention to his new toy dog, which he is very proud of.

_____D. Blacky feels justified in this furious outburst against the toy dog because, after all, discipline is vital to the development of a well-rounded personality.

_____E. Blacky is delighted to have this little companion to whom he can give advice, love and affection.

- -

Cartoon VIII

_____A. Standing off at a distance like this, Blacky is impressed primarily by the fact that his family is such an intimate group.

_____B. Blacky is pleased to see Mama and Papa being affectionate to Tippy, since he feels that Tippy deserves a turn at getting attention.

_____C. Blacky believes that insight into his own jealousy of Tippy will enable him to handle himself better in competitive situations later on.

_____D. As Blacky watches the rest of the family, he'll act like a helpless infant so they will have to treat him like a baby the way they once did.

_____E. Blacky suspects that Tippy has been trying to win over Mama and Papa because Tippy is envious of their feelings toward Blacky.

APPENDIX J

DATA PERTAINING TO DIASTOLIC PRESSURE UNDER VARYING CONDITIONS, SUBJECTIVE RATINGS OF ANGER AND GUILT POSITION

GROUP I

Subject	Resting Reading	Arousal Reading	Difference (Arousal-Resting)	After Expression Reading	Difference (Expression-Arousal)	Guilt Rating	Subjective Rating of Anger
1	83	87	+ 4	82	- 5	H	3
2	80	85	+ 5	80	- 5	H	4
3	73	90	+17	92	+ 2	H	3
4	78	86	+ 8	82	- 4	H	3
5	76	77	+ 1	66	-11	H	2
6	80	84	+ 4	90	+ 6	H	3
7	80	88	+ 8	81	- 7	H	4
8	78	91	+13	80	-11	H	4
9	84	94	+10	86	- 8	H	3
10	82	94	+12	86	- 8	L	4
11	75	78	+ 3	75	- 3	L	3
12	83	94	+11	94	0	L	4
13	81	87	+ 6	31	- 6	L	4
14	78	92	+14	86	- 6	L	5
15	82	90	+ 8	79	-11	L	4
16	85	88	+ 3	88	0	L	4
17	70	82	+12	78	- 4	L	2
18	74	85	+11	78	- 7	L	4
19	78	90	+12	79	-11	L	3
20	80	90	+10	84	- 6	L	4
Σ	1580	1752	+172	1647	-105	9 H, 11 L	70
$\bar{X}$	79.0	87.6	+8.6	82.35	-5.25		3.43

GROUP II

Subject	Resting Reading	Arousal Reading	Difference (Arousal-Resting)	After Expression Reading	Difference (Expression-Arousal)	Guilt Rating	Subjective Rating of Anger
1	76	88	+ 12	84	- 4	L	3
2	90	94	+ 4	94	0	L	4
3	76	84	+ 8	84	0	L	3
4	70	84	+ 14	70	-14	L	4
5	70	78	+ 8	73	- 5	L	3
6	80	90	+ 10	80	-10	L	4
7	80	88	+ 8	80	- 8	L	4
8	88	92	+ 4	88	- 4	L	4
9	82	88	+ 6	90	+ 2	L	3
10	80	94	+ 14	89	- 5	H	3
11	84	95	+ 11	90	- 5	H	3
12	80	92	+ 12	86	- 6	H	3
13	76	88	+ 12	82	- 6	H	2
14	88	94	+ 6	94	0	H	3
15	60	60	0	60	0	H	3
16	80	90	+ 10	90	0	H	4
17	82	88	+ 6	70	+18	H	4
18	80	86	+ 6	80	+ 6	H	3
19	88	80	- 8	80	0	H	4
20	82	87	+ 5	90	+ 3	H	4
Σ	1592	1740	+148	1654	-38	11 H, 9 L	68
$\bar{X}$	79.6	87.0	+7.4	82.7	-1.9		3.40

GROUP III

Subject	Resting Reading	Arousal Reading	Difference (Arousal-Resting)	After Neutral Activity Reading	Difference (Neutral-Arousal)	Guilt Rating	Subjective Rating of Anger
1	76	84	+ 8	84	0	L	3
2	84	90	+ 6	90	0	L	4
3	78	82	+ 4	84	2	L	4
4	81	84	+ 3	82	- 2	L	3
5	81	87	+ 6	85	- 2	L	4
6	83	90	+ 7	84	- 6	L	4
7	78	82	+ 4	79	- 3	L	2
8	78	91	+13	87	- 4	L	4
9	78	81	+ 3	80	- 1	L	3
10	78	83	+ 5	82	- 1	L	3
11	78	94	+16	90	- 4	L	4
12	83	92	+ 9	92	0	H	3
13	78	85	+ 7	83	- 2	H	4
14	83	92	+ 9	90	- 2	H	3
15	81	88	+ 7	92	4	H	3
16	78	86	+ 8	85	- 1	H	4
17	78	88	+10	88	0	H	3
18	90	93	+ 3	91	- 2	H	2
19	74	86	+12	84	- 2	H	4
20	73	91	+18	84	- 7	H	4
Σ	1591	1749	+158	1716	-33	9 H, 11 L	68
$\bar{X}$	79.55	87.45	+7.9	85.8	-1.65		3.40

GROUP IV

Subject	Resting Reading	After Counting Reading	Difference (Counting-Resting)	After Neutral Activity	Difference (Neutral-Counting)	Guilt Rating	Subjective Rating of Anger
1	78	76	-2	79	+3	H	1
2	91	86	-5	86	0	H	3
3	76	76	0	78	+2	H	3
4	84	81	-3	82	+1	H	2
5	80	84	+4	86	+2	H	3
6	83	88	+5	94	+6	H	3
7	71	72	+1	72	0	H	3
8	71	72	+1	73	+1	H	3
9	90	89	-1	92	+3	H	3
10	78	82	4	83	+1	H	3
11	92	98	+6	94	-4	H	3
12	79	84	+5	83	-1	H	1
13	85	76	-9	78	+2	L	3
14	82	82	0	81	-1	L	2
15	92	89	-3	76	-13	L	3
16	88	84	-4	86	+2	L	1
17	84	84	0	80	-4	L	3
18	88	80	-8	80	0	L	3
19	80	82	+2	83	+1	L	3
20	75	78	+3	80	+2	L	4
Σ	1647	1643	-4	1646	+3	12 H, 8 L	53
$\bar{X}$	82.35	82.15	-.2	82.30	+.15		2.65