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An Experimental Investigation of Psychogalvanic Responses in a Threat Situation

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AN EXPERIMENTAL INVESTIGATION OF PSYCHOGALVANIC RESPONSES IN A THREAT SITUATION

by

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VITA

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PREFACE

The author wishes to take this opportunity to express briefly, but most sincerely, his gratitude to Father Vincent V. Herr, S.J. for his continuing assistance and genuine interest in the preparation of this paper.

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CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

The psychogalvanic reflex (PGR) has had a long and varied history. The phenomenon has been investigated by means of different techniques and a variety of instruments. Many types of stimuli have been employed to evoke the response from a great variety of subjects. The phenomenon has been employed in studies of such diverse topics as lie detection, advertising, speech defects, mental disorders, and the conditioned reflex. The phenomenon has been christened and re-christened. And, of course, many interpretations have been advanced regarding the underlying physiological mechanisms involved and the psychological significance of the phenomenon (20,31).

Although the phenomenon of static electricity in the human body had long been recognized, it was not until 1888 that a serious investigation of the electrical phenomenon of the body was begun by Fere' (31). Attaching two electrodes to the forearm of a subject and connecting these in series with a galvanometer, Fere' passed a weak electrical current through the subject. Following the presentation of a variety of stimuli (sounds, odors, colors) Fere' noted the momentary deflections in the gal-

vanic readings. Such deflections Fere' attributed to static electricity. D'Arsonval, the physicist, quickly pointed out the inadequacy of such an explanation however, emphasizing also the importance of the sweat glands in such galvanic reactions.

In 1890 Tarchanoff discovered that such momentary deflections of the galvanometer needle could be obtained without the application of an external source of current. In other words, when the electrodes were attached to two areas of the skin, the galvanometer recorded a difference in electrical potential. When an external current was applied in order to restore the galvanometer needle to its normal resting position, or even when no external current was applied, momentary deflections of the needle were obtained by the presentation of sensory stimuli.

Because Fere' employed an external electrical current and Tarchanoff did not (or only applied a current sufficient to restore the normal balance of the galvanometer), it has been common practice to speak of the "Fere' phenomenon" and the "Tarchanoff phenomenon". In view of the fact that it is generally accepted that both phenomena probably have the same underlying physiological mechanisms (20), and because the Fere' method has certain inherent advantages over the Tarchanoff method (31), the vast majority of PGR investigations have employed the former. So it is with the present study.

As indicated earlier, the psychogalvanic reflex has

been known by different names. The most commonly employed terms today are PGR, GSR (galvanic skin response), and EDR (electrodermal response). Although all three terms shall be used in this discussion, the term "PGR" is preferred and shall be employed wherever possible.

Another important difference in PGR terminology is the use of "resistance" and "resistance changes", "conductance" and "conductance changes". By employing the Fere' method of measurement it is possible to determine the basic resistance of the individual, as well as the momentary change in resistance (the PGR). In other words, the relatively constant physiological state of the person may be measured in the ohms resistance of the body to the passage of a weak current of electricity. Upon presentation of a stimulus, the change in the level of resistance is recorded. Thus, the PGR may be determined by computing the difference between R_1 and R_2, where R_1 is the ohms resistance prior to stimulation and R_2 is the ohms resistance following stimulation.

The same measurements may also be expressed in terms of conductance and conductance change, the term conductance signifying the degree to which the body transmits an externally applied electrical current. Mathematically, the conductance value is simply the reciprocal of the resistance value. Hence, the basic conductance (the value prior to stimulation) is $\frac{1}{R_1}$. The conductance change is computed by the formula $\frac{1}{R_2} - \frac{1}{R_1}$. For reasons

which will be discussed in Chapter Three, the use of the terms conductance and conductance change is generally preferable to resistance and resistance change. Wherever possible, therefore, these terms shall be employed in the current discussion.

One last point concerning PGR recording should be noted here. It is possible to determine two types of conductance changes in an individual: relatively slow or gradual changes in either direction, and momentary rapid changes, always in the same direction. The former type of changes are frequently considered as alterations in the general level of physiological functioning. The latter type of changes, because they are unidirectional and of brief duration, may be considered as transitory states of physiological imbalance (31). It is to these momentary changes that the term PGR is applied and, unless otherwise indicated, it is to such changes that the present paper will be limited.

Statement of the Problem.

At the very beginning of this paper it was pointed out that the PGR has been employed in studies of mental disorders and the conditioned reflex. In recent years a number of investigations have combined these two areas of research. That is to say, studies have been conducted on conditioning the PGR in mentally disturbed subjects. Although these studies shall be considered in greater detail in the next chapter, it should be pointed out here that they have indicated that the rate of conditioning the PGR is

related to the degree of anxiety found in the subjects. Such studies, however, have been concerned only with the presence or absence of the PGR response upon presentation of the conditioned stimulus: they have not been concerned with the magnitude of the response elicited.

The magnitude of the PGR response, however, is known to be influenced by a variety of factors: type of apparatus, type and placement of electrodes, amount of current, age of subjects, type of stimulus presented to the subject, and so on. The general problem for this investigation, therefore, is the relationship between the magnitude of PGR responses and anxiety. That is to say, is PGR functioning related to anxiety, such as might be experienced in a threatening situation?

Hypothesis.

From this general discussion of the problem we may now turn to a more formal presentation of the hypothesis of the present investigation. Actually, the hypothesis is two-fold, the second half depending upon the first. It is suggested that the PGR responses of subjects in a mildly threatening situation will differ from those of subjects not threatened: the introduction of threat will affect the PGR responses of subjects. Should this portion of the hypothesis be supported by the experimental data, it is further suggested that the degree to which PGR responses are affected by the threat situation will be related to the verbally expressed con-

cern that one has for his bodily well being. In other words, the more concerned one is for his well being, the more his PGR responses will be affected in a threatening situation.

CHAPTER II

REVIEW OF RELATED LITERATURE

Of the many types of stimuli employed to elicit PGR responses one of the most frequently used is association words. In 1907, for example, Peterson and Jung (23) verbally presented a list of words to a group of subjects. Comparing the mean magnitude of PGR responses for each of the stimuli, the authors concluded that the psychogalvanic reflex constituted a good indicator of the emotional tone of words. That is, the more emotion evoking a word is, the greater is the PGR reaction to hearing the word. Smith (25) and Jones and Wechsler (13) also sought to establish a hierachy of emotionally toned stimulus words, employing a list of one hundred stimuli. Such studies assumed, of course, that the intensity of emotions may be measured by the magnitude of PGR responses--an assumption that has been seriously questioned by more recent investigators (31).

Disregarding such an assumption, other investigators have employed lists of stimulus words in studying a variety of problems. The mean PGR response to a list of twelve stimulus words was used by Haggard, for example, in comparing the general level of PGR responsivity of various age groups (10).

In another study, a list of stimulus words was used in an attempt to differentiate various personality profiles. On the basis of PGR responses given by one-hundred normal subjects to a list of twenty-four words, Hsü observed different "patterns" of responses. Isolating those stimuli which elicited the largest responses, he reported finding five different "clusters" of stimulus words. Thus, one group of subjects responded most to one set of words, a second group of subjects to another set of words, and so on. Analyzing the words comprising each cluster, Hsü concluded that the PGR had differentiated five personality profiles: two types of aggressive personality, two types of submissive, and one mixed type (12).

In the study by Haggard the influence of age was determined by comparing the mean PGR response of each age group to the entire list of stimulus words. That is to say, the levels of responsivity to the total stimulus situation were compared for the various age groups. In the study by Hsü, the pattern of responses was studied. In other words, the over-all PGR responsivity was not considered, but rather those stimuli which evoked the greatest reaction was the point of interest. Both of these approaches, together with a comparison of variances of the PGR responses, were used by Herr and Kobler in the analysis of their data (11). Employing a list of sixteen "emotional" and sixteen "neutral" words, twenty patients diagnosed as neurotic and twenty normal subjects were tested. The authors reported that the size of the psycho-

galvanic responses of the neurotic group was not significantly different from that of the normal group. The variances in the two groups, however, were significantly different. Moreover, the patterns of responses were different for the two groups: the normal group gave the largest responses to one set of stimuli, the patient group responding most to a second set.

In the present study a list of twenty stimulus words was employed, the words being taken from the longer list employed by Herr and Kobler. The analysis of the data, found in Chapter Four, also follows the approach utilized by those authors: response to the total situation with respect to both means and variances, and the pattern of response to the components of the total situation (i.e., the individual stimulus words).

In addition to association words, cutaneous pain and the threat of pain have been employed as stimuli in PGR investigations. Paintal, for example, administered a faradic electric shock to a group of 450 normal subjects and a group of 450 psychiatric patients (22). He reported no significant difference between the mean responses of the two groups, concluding therefore that the psychiatric group was not physiologically impaired with respect to their ability to give psychogalvanic reactions. Paintal also instructed his subjects that they were to receive a second shock, measuring their PGR responses to the threat. In comparing the mean responses of the two groups, he found that the patients gave significantly smaller PGR responses than did the normal subjects.

Paintal therefore concluded that the mentally disturbed subjects were not so aware of significance of the threat instructions as were the normal subjects.

Malmo, Shagass, and Davis obtained much the opposite result in their investigation (18). Employing ten normal subjects and ten patients diagnosed as "anxious", they reported smaller PGR reactions to thermo-pain for the anxious subjects than for the normal subjects. Moreover, the patients responded with larger PGR deflections than did the normal subjects to the threat of pain. This apparent contradiction between the findings of Paintal and Malmo quite possibly is due to the nature of the disorders suffered by the patient groups: in the former case, the patient group consisted of persons diagnosed as psychotic; in the latter case, the patient group consisted of psychiatric patients manifesting a marked degree of anxiety. Undoubtedly some of the patients employed by Paintal might have been diagnosed as "anxious", but just what percentage is not known.

In the studies by Paintal, Malmo, and others, the PGR response to pain or to the direct threat of pain has been investigated. Although the present study utilizes the threat of cutaneous pain, it differs from the preceding experiments in that no effort was made to measure the immediate response to the threat. Rather, as indicated in further detail in Chapter Three, the overall effect of a threatening situation was investigated. In other words, are PGR responses to the stimulus words affected by the

introduction of a generally threatening situation?

The study by Malmo, Shagass, and Davis bears upon the present investigation in another way. As previously indicated, their study was on the effect of threat on "anxious" patients. A number of other studies have been concerned with the relationship between anxiety states and physiological functioning. Malmo and Shagass, for example, investigated the physiological functioning of persons threatened with pain (19). Employing seventy-five psychiatric patients and eleven normal subjects, a number of physiological processes were examined in the threat situation. The patients were divided into three groups, the groupings being made on the basis of psychiatric diagnosis of the severity of the anxiety state. Although the differences between the PGR responses of the clinical groups generally fell short of statistical significance, the authors were led to conclude that "in general, severity of anxiety appeared to be related to degree of physiologic disturbance."

In another study of the relationship between anxiety and PGR functioning, Wishner employed eleven neurotic patients, all manifesting marked anxiety, and ten normal subjects (30). In comparing the PGR responses of the two groups to a variety of stimuli (verbally presented questions and sensory stimulation), Wishner found that the anxious subjects responded with larger galvanic reactions than the normal group.

A number of investigations have dealt with the relation-

ship between anxiety and the rate of conditioning the PGR to verbal stimuli. Welch and Kubis, for example, investigated the rate at which a conditioned reflex could be established in normal persons and in patients diagnosed as "anxious" (28). Employing twenty-two normal subjects and twenty-four patients, they reported that a conditioned PGR response was established with significantly less trials in the anxious group than in the normal group. Moreover, the anxious subjects resisted experimental extinction of the conditioned reflex longer than did the normal group.

In another study by the same authors, eighty-two normal subjects and fifty-one "anxious" subjects were employed. Again the patient group manifested the conditioned reflex more rapidly than the normal group. Furthermore, when the patients were divided into two groups on the basis of the psychiatric diagnosis of degree of anxiety, it was found that the rate of conditioning agreed with the diagnosis 91% of the time. Once again, it may be concluded that psychogalvanic functioning is related to "anxiety" states (29).

The study by Bitterman and Holtzman further supports this conclusion (2). Employing normal subjects in an experimentally induced "stress" situation, the authors reported that the subjects who manifested the greatest amount of "anxiety" also showed the fastest rate of conditioning.

Somewhat conflicting results, however, were obtained by Lacey, Smith, and Green (16). Forty association words were pre-

sented to each of forty-two subjects. One word was given six times, each time being succeeded by electric shock. The authors found that subjects classified as anxious (using Taylor's scale of Manifest Anxiety) established a conditioned response more slowly than subjects classified as having little anxiety. Consequently, the authors concluded (16, p. 216):

> The chronic anxiety level of the subject may be related to the ease of acquisition and spread of anxiety. Low anxiety subjects condition better but generalize less. This implies more accurate discrimination and appropriateness of response in low anxiety subjects.

Although the results of this last investigation apparently contradict the studies by Welch and Kubis, and Bitterman and Holtzman, the general conclusion remains that PGR functioning is related to anxiety. Thus, Lacey, Smith, and Green were led to conclude (16, p. 215): "The human organism, too, seems extremely sensitive to danger even in the slight degree employed in our experiments. We are anxiety-prone."

Units of PGR Measurement.

One final line of investigation must be considered. If the magnitude of PGR responses is to be measured, rather than simply the appearance versus the non-appearance of the response, it is necessary that an adequate unit of measurement be employed. In the early years of PGR research it was customary either to measure the magnitude of the deflection of the galvanometer needle, usually in terms of millimeters, or to measure the response in terms of

ohms change in resistance. It has been demonstrated repeatedly, however, that such units of measurement are inadequate (9). In the first place, such indices fail to account for the basic level of organismic activity. In other words, a one-thousand ohm response at a basic resistance level of 10,000 ohms does not have the same significance as a one-thousand ohm response at a basic resistance level of 50,000 ohms (8). The same, of course, is true of measurements made in terms of millimeters deflection. In other words, the magnitude of PGR responses in terms of ohms resistance change or millimeters deflection is related to the basic resistance level of the subject. This relationship, however, is not linear: increases in the basic resistance level are not accompanied by proportional increases in the ohms deflections (8).

Not only are these units inadequate because of their relation to the basic level of resistance, they also lack the characteristics necessary for more refined statistical techniques. Because of these deficiencies, many types of transformation units have been proposed.

In 1934 Darrow suggested that PGR measurements be expressed in terms of conductance changes (4). Thus, the measurement of the response utilizes somewhat the measure of basic bodily activity. It should be noted that the particular advantage of the Fere' method of recording over the Tarchanoff method is that the former yields this index of general bodily activity (31). Although expression of PGR responses in terms of conductance change appears

to be an improvement over "ohms drop", the magnitude of responses are still related to the original conductance level of the subject (5).

Inasmuch as many psychological measurements may best be expressed in terms of logarithmic units, Darrow later suggested that PGR responses be expressed as changes in log conductance (5). That is to say, instead of computing the PGR response by the simple formula of C_2 minus C_1, Darrow suggested the formula log C_2 minus log C_1 (where C_1 is the conductance value prior to stimulation and C_2 is the conductance value following stimulation). In 1945 Haggard subjected these two formulas, as well as the "ohms drop" method, to statistical evaluation (8). He concluded that the log conductance unit was the most independent of the basic conductance level, but that it still was inadequate: it tended to compensate for the higher basic conductance levels but not for the lower ones. By computing the logarithmic value of each ohms drop Haggard found that a linear relation did exist between the magnitude of response and the basic resistance level. Moreover, if a constant were added to each response value and the sum was then divided by the basic resistance level, the resulting scores were independent of the basic resistance levels. Haggard therefore concluded that this new unit of measurement was superior to any of those currently in use.

Herr and Kobler also found the Haggard method of transformation adequate for their data (11). Lacey (14) and Lacey and

Siegel (15), however, arrived at the opposite conclusion when they applied Haggard's formula to their data. Moreover, they concluded that either conductance change or log conductance change was acceptable. Schlossberg and Stanley likewise came to the conclusion that the conductance change method was basically satisfactory (24). They suggested, however, that the change in the square roots of the conductances was still better, having greater normalcy of distribution. Thus, Woodworth and Schlossberg were led to conclude (31, p. 140):

> Conductance would seem to be adequate for most purposes, but the square root conversion might be advisable whenever elaborate statistical treatment is based on the assumption of strict normality of the distribution of scores.

One additional transformation method should be noted. In his study of PGR responses to electric shock and threat of shock, Paintal suggested that each response of a subject should be considered as a ratio to the largest response given by that subject (22). Employing this method, however, Albrecht found that the distribution of such ratio scores failed to meet the criteria of normalcy of distribution and independence of basics (1).

From the foregoing it is apparent that a major consideration in the treatment of PGR data is the selection of a suitable unit of measurement. As Woodworth and Schlossberg pointed out after analyzing the responses of two subjects to electric shock (31, p. 141):

> Clearly the choice of units is of the greatest importance, if this choice can make the same basic data show subject A to have anywhere from 2/3 to 30 times the response of B.

Although the present study shall not seek to evaluate these various transformation methods, it should be pointed out that a suitable unit of measurement must be obtained before the data is evaluated in terms of the problem being investigated. The selection of such a unit shall be described in the following chapter.

CHAPTER III

STATEMENT OF THE PROCEDURE

Does the introduction of a threatening situation alter the PGR responses of subjects, and is the degree of such modification (if it exists) related to the individual's general concern for his bodily well-being? These are the specific problems which the current investigation seeks to answer. In order to do so, it is necessary that a number of conditions be satisfied. First, some form of threat must be introduced into the testing situation. Second, the subjects employed must differ in their general concern for their bodily well-being. Third, there must be a satisfactory unit of PGR measurement. And fourth, the obtained data must be subjected to adequate statistical analysis. This chapter is devoted to a discussion of the first three of these conditions, the statistical analysis being explained in the following chapter.

The Stimulus Words and the Threat Situation.

From the list of association words employed by Herr and Kobler (14), twenty-six words were selected for the present study. At the beginning of the experimental session, after the PGR electrodes had been attached to the subject, each subject was given these instructions:

> I am going to read a series of words. As you hear each word, give the first word that comes to your mind. Don't try to think of any word in advance. Simply, when you hear the word, say the first word that comes to mind. Do you understand?*

The stimulus words were then presented to the subject, the sequence of the stimuli being uniform for all subjects. Although the verbal response to each stimulus word was recorded, no attempt was made to evaluate these responses. In addition, of course, the PGR response to each stimulus word was recorded.

The first six stimulus words were "buffer" words, given simply to acquaint the subject with the experimental task and to provide E with a rough index of the range of responses given by the subject. This rough index of the range of responses made it possible for E to adjust the recording instrument in the cases of subjects whose responses were exceedingly large. Hereafter, the "buffer" words (country, shoe, window, bird, green, and table) and the PGR responses given by the subjects to these stimuli shall not be considered.

The next four words constitute what shall be termed hereafter as the "pre-test" stimuli. They serve a two-fold purpose: first, for matching Ss according to their general level of responsivity and, second, for comparison with the responses given to subsequent stimuli.

The next ten stimulus words constitute the "test" stimu-

*Questions concerning the nature of the experiment were deferred until the conclusion of the experimental session.

li. In the case of the Experimental Ss, these stimuli were accompanied by the threat instructions. In the case of the Control Ss, the stimuli were presented without threat.

Following the test stimuli six additional words were presented. These constitute the "post-test" stimuli and shall be used to determine whether or not the threat instructions produced any lasting changes in PGR responses. They were given to all Ss in the same manner: without threat.

The entire list of stimulus words is presented below, together with their classifications.

country	Responses measured
shoe	but not used for
window	testing hypotheses.
bird	Same for both the
green	Experimental and
table	the Control groups.
clock	"Pre-test" stimuli.
high	Used for matching
glass	Experimental and
love	Control subjects.
tree	
sick	"Test" stimuli.
chair	For the Experimental
sin	group, these words are
flower	presented in a threat
closed	situation. For the
noise	Control group, the
hospital	words are presented
sand	without threat.
sex	
bell	
afraid	"Post-test" stimuli.
subway	Presented to both
ashamed	the Experimental
white	group and the Control
open	group without threat.

Between the presentation of the words "sin" and "flower", each subject was asked to move his fingers about in the electrode cups in order to reduce the degree of polarization of the electrodes. This point was selected because it is approximately midway through the entire experimental session.

Following the presentation of the pre-test stimuli, the Control and Experimental subjects were given different instructions. In the case of the Experimental Ss, these instructions were intended to constitute a mildly threatening situation. The subjects were informed that there was a possibility of experiencing an electric shock. It was hoped that such instructions might duplicate the fear some subjects have reported previously: the fear engendered merely by being attached to a somewhat complex electrical apparatus. In the case that any of the subjects employed in the present investigation had such a fear already, it was expected that the introduction of the threat instructions would serve to intensify such feelings. The instructions given to the Experimental subjects were as follows:

> I am going to vary the amount of current passing through the machine during this next period. Please let me know if you feel anything. You may not, but if you do feel a shock, let me know.

Immediately prior to these instructions an apparatus, hidden from view during the preliminary portion of the experiment, was revealed and the "proper" electrical connections were made to the galvanometer. As the test stimuli were presented, one or more

lights flashed on the control board of the newly introduced apparatus. It was hoped that seeing the apparatus and the flashing lights would reinforce the subject's feeling of threat. The subjects, moreover, were asked on several occasions if they had felt any shock, these inquiries being made immediately prior to the presentation of the stimulus words "sin" and "hospital".

Instead of receiving the "threat" instructions, the Control subjects were told: "Now we must wait about one minute before continuing." The reason for this rest period was to match the Experimental group's interruption in receiving the stimulus words.

Following the presentation of the test words, the apparatus employed in the threat situation was disconnected and removed from sight. The Experimental subjects were further instructed: "Now I am going to give you some more words, but I won't be varying the current; so there won't be any more chance of your feeling anything."

Again, to compensate for the time interval, the Control subjects were told that there would be a short interruption (one-half minute).

At the conclusion of the experimental session, all subjects were interrogated about their attitude toward the experiment, particularly if and when they were concerned about receiving shock.

Selection of Subjects.

Inasmuch as a portion of the present study considers the

relationship between one's response to a threatening situation and his general level of concern for his physical well-being, it was necessary to obtain a suitable criterion of this level of concern. Several methods of selecting subjects with varying degrees of anxiety have been utilized in previous investigations. Welch and Kubis (29), Malmo, Shagass, and Davis (19), for example, employed clinical diagnosis in determining the degree of anxiety present in their subjects. Taylor, on the other hand, constructed a scale of manifest anxiety, employing items from the Minnesota Multiphasic Personality Inventory (26). Sixty-five items were selected by a group of judges as indicative of generalized anxiety and, together with 135 neutral items, incorporated in the new scale. Using those subjects whose scores fell toward the extremes of a sample population of 325 college students, Taylor sought to determine the relationship between anxiety and the rate of conditioning the eyelid reflex.

In 1953 Taylor revised her original scale to include only fifty critical items plus 175 neutral items (27). This scale was utilized by Bitterman and Kniffin in their investigation of "perceptual defense" (3). As in Taylor's original study, the authors selected subjects whose scores indicated either "high-anxiety" or "low-anxiety".

The present investigation likewise sought to measure anxiety, but anxiety as specifically related to the concern the

individual manifests for his bodily well-being. On the assumption that such "concern" for bodily welfare would be revealed by the number of complaints that the individual makes regarding his health a scale was constructed. As in Taylor's study, items were selected from the MMPI by a group of judges. Those items on which all three judges agreed were incorporated into the new scale. Fifty-seven items were included. On pages 57-58 of the Appendix these items are listed.

The MMPI answer sheets of 215 male college Freshmen at Loyola University, Chicago, were scored with the new scale. The mean score of this group was 7.1, the standard deviation being 3.4. From the original group of 215 students forty-five were selected as subjects for the experiment proper. Ten Ss had scores one sigma or more above the mean of the original population. Ten Ss had scores one sigma or more below the mean. The remaining twenty-five Ss had scores at or within one point of the mean score (scores of 6,7,and 8). This group was then divided, ten subjects being assigned to the Experimental group and fifteen subjects being assigned to the Control group. Thus, four groups of subjects were chosen for the investigation, representing three levels of "concern for bodily well-being": high, middle, and low.

PGR Measurement.

The apparatus used in the present study was the same as that employed by Herr and Kobler (11). Inasmuch as the apparatus

was a "closed" bridge type of galvanometer, the amount of current passing through all subjects, when balanced, was constant. The amount of current was 160 microamperes. Readings of psychogalvanic responses were made visually: the light reflected from the moving coil of the galvanometer was projected onto a calibrated scale immediately in front of the experimenter. Deflections as great as 2100 ohms could be read from the scale in units of five ohms. By recording the machine setting and the deflection from the "balanced" position of the galvanometer, it was possible to compute the basic resistance of the subject and the ohms drop in response to stimulation. The electrodes consisted of two small cups filled with a 0.1 percent saline solution, the second and fourth fingers of the subject's right hand being immersed in the solution.

As indicated in Chapter Two, a major problem in PGR investigation is the selection of an adequate unit of measurement. Employing the data collected in this study, a number of units were tentatively adopted. These were: ohms drop, change in log resistance, change in conductance, change in log conductance, change in conductance ratio, and the square root of change in conductance ratio. The first five of these units were considered inadequate for the purposes of this paper. The first two (ohms drop and change in log resistance) clearly failed to meet the requirement of independence of basic resistance level. Although change in conductance, change in log conductance, and change in conductance ratio met this requirement fairly well, all three lacked normalcy of dis-

tribution (as did, also, the first two units of measurement).

The last mentioned transformation method appears to have met the requisites of normalcy and independence. Measurements were computed as follows: $\sqrt{\frac{C_2 - C_1}{C_1}} \times 100{,}000.$ This unit of measurement is not to be confused with that suggested by Schlossberg (24). In the present formula, account is taken of the basic conductance level of the subject prior to his response. In the method used by Schlossberg, the difference is found between the square root of conductance 2 and the square root of conductance 1.

In determining the adequacy of this new transformation unit, the pre-test responses of all forty-five subjects were computed. The reason for employing only the pre-test responses was that these were the only responses given by all Ss under the same conditions. Thus, the introduction of threat conceivably could have affected the distribution of scores, indicating that the unit was or was not normally distributed. In Figure 1 the distribution of the obtained scores for the pre-test situation is presented. It appears from inspection that the distribution rather closely approximates the "normal curve".

By employing the Chi square test of "goodness of fit", it is seen that this distribution of scores does not differ significantly from that of the normal curve (7). The Chi square value is 5.761, which, for eight degrees of freedom, represents a "P" value of approximately 0.67. In other words, the obtained distri-

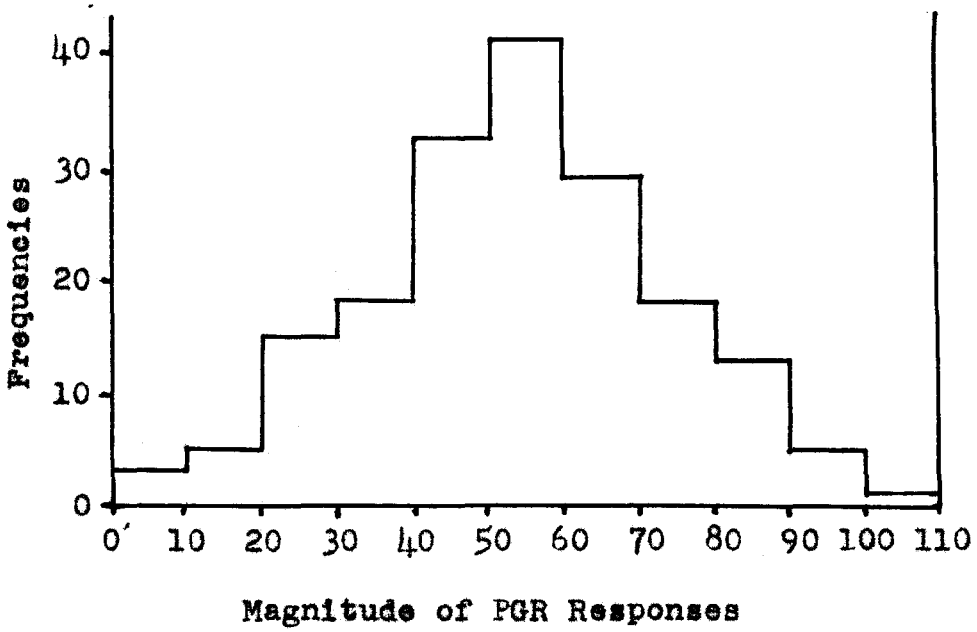

FIGURE 1

FREQUENCIES OF PGR RESPONSES OF DIFFERENT MAGNITUDES

bution curve falls well within the range of chance expectancy.

Inasmuch as the criterion of normality of distribution has been satisfied, it seems reasonable to assume that the scores also possess the characteristic of additivity: that the units of measurement are equal throughout the entire range of measurements. Therefore, the individual responses may be combined and subjected to further statistical treatment.

The first such treatment consists of determining whether or not there is adequate independence of scores with respect to their basic resistance levels. Because of the lack of normality of distribution and, in all likelihood, lack of additivity, the independence obtained with the conductance change, log conductance

change, and conductance change ratio methods of transformation is open to serious doubt (at least for the data obtained in the present study). Determining the independence of scores required the combining of scores.

The mean response in terms of $\sqrt{\text{conductance change ratio}}$ is shown in Figure 2 for seven basic resistance levels. The basic resistance levels actually are mid-points: the resistance level of 10,000 ohms embraces all responses given with basics ranging from 8,750 to 11,249 ohms. The actual means for the various basics (beginning with the lowest basic resistance level) are: 56.35, 59.89, 48.89, 52.02, 53.34, 48.57, and 51.66. Applying a simple

FIGURE 2
DISTRIBUTION OF PGR MAGNITUDES
ACCORDING TO BASIC RESISTANCE LEVELS

Rank-difference correlation to these mean PGR responses, a Rho of -0.64 is found. Estimating the value of "r" (Rho x 1.04), this correlation is found to be well within the range of chance expectancy. Moreover, employing matched groups as this investigation does, it is doubtful that independence is a necessary condition for proper evaluation of the data: the subjects are matched on the basis of their actual responses, regardless of their basic resistance levels. If the basics remain relatively constant, or if there is a uniform change in basics for the sub-groups (assuming the relationship between basics and PGR magnitudes is linear for the transformation unit employed), then the criterion of independence of basics becomes meaningless.

CHAPTER IV

EXPERIMENTAL FINDINGS AND INTERPRETATION

In Chapter One it was indicated that the present study sought to investigate a two-fold hypothesis, the second being dependent upon the first. In evaluating the data collected in this study, the two hypotheses shall be considered separately at first.

The description of the experimental procedure in the previous chapter pointed out that the Control and Experimental groups were selected from subjects scoring at or about the mean of the sample scores on the scale of concern for bodily well-being. Also, the two groups were matched according to their PGR responses to the four pre-test stimuli. This was accomplished by computing the mean response of each subject to the pre-test words. Of the fifteen Ss in the original Control group and ten Ss in the Experimental group, eight subjects were selected from each group. These subjects represented the best available matching on the basis of the individual pre-test mean scores. These mean scores of the selected subjects are given in Table I. Hereafter, all references to the Control group and to the Experimental group shall be to these matched groups. In other words, the data derived from these Ss shall be

employed to test the first half of the hypothesis of this study.

In order to evaluate the influence of the threat situation, the two matched groups shall first be compared with each other on the basis of their responses to the test stimuli and the post-test stimuli. It is necessary, however, that it be shown that the two groups do not differ significantly in their responses to the pre-test stimuli. As the first index of this, the means of the "subject scores" for the two groups may be compared (where the "subject score" refers to the mean response of a subject to the four pre-test stimuli). The mean of these scores, shown in Table I, for the Control group is 54.2; for the Experimental group, 53.4. By applying Fisher's "t" formula, a value of 0.47 is obtained.

TABLE I

PRE-TEST SUBJECT-SCORES OF MATCHED CONTROL AND EXPERIMENTAL GROUPS

Subject	Control	Experi.
a	66.3	70.1
b	60.1	68.8
c	58.7	54.6
d	58.3	52.6
e	53.7	52.4
f	52.9	51.4
g	42.4	40.8
h	39.9	36.3
Means	54.2	53.4
Variances	67.92	121.78
Sigmas	8.24	11.04

t = 0.47
F = 1.80

(Inasmuch as the scores have been matched as closely as possible from larger samples, the formula employed here is designed for testing the significance of difference between the means of correlated pairs of means (7). To be significantly different even at the 0.10 level of confidence, a "t" of 1.895 is required. Hence, employing the criterion of similarity of means for the two groups of subjects, it may be concluded that these groups are adequately matched.

A second criterion of the adequacy of matching is the similarity of the pre-test variances of the two groups. Employing the "F" test for homogeneity of variance (6), a value of 1.80 is obtained. Falling far short of the 3.79 value required for the 0.05 level of confidence, it may be concluded that the two groups are adequately matched for this second criterion.

The final test of the adequacy of matching is a consideration of the mean PGR response of each group to each of the pre-test stimuli. In other words, instead of comparing the subject-scores, a comparison of the stimulus-values is made (where the "stimulus-value" is the mean response of all Ss to a stimulus word). The reason for this is that it would be possible for the two groups to be quite similar in their general level of responsivity (comparable means and variances) but entirely different in the pattern of their responses. In Table II the mean response to each of the pre-test words is presented for the Control and Experimental groups. The means for the two groups are naturally the same as found in

Table I. The obtained "t" is 0.78, where a value of 2.353 is required for the 0.10 level of confidence.

TABLE II

MEAN PRE-TEST STIMULUS-VALUES FOR CONTROL AND EXPERIMENTAL GROUPS

Stimulus Words	Control Group	Experi. Group
Clock	49.4	49.2
High	48.4	47.3
Glass	53.7	55.2
Love	65.3	61.9
Group Means:	54.2	53.4
Value of t is 0.78		

From these statistical tests applied to the pre-test responses of the Control and Experimental groups, it may be concluded that the two groups are not significantly different in their initial psychogalvanic responses. Any differences which may be found in the test and post-test situations, therefore, may be attributed to the experimental variable: the introduction of the threat situation.

In evaluating the influence of the threat situation on the Experimental Ss, a number of procedures shall be employed. The first of these is a comparison of the Control and Experimental Ss during the test situation. All subjects received the same stimulus words in the same sequence, the Experimental subjects also receiv-

ing the threat situation. The mean response of each subject is presented in Table III, together with the mean of these values for the Control group and for the Experimental group. Employing Fisher's "t" formula, the difference between these two means is found to be significant at the 0.10 level of confidence. Such a finding, of course, is not highly significant in itself. Further comparisons of the same type, however, will be found to yield somewhat similar results, strengthening the tentative conclusion that the threat situation actually did alter the PGR responsivity of the Experimental subjects.

TABLE III

TEST-SITUATION SUBJECT-SCORES OF MATCHED CONTROL AND EXPERIMENTAL GROUPS

Subject	Control	Experi.
a	65.3	53.0
b	43.5	53.7
c	60.6	61.1
d	56.0	42.7
e	44.1	43.0
f	68.1	47.1
g	46.5	26.1
h	43.2	41.3
Means	53.4	46.0
Variances	94.05	96.94
Sigmas	9.7	9.8
	t = 1.89	
	F = 1.02	

Although the data indicate that the mean response level of the Experimental Ss was somewhat altered by the threat situation,

there is no indication that the variance of responses was affected. As shown in Table III, the F ratio for the obtained data is 1.02, a value falling far short of the 3.79 required to indicate a difference significant at the 0.05 level of confidence (6).

As mentioned earlier, it is important to consider the stimulus-values as well as the subject-scores. A comparison of the ten test mean responses is presented in Table IV. It is interesting to note that the mean response of the Experimental group to each of these stimuli is lower than the corresponding mean response of the Control group. In other words, the stimuli consistently evoked smaller responses from the Experimental group than from the Control group. Moreover, applying Fisher's "t" formula

TABLE IV

TEST-SITUATION STIMULUS-VALUES FOR CONTROL AND EXPERIMENTAL GROUPS

Stimulus Words	Control Group	Experi. Group
Tree	55.5	42.8
Sick	47.3	46.6
Chair	47.8	38.5
Sin	71.1	58.3
Flower	47.9	45.6
Closed	52.8	51.3
Noise	46.1	42.7
Hospital	46.7	38.1
Sand	43.7	36.5
Sex	75.1	59.5
Group Means:	53.4	46.0
Value of t is 4.358		

to the data, the difference between the two groups is found to be significant beyond the 0.01 level of confidence. (A "t" of 3.250 is required for the 0.01 level; the obtained "t" is 4.358.)

One final test of the influence of the threat instructions on PGR responses is now presented. The mean pre-test score of each subject is matched with his mean test response. In Table V these values are given for both the Control group and the Experimental group. In the case of the Control group, the mean test response is only slightly smaller than the pre-test mean, 53.4 as against 54.2. The mean test response of the Experimental group, however, is considerably smaller than the pre-test mean, 46.0 as against 53.4. By applying the "t" test to both sets of data, the differences of the two groups are further revealed. For the Con-

TABLE V

PRE-TEST AND TEST RESPONSES OF CONTROL & EXPERIMENTAL GROUPS

Control		Subject	Experi.	
Pre-test	Test		Pre-test	Test
66.3	65.3	a	70.1	53.0
60.1	43.5	b	68.8	53.7
58.7	60.6	c	54.6	61.1
58.3	56.0	d	52.6	42.7
53.7	44.1	e	52.4	43.0
52.9	68.1	f	51.4	47.1
43.4	46.5	g	40.8	26.1
39.9	43.2	h	36.3	41.3
54.2	53.4	Means	53.4	46.0
0.24		t values	2.31	

trol group a "t" value of 0.24 is obtained, where the required value for the 0.10 level of confidence is 1.895. The "t" value for the Experimental group, on the other hand, is 2.31, indicating that the difference between the pre-test and test means is significant at approximately the 0.05 level of confidence.

From the foregoing tests it seems reasonable to conclude that the PGR responses of the Experimental group were affected by the introduction of the threat situation, both the magnitude and the pattern of responses being altered. This being the case, consideration may now be made of the responses given by the two groups in the post-test situation. In other words, the question may be posed: is there any after-effect resulting from the threat situation? In seeking to answer this question, the same statistical techniques shall be employed as in evaluating the threat situation.

TABLE VI

POST-TEST SUBJECT-SCORES OF MATCHED CONTROL AND EXPERIMENTAL GROUPS

Subject	Control	Experi.
a	63.5	29.5
b	38.7	31.1
c	41.9	53.4
d	54.0	45.8
e	24.4	18.4
f	65.8	47.3
g	56.5	16.2
h	35.0	35.3
Group Means	47.5	34.6

t = 2.107
F = 1.18

In Table VI are presented the post-test subject-scores of the Control and Experimental groups. Applying the "t" formula, a value of 2.107 is obtained, indicating that the two groups are significantly different with respect to their means at almost the 0.05 level of confidence. It may be noted that this closely corresponds to the 0.10 level obtained when comparing similar scores for the test period. The post-test responses of the two groups also resemble the test responses in that no significant difference is obtained when comparing the variances of the two groups. Thus, an "F" of 1.18 is obtained, falling far short of the value required for the 0.10 level of confidence.

TABLE VII

POST-TEST STIMULUS-VALUES OF THE CONTROL AND EXPERIMENTAL GROUPS

Stimulus Words	Control Group	Experi. Group
Bell	46.5	37.0
Afraid	51.0	35.2
Subway	48.2	27.8
Ashamed	59.5	45.5
White	40.8	28.5
Open	38.6	33.7
Group Means	47.4	34.6
Value of t is 5.94		

Comparing the means of the two groups for the stimulus values, another difference between the two groups may be observed, one similar to that found in the test situation. As shown in Table VII, the mean post-test response of the Control group is

[illegible] the mean response of the Experimental group, 34.6. Comparison of these two means yields a "t" value of 5.94, a figure well beyond the 4.032 value needed for the 0.01 level of confidence. Therefore, just as in the test situation, the stimuli elicited responses which were significantly smaller for the Experimental group than for the Control group.

The final comparison of the two groups is made in terms of changes within each group. In Table VIII are presented the [illegible] scores for each group to both the test stimuli and the [illegible] stimuli. As indicated, the mean post-test response of [illegible] mental group diminished from the mean test response, [illegible]. Although this drop represents a difference signifi[illegible] 0.02 level of confidence, it is not clear to what ex-

TABLE VIII

TEST AND POST-TEST SUBJECT-SCORES OF CONTROL AND EXPERIMENTAL GROUPS

Control		Subject	Experi.	
[illegible]	ost-test		Test	Post-test
[illegible]	63.5	a	53.0	29.5
[illegible]	38.7	b	53.7	31.1
[illegible]	.9	c	61.1	53.4
[illegible]	.0	d	42.7	45.8
[illegible]	[illegible]	e	43.0	18.4
[illegible]	[illegible]	f	47.1	47.3
[illegible]	[illegible]	g	26.1	16.2
[illegible]	35	[illegible]	41.3	35.3
53.4	47.	[illegible]ns	46.0	34.6
1.72		[illegible]s	2.95	

tent the change may be attributed to the threat situation. The reason for this is that the Control group likewise showed a considerable decrease in the magnitude of responses during the post-test period, the mean score dropping from 53.4 to 47.5. This decrease represents a difference significant at close to the 0.10 level (the obtained "t" being 1.72, with a value of 1.895 required for the 0.10 level). Hence, the result of this test of the difference between the two groups in the post-test situation remains unclear. Nevertheless, from the comparisons of the subject-scores and stimulus-values for the two groups, it appears safe to conclude that, having experienced the threat situation, the Experimental Ss continued to respond differently than the Control Ss, even when the threat was removed.

Evaluation of Influence of Concern for Bodily Well-being.

In testing whether or not the degree of concern for bodily well-being is related to PGR responses in a threat situation, three groups of Ss were selected (as indicated on page 24). The three groups differed in their scores on the new scale of "Concern for Bodily Well-being". The first group shall be termed the "High" group, indicating that the score of each subject on the scale was one sigma or more above the mean of the sample population. The second group, known as the "Middle" group, is composed of Ss whose scores were at or about the mean. This group is the same that was used in evaluating the effect of threat, being com-

pared with the non-threat Control group. The third group, or "Low" group, is made up of Ss having scores one sigma or more below the mean of the sample population. Unlike the first portion of the investigation, where the Control and Experimental groups were matched for their scores on the newly constructed scale but subjected to different experimental conditions, the three groups used in this portion of the study differ in their scores but were subjected to the same experimental condition: threat.

As in the first portion of the investigation, the Ss were matched on the basis of their mean pre-test responses. From the original groups of ten subjects each, eight subjects were assigned to each of the three groups. The same eight Ss comprising the Experimental group in the first part of the study constitute the Middle group of this second portion.

As in the preceding discussion, it is necessary to determine whether or not the groups of subjects are adequately matched. Again this is done by comparing the subject-scores of the three groups and the stimulus-values of the three. In Table IX are presented the subject-scores and means of the three groups. Application of analysis of variance to these scores reveals no significant differences. Because almost all of the total variance is due to the differences between the matched individuals, the resulting "F" value is only 0.15. A comparison of the mean stimulus-values likewise fails to indicate any significant differences between the groups, the obtained "F" being only 1.34, where a value of 5.79 is

needed to reach the 0.05 level of confidence (Table X).

TABLE IX

PRE-TEST SUBJECT-SCORES
OF MATCHED GROUPS

Subject	High Group	Middle Group	Low Group
a	70.2	70.1	83.8
b	63.2	68.8	74.3
c	58.2	54.6	54.7
d	53.7	52.6	51.2
e	52.2	52.4	50.5
f	51.1	51.4	46.1
g	42.4	40.8	37.9
h	40.6	36.3	37.6
Means	53.9	53.4	54.5
	F = 0.15		

TABLE X

PRE-TEST STIMULUS-VALUES
OF MATCHED GROUPS

Stimuli	High Group	Middle Group	Low Group
Clock	49.8	49.2	47.6
High	48.9	47.3	54.2
Glass	54.9	55.2	51.7
Love	62.3	61.9	64.5
Means	53.9	53.4	54.5
	F = 0.19		

In evaluating the test situation subject-scores of the three groups, analysis of variance again fails to indicate any significant differences, the "F" value being only 0.43 (Table XI). This would seem to indicate that all three groups were equally affected by the threat instructions, or equally unaffected. However, analysis of the stimulus-values of the three groups does indicate a difference. The obtained "F" (3.79) indicates a difference significant beyond the 0.05 level (Table XII).

TABLE XI

TEST SUBJECT-SCORES
OF MATCHED GROUPS

Subject	High Group	Middle Group	Low Group
a	44.4	53.0	74.7
b	46.7	53.7	58.2
c	42.3	61.1	42.9
d	48.7	42.7	47.3
e	44.2	43.0	55.7
f	49.3	47.1	26.4
g	39.6	26.1	36.4
h	31.2	41.3	40.7
Means	43.3	46.0	47.8
F = 0.43			

Another test of the differential influence of the threat instructions is the comparison of the decreases from the levels of pre-test responses. In Table XIII the mean pre-test and mean test response of each group is presented. It should be noted that the greatest drop in response magnitude is found in the High group, the second greatest drop in the Middle group, and the smallest

TABLE XII

TEST STIMULUS-VALUES
OF MATCHED GROUPS

Stimulus	High Group	Middle Group	Low Group
Tree	49.1	42.8	49.8
Sick	44.2	46.6	48.6
Chair	42.3	38.5	44.7
Sin	51.9	58.3	49.3
Flower	45.1	45.6	47.0
Closed	42.8	51.3	44.3
Noise	40.7	42.7	45.5
Hospital	32.9	38.1	46.9
Sand	30.2	36.5	41.3
Sex	53.8	59.5	60.5
Means	43.3	46.0	47.8
	F = 3.79		

p in the Low group. Moreover, applying Fisher's "t" test to means of each group, the most significant difference occurs in High group, the least significant in the Low group. More specifically, the level of confidence for the High group is beyond 1; for the Middle group, beyond 0.05; and for the Low group, ond 0.10.

TABLE XIII

MEAN PRE-TEST AND TEST RESPONSES
OF MATCHED GROUPS

	High Group	Middle Group	Low Group
Pre-test mean:	53.9	53.4	54.5
Test mean:	43.3	46.0	47.8
t:	3.65	2.31	2.11

Although the subject-scores of the three groups show no significant differences, this comparison of the decreases in PGR response levels indicates that very likely there is a definite relationship between the degree of concern for bodily well-being and the degree to which the threat situation affects PGR responses.

Comparison of the post-test responses of the three groups reveals results similar to those found in the test situation. In the first place, the differences between the mean subject-scores fall far short of significance. As shown in Table XIV, the "F" value is less than 1.00. Secondly, as in the test period, the differences between the mean stimulus-values of the groups do prove to be statistically significant. With a "F" of 9.1, these differences are significant beyond the 0.01 level (Table XV).

TABLE XIV

POST-TEST SUBJECT-SCORES
OF MATCHED GROUPS

Subject	High Group	Middle Group	Low Group
a	27.5	29.5	58.7
b	34.9	31.1	56.8
c	47.6	53.4	40.0
d	45.4	45.8	32.6
e	40.9	18.4	45.9
f	50.2	47.3	26.4
g	34.0	16.2	34.4
h	29.6	35.3	45.8
Means	38.8	34.6	42.6
	F = 0.858		

TABLE XV

POST-TEST STIMULUS-VALUES
OF MATCHED GROUPS

Stimulus	High Group	Middle Group	Low Group
Bell	40.3	37.0	37.0
Afraid	40.6	35.2	43.3
Subway	37.2	27.8	40.9
Ashamed	46.2	45.5	49.7
White	35.4	28.5	43.2
Open	32.8	33.7	41.5
Means	38.7	34.6	42.6
	F = 9.1		

One final test is to be made in evaluating the post-test responses of the three groups: the comparison of the mean test and mean post-test responses of each group. As indicated in Table XVI, the mean post-test response of each group was lower than its corresponding test response. Whereas the difference between means is significant at the 0.02 level of confidence for the Middle group, the differences for the other two groups are significant only at approximately the 0.10 level. Inasmuch as the same comparison for the Control group in the first half of the study yielded a differ-

TABLE XVI

MEAN TEST AND POST-TEST RESPONSES
OF MATCHED GROUPS

	High Group	Middle Group	Low Group
Test mean:	48.3	46.0	47.8
Post-test mean:	38.7	34.6	42.6
t:	1.81	2.95	1.81

ence significant at almost the 0.10 level, it is quite possible that the differences obtained here are due to the nature of the stimuli employed in the post-test situation, the slightly greater decrease in response level of the Middle group simply representing the influence of sampling error.

Even if the decrease in magnitude of responses during the post-test period is due to the stimulus words employed, the fact remains that the stimulus-values for the three groups are significantly different. It may be concluded, therefore, that there is some residual of the threat period.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was two-fold: first, to learn whether the introduction of a mildly threatening situation affects the PGR responses of subjects and, second, if threat does alter PGR responses, to determine whether the amount of influence is related to the degree to which the individual apparently is concerned with his physical well-being. Because of this two-fold purpose, the investigation may be considered as consisting of two parts. Prior to the actual investigation, however, it was necessary to establish some criterion of the degree to which an individual is concerned about his bodily well-being.

Assuming that the individual who is more concerned about his well-being will also express more interest in his bodily functions or complain of more physical defects, a scale of fifty-seven items was constructed from the items appearing in the MMPI. On the basis of the distribution of scores on this scale by a sample population of 215 male college Freshmen, the subjects used in the actual experiment were selected. Three groups of subjects were selected, representing three levels of "concern": high, middle, and low. The Middle group was divided into a Control group and an

Experimental group, these two groups being employed to determine whether or not the introduction of threat affects PGR responses to other stimuli.

All Ss were given a list of twenty-six stimulus words during the experimental session, their PGR responses to each word being recorded. The first six words, however, constituted "buffer" stimuli, the responses to these stimuli not being used in the actual evaluation of the data. All Ss received the stimuli in the same sequence. As the unit of PGR measurement a new transformation method was employed, the units apparently satisfying the basic requirements for refined statistical analysis.

Eight Ss were selected from the Control group and from the Experimental group. These subjects were matched in terms of their responses to the first four stimuli. The two sub-groups represented the best available matching in terms of means and variances. The following ten stimulus words were presented to the Experimental subjects in a threat situation; to the Control subjects without threat. The threat consisted of instructions to the subject that, inasmuch as the amount of current used in the recording instrument was to be varied, he might feel an electric shock. An additional apparatus was introduced during this period to reinforce the threat situation.

In comparing the responses of the two groups to these ten stimulus words, it was found that the magnitude of responses given by the Experimental group was considerably lower than that

given by the Control group. This is not to say that all Experimental Ss gave smaller responses than their matched Control Ss, or that they all gave smaller responses than they did to the stimuli presented prior to the threat situation, but rather that the general trend of the Experimental group was to give smaller responses in the threat situation than they probably would have given had there not been the threat. Although the means of the responses of the Experimental subjects generally were smaller, and although the pattern of responses to the stimuli appears definitely to have been altered, the variance of the Experimental group was not so affected.

Following the threat situation, the Experimental subjects were given an additional six stimulus words. The Control group likewise received these stimuli. Again there was a decrease in the magnitude of responses given by the Experimental group, a decrease considerably larger than that found in the Control group. Again, the pattern of responses of the Experimental group was significantly different from that of the Control group. It may be concluded, therefore, that the introduction of threat not only alters PGR responses, but that this influence persists even after the immediate threat has been removed.

In the second portion of the investigation, the Experimental group used in the first half was matched with the High group and with the Low group. All three groups received the same stimuli in the same sequence. All three groups received the threat situation. They differed only in their degree of concern for their

physical well-being. The same matching procedure was used as before, with eight subjects being assigned to each group. Statistical analysis revealed no significant difference between the three groups prior to the introduction of threat.

During the threat situation the response means of all three groups showed a considerable decline. Although no significant difference was found between the groups, all showed decreases that were significant when compared to the responses given prior to the introduction of threat. Moreover, if the difference between the Control group and Experimental group may be accepted as a true difference, then the similarity of the three groups in the second portion of the study would strongly suggest that the diminished responses resulted from the introduction of the threat situation. In addition, the greatest decline in response level was found in the High group; the smallest decline occurred in the Low group. The importance of this finding is further substantiated by the fact that the most significant difference between threat responses and pre-threat responses occurred in the High group, the least significant in the Low group. Consequently, although the differences between the responses of the three matched groups was not statistically significant, there is strong evidence that the affect of the threat situation was related to the degree of concern manifested by the subjects: those with the greatest concern were most affected, those with the least concern were the least affected. In other words, those subjects with the least measured concern

most closely approached the response level of the Control subjects employed in the first half of this study: subjects not receiving the threat instructions.

Again, all three groups showed a diminished response level to the stimuli presented following threat: diminished from the level of the threat responses. Like the reactions elicited during the threat period, no significant difference was found between the three groups during this post-threat period. The values of the stimuli, however, were significantly different for the three groups (as they were in the threat situation). Thus, once again the threat situation apparently left its mark, this time after the threat had been removed.

Conclusion.

In conclusion it may be said that the apprehension of threat not only is capable of evoking an immediate bodily reaction but that the delicate physiological mechanisms of the body are upset to a greater or lesser degree even when responding to stimuli other than the threat itself. Even a threat so mild as that used in the present investigation is capable of disturbing this delicate mechanism. Moreover, once the physiological responding mechanism is disturbed, it does not readily return to its normal state. Furthermore, one of the factors influencing the responses of the person in a threatening situation is the degree to which he is concerned about his bodily welfare. It naturally is to be expected

that other factors will influence such physiological reactions in a threat situation. It seems only logical to conclude, however, that the greater the significance that a threatening situation has for an individual, either because of his apprehension of the threat or because of the degree to which he is concerned about his physical well-being, the more disrupting will be a threatening situation of the mental and organic functioning of the person. It is obvious, therefore, that the establishment of rapport is essential in any study involving sensitive recording of the physiological response mechanisms of the body.

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APPENDIX

SCALE OF "CONCERN FOR BODILY WELL-BEING"

I have a good appetite. (False)
My hands and feet are usually warm enough. (False)
There seems to be a lump in my throat much of the time. (True)
I have diarrhea once a month or more. (True)
I am very seldom troubled by constipation. (False)
I am troubled by attacks of nausea and vomiting. (True)
I am bothered by acid stomach several times a week. (True)
I have a cough most of the time. (True)
Much of the time my head seems to hurt all over. (True)
Once a week or oftener I feel suddenly hot all over, without apparent cause. (True)
I am in just as good physical health as most of my friends. (False)
I am almost never bothered by pains over the heart or in my chest. (False)
Parts of my body often have feelings like burning, tingling, crawling, or like "going to sleep." (True)
I have had no difficulty in starting or holding my bowel movement. (False)
I hardly ever feel pain in the back of the neck. (False)
I am troubled by discomfort in the pit of my stomach every few days or oftener. (True)
I have little or no trouble with my muscles twitching or jumping. (False)
There seems to be a fullness in my head or nose most of the time. (True)
Often I feel as if there were a tight band about my head. (True)
I have a great deal of stomach trouble. (True)
I have never vomited blood or coughed up blood. (False)
I do not worry about catching diseases. (False)
During the past few years I have been well most of the time. (False)
I have never had a fit or convulsion. (False)
I am neither gaining nor losing weight. (False)
The top of my head sometimes feels tender. (True)
I do not tire quickly. (False)
I have never had a fainting spell. (False)
I seldom or never have dizzy spells. (False)

I can read a long while without tiring my eyes. (False)
I feel weak all over much of the time. (True)
I have very few headaches. (False)
Sometimes, when embarrassed, I break out in a sweat which annoys me greatly. (True)
I have had no difficulty in keeping my balance in walking. (False)
I do not have spells of hay fever or asthma. (False)
I have never had any breaking out on my skin that has worried me. (False)
I hardly ever notice my heart pounding and I am seldom short of breath. (False)
My neck spots with red often. (True)
I have numbness in one or more regions of my skin. (True)
My eyesight is as good as it has been for years. (False)
I do not often notice my ears ringing or buzzing. (False)
I am troubled by attacks of nausea and vomiting. (True)
I have never been paralyzed or had any unusual weakness. (False)
Sometimes my voice leaves me or changes even though I have no cold. (True)
I have no trouble walking. (False)
I do not dread seeing a doctor about a sickness or injury. (False)
I have had no difficulty starting or holding my urine. (False)
I have to urinate no more often than others. (False)
I have never noticed any blood in my urine. (False)
I believe my sense of smell is as good as other people's. (False)
There is something wrong with my sex organs. (True)
I practically never blush. (False)
I am not afraid of picking up a disease or germs from door knobs. (False)
I am not bothered by a great deal of belching of gas from my stomach. (False)
My mouth feels dry almost all the time. (True)
My skin seems to be unusually sensitive to touch. (True)
I have never had any black, tarry-looking bowel movements. (False)

APPENDIX II

TABLE XVII

ANALYSIS OF VARIANCE OF THE DATA OF TABLE IX:
PRE-TEST SUBJECT-SCORES

Source of Variation	Sum of Squares	df	Mean Squares	F
Between columns	5.18	2	2.59	0.15
Between rows	3341.48	7	477.35	
Rows by columns	232.57	14	16.61	
Total	3579.23	23		

TABLE XVIII

ANALYSIS OF VARIANCE OF THE DATA OF TABLE X:
PRE-TEST STIMULUS-VALUES

Source of Variation	Sum of Squares	df	Mean Squares	F
Between columns	2.42	2	1.21	0.19
Between rows	361.53	3	120.51	
Rows by columns	37.69	6	6.28	
Total	401.65	11		

TABLE XIX

ANALYSIS OF VARIANCE OF THE DATA IN TABLE XI:
TEST SUBJECT-SCORES

Source of Variation	Sum of Squares	df	Mean Squares	F
Between columns	81.66	2	40.83	0.43
Between rows	1269.60	7	181.37	
Rows by columns	1302.51	14	93.04	
Total	2653.77	23		

TABLE XX

ANALYSIS OF VARIANCE OF THE DATA IN TABLE XII:
TEST STIMULUS-VALUES

Source of Variation	Sum of Squares	df	Mean Squares	F
Between columns	102.12	2	51.06	3.79
Between rows	1098.13	9	122.01	
Rows by columns	242.77	18	13.49	
Total	1443.02	29		

TABLE XXI

ANALYSIS OF VARIANCE OF THE DATA IN TABLE XIV: POST-TEST SUBJECT-SCORES

Source of Variation	Sum of Squares	df	Mean Squares	F
Between columns	252.96	2	126.48	0.86
Between rows	641.75	7	91.68	
Rows by columns	2062.51	14	147.32	
Total	2957.22	23		

TABLE XXII

ANALYSIS OF VARIANCE OF THE DATA IN TABLE XV: POST-TEST STIMULUS-VALUES

Source of Variation	Sum of Squares	df	Mean Squares	F
Between columns	191.28	2	95.64	9.12
Between rows	300.96	5	60.19	
Rows by columns	104.80	10	10.48	
Total	597.04	17		

APPROVAL SHEET

The dissertation submitted by Eugene J. Albrecht has been read and approved by five members of the Department of Psychology.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the dissertation is now given final approval with reference to content, form, and mechanical accuracy.

The dissertation is therefore accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

Sept. 10, 1956
Date

Vincent V. Herr, S.J.
Signature of Adviser