

PALMAR PERSPIRATION AS AN INDEX OF TENSION  
AND ITS RELATIONSHIP TO PERSONALITY FACTORS

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A Thesis

Presented to

The Faculty of the Department of Psychology  
The University of Houston

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In Partial Fulfillment  
of the Requirements for the Degree  
Master of Arts in Psychology

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by

Mary M.B. Castle

August 1953

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## ABSTRACT

The aim of this study was to investigate palmar perspiration as an indicator of emotional tension, and to discover whether it is sensitive to changes in emotional level. Also, it was hypothesized that individual differences in palmar perspiration level might be related to personality factors.

Research on the palmar perspiration index has been limited. Physiological studies have revealed that sweating is in part a response of the sympathetic nervous system. Palmar perspiration is the most sensitive to sympathetic stimulation and the least sensitive to temperature changes. For this reason it has been termed "emotional sweating". A colorimetric technique was developed by Silverman and Powell<sup>1</sup> for recording perspiration from the finger-tips. This technique is applicable to experimental study of the perspiration index.

A group of fifteen men and fifteen women were used as subjects in the present study. They were exposed to an experimentally-produced frustrating situation, during which time a perspiration index was taken. Another perspiration index had been taken just before the frustrating test situation was introduced, while they were "anticipating difficulty". Fifteen minutes after the end of the frustrating experience another perspiration index was taken, supposedly indicating the individual's "normal" perspiration level. Later each subject was given the Minnesota Multiphasic Personality Inventory.

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<sup>1</sup> J.J. Silverman and V.E. Powell, "Studies on palmar sweating", American Journal of Medical Science, 208: pp.297-305, 1944.

Nine M.M.P.I. scales and the Taylor Scale of Manifest Anxiety were scored on the test. The perspiration indices were measured on a densitometer.

The anxiety scores were correlated with each of the perspiration indices. There was a .56 correlation between anxiety and the perspiration index taken fifteen minutes after the frustrating experience; a .49 correlation between anxiety and the perspiration index taken during the test; and a .24 correlation between anxiety and the perspiration index taken while "anticipating difficulty". Considering the chances for error in both the perspiration test and especially the personality inventory, the first of these correlations was considered very high, the second one definite.

"t" ratios were derived for the difference between the "normal" perspiration level and the "frustration" level and between the "anticipation" level and the frustration level. The first difference was found to be significant at the .02 level of confidence, the second difference not significant.

In the analysis of the M.M.P.I. scores, the subjects were divided into two groups, according to perspiration level. Group I contained the fifteen subjects with the heaviest palmar perspiration; Group II contained the fifteen subjects with the lightest palmar perspiration. Group I was found to have made significantly higher scores on the Schizophrenia, Psychopathic Deviate, Depression, Social Interest, Psychasthenia, and Paranoia scales. There were no significant differences between the two groups on the Hypomania, Hysteria, and Hypochondriasis scales. Group I had an overall greater number of scores above 70 (the neurotic level) than Group II. It was concluded that persons with heavy palmar perspiration levels are more likely to show neurotic tendencies than persons with low palmar perspiration levels.

## CHAPTER I

### THE PROBLEM AND DEFINITION OF TERMS USED

Physiological research and several psychological studies point to the possibility that palmar perspiration may give a physical measure of emotional tension. However, there has been no well-controlled experimentation with the perspiration index using experimentally-produced tension situations. Nor has palmar perspiration been studied in relation to personality factors.

#### I. THE PROBLEM

Statement of the problem. It was the purpose of this study to determine (1) whether there is a significant change in the level of an individual's palmar perspiration due to exposure to a frustrating situation; (2) whether there is a consistent relationship between level of perspiration and anxiety; and (3) whether perspiration level is significantly related to personality factors.

Importance of the study. Much psychological research has been carried out in the endeavor to obtain physical measures applicable to the study of problems in psychology. Of particular value would be a quantitative measure of tension. To date there has been no really satisfactory technique developed for this purpose.

Body perspiration is known to be in part a response of the sympathetic branch of the autonomic nervous system, which controls emotional behavior. The sweat glands on the palms of the hands are particularly sensitive to sympathetic stimulation and minimally sensitive to thermal

changes. There is low galvanic resistance on the palms as well as on the soles of the feet. On the basis of these facts, palmar sweating might be a revealing index of emotional tension. Several studies<sup>1</sup> have been made along this line, but no clinical implications were made. It was the purpose of the present study to investigate the sensitivity of the perspiration index to reactions of frustration, and to observe any consistent relationship between palmar perspiration level and personality factors.

## II. DEFINITION OF TERMS USED

Palmar perspiration. In the present paper, the term, palmar perspiration, shall be used to imply "emotional sweating", such as that observed on the finger tips.

Perspiration index ("P.I."). The perspiration index or the abbreviation, "P.I." refers to the level of perspiration of an individual.

Anxiety. Anxiety is here interpreted to mean apprehension resulting from threats to an individual's basic security as a personality.<sup>2</sup>

Normal anxiety. In the experience of normal anxiety, all elements of the conflict situation are conscious or capable of becoming conscious. Normal anxiety is in proper proportion to the objective threatening situation, and is relieved when the threat is removed. Furthermore, the anxiety is used

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<sup>1</sup> R. Gladstone, "A group test of palmar sweat", Journal of General Psychology, 48: pp. 29-49, 1953.

<sup>2</sup> Rolfe May, The Meaning of Anxiety (New York: The Ronald Press, 1950), p.191.



as a drive in the solution of the conflict.<sup>3</sup>

Neurotic anxiety. Neurotic anxiety is anxiety out of proportion to the objective threatening situation. It is preceded by conscious conflict, which is subsequently repressed. The individual is unaware of the real source of his anxiety, and resorts to defense mechanisms in an effort to avoid his conflict.<sup>4</sup>

Frustration. The interpretation of frustration used in the present report is that of aggression inhibited and displaced inward against the self. It is strongest when the source of the inhibition is the self.<sup>5</sup>

Manifest anxiety. Manifest anxiety shall be taken here to mean conscious symptoms of anxiety.

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<sup>3</sup> Ibid., p. 194.

<sup>4</sup> Ibid., p. 197.

<sup>5</sup> John Dollard et al, Frustration and Aggression (New Haven: Yale University Press, 1947). pp. 46-48.

## CHAPTER II

### REVIEW OF THE LITERATURE

The earliest extensive study of human perspiration was done by the physiologist, Kuno<sup>1</sup>, who concluded that there are two kinds of sweating - thermal sweating, which occurs over the general body area, and emotional sweating, which is primarily limited to the palms of the hands, the soles of the feet, and, in sexually mature persons, the armpits. Kuno believed that there must be two distinct neurological centers controlling the two kinds of sweating, since they appear under different physical conditions. Emotional sweating is little affected by thermal changes, and is often accompanied by constriction of the skin vessels, goose skin, phenomena ordinarily associated with a cool body temperature. Only very extreme temperature changes affect palmar sweating, and such changes might be regarded as threatening to the organism, and, therefore, of an emotional nature.

Kuno observed that animals exhibit sweating on their footpads during times of excitement, such as when threatened by attack or during battle for food or mate. The moisture on the footpads increases friction, an advantage during physical activity. In humans sweating on the palms appears during strenuous physical activity, and facilitates the grasping of objects. In fact, there is evidence that palmar sweating and the grasping reflex have a common neurological origin<sup>1</sup>. Emotional sweating also occurs in times of

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<sup>1</sup> A. Kuno: cited by O.H. Mowrer et al, Psychotherapy: A Symposium on Theory and Research (New York: Ronald Press, 1953), pp.227-228.

danger or anticipation of danger.

Kuno found wide individual differences in palmar perspiration level, as well as some differences between the two palms of an individual, though increase in sweating is simultaneous for the two hands. Distribution even varies from one part of the palm to another.

Research on palmar sweating was continued by Silverman and Powell<sup>2</sup>, who compared the baseline levels of a group of normal individuals with the baselines of a group of hospitalized neurotics. The neurotic group had characteristically heavier perspiration than the normal group.

Wright<sup>3</sup> compared a group of neurotics with a group of psychopaths, and found marked differences in palmar perspiration level, the neurotics' perspiration being much heavier. He linked the palmar perspiration level with anxiety.

Gladstone<sup>4</sup> used the Silverman and Powell technique on large groups in situations of various emotional levels, having the subjects administer the perspiration tests themselves, given verbal instructions by the experimenter. He found that sweating could be increased by painful stimuli, heat applied to a local area, mental arithmetic, emotion, physical labor and activity, attempted deception, expectation of difficulty, and extremely pleasant or unpleasant feelings. A decrease in palmar sweat is induced by

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<sup>2</sup> J.J. Silverman and V.E. Powell, "Studies on palmar sweating", American Journal of Medical Science, 208: pp.297-305, 1944.

<sup>3</sup> E. Wright, cited by O.H. Mowrer et al, op. cit., p.230.

<sup>4</sup> R. Gladstone, "A group test of palmar sweat", Journal of Psychology, 48: pp. 29-49, 1953.

exhaustion, sexual arousal, feelings of well-being, and poor physical condition. Gladstone found that sweating begins on the palms immediately on exposure to a suitable stimulus, reaching a maximum in five seconds to two and one half minutes after initial exposure. There is a gradual decline then, the baseline being reached within five minutes after removal of the stimulus in the case of conation, and slightly longer after an emotional stimulus.

Recently, Mowrer<sup>5</sup> has experimented with the perspiration index as a possible indication of resistance by patients during therapy. He found a high degree of relationship between perspiration level changes and patients' self-ratings of tension changes during the course of therapy. Mowrer also recorded the perspiration indices of the therapist, which, in some cases, were at a higher level than the patient's, but were much more stable. He concluded that there may be physiological differences among individuals in regard to perspiration level, and that variations from the baseline may be most significant. Mowrer sees the perspiration index as a promising tension measure, especially because its fluctuations do not disturb the homeostatic equilibrium of the body, a criticism he makes of the P.G.R.

In the present study the palmar perspiration index was correlated with scores on the Minnesota Multiphasic Personality Inventory and on the Taylor Anxiety Scale. Therefore, a brief review of the literature on these scales is in order. The validity of the M.M.P.I. has been considered in a

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<sup>5</sup> Mowrer et al, op. cit., pp. 231-241.

number of studies<sup>6</sup>, the general conclusion being that the M.M.P.I. is a reasonably valid index of personality factors, provided there is full cooperation from the subjects. Deliberate deception on the part of the subject can easily distort the profile, in spite of the F and K validity scales. For this reason, individual administration is preferable to group administration. The Taylor Scale of Manifest Anxiety<sup>7</sup>, consisting of fifty items from the M.M.P.I., formed the basis of the Taylor Biographical Inventory, which has been used by Taylor and Spence<sup>8</sup> in experimentation concerned with the influence of anxiety on learning. The Anxiety Scale successfully discriminated anxious from non-anxious subjects. Bitterman and Kniffin<sup>9</sup> have used the Taylor scale within the M.M.P.I. to distinguish anxious subjects in an experiment concerned with the influence of anxiety on perceptual threshold.

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<sup>6</sup> C.P. Stone and D.W. Taylor, editors, Annual Review of Psychology, (Stanford: Annual Reviews, Inc., 1950), I, pp. 260-262.

<sup>6</sup> Stone and Taylor, *ibid.*, (1953), IV, pp. 306-308.

<sup>7</sup> J. Taylor, "A personality scale of manifest anxiety", Journal of Abnormal and Social Psychology, 48, 2, pp. 285-290, 1953.

<sup>8</sup> J. Taylor and K. Spence, "Relationship of anxiety level to performance in serial learning", Journal of Experimental Psychology, 44, pp. 61-64, 1952.

<sup>9</sup> M.E. Bitterman and C.W. Kniffin, "Manifest anxiety and perceptual defense", Journal of Abnormal and Social Psychology, 48, 2, pp. 248-252, 1953.

## CHAPTER III

### PROCEDURE AND MATERIALS USED

The subjects for this study were fifteen men and fifteen women, selected randomly as to age and occupation. Care was taken to select persons who had a conscientious attitude toward taking personality tests. Subjects were tested individually.

The first part of the testing procedure concerned the perspiration index. The subject was told that he was to be given an oral intelligence test, made up of selected parts of the Stanford-Binet Scale<sup>1</sup>. An explanation of the testing procedure was given as follows: "The test consists of three parts: (1) you will be given a code system to decipher, after which you are to spell words in the code, without looking at the code system. (2) I will recite series of digits for you to repeat back to me, sometimes forward and sometimes backward, as requested. (3) I will recite orally some disarranged sentences, which you are to put in order and recite back to me. Two perspiration indices will be taken, one just before the test and one during the test. Do not touch your fingers to anything during the time between the two perspiration tests." The technique for taking the perspiration index was then explained to the subject.

The colorimetric technique. Perspiration indices were done according to the Silverman and Powell technique<sup>2</sup>, in addition to the variations

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<sup>1</sup> L.M. Terman and M.A. Merrill, Measuring Intelligence (Boston: Houghton Mifflin Co., 1937), pp.120-21, 276-77, 289, 295, 297, 302.

<sup>2</sup> Silverman and Powell, op. cit.

devised by Gladstone<sup>3</sup> and Light<sup>4</sup>, as follows: The three middle fingers of the hand are painted to the first joint with a solution of anhydrous ferric chloride and chemically pure acetone in the proportions of 13g.  $\text{FeCl}_3$  to 400 cc. acetone, with 3 drops of HCL added as a preservative. This solution dries rapidly. The fingers must be well-coated, though not heavily coated, with the solution. Too little or too much solution will affect the density of the print. A glass applicator is best for applying the solution. When the fingers are dry, they are placed on tannic acid paper on a scales, and one pound of pressure is obtained. It is important that the entire painted area be touching the paper.

The paper used is Dietzgen 198M and is prepared by soaking it for three minutes in a glass dish containing a filtered 5% solution of tannic acid in distilled water.

During the three minutes the fingers are on the scales, the water from the perspiration will dissolve the ferric chloride, which reacts with the tannic acid in the paper to form a stain on the paper. The finger stains may then be measured by use of a densitometer<sup>5</sup>. A light is flashed on the print through a lens opening of a constant size. The amount of light passing through the print is reflected upon a photoelectric cell. The reflected light is measured by an attached microammeter.

During the test concerned with the perspiration index, the experi-

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<sup>3</sup> Gladstone, op. cit.

<sup>4</sup> Light, cited by Mowrer et al, op. cit., p. 230.

<sup>5</sup> Gladstone, op.cit.

menter maintained an austere attitude toward the subject at all times. The Stanford-Binet items were deliberately increased in difficulty in an effort to create the greatest possible amount of tension. The first perspiration index was to indicate the amount of tension felt by the subject while anticipating the test; the second index was to indicate the amount of tension felt by the subject during a stress situation.

After the test was completed, the experimenter explained to the subject that the tests had been increased in difficulty deliberately, in order to create a frustrating situation, and that nobody could be expected to perform the test successfully. Then the subject was told to relax for fifteen minutes, after which time a baseline (normal) perspiration index was taken. This completed the first part of the procedure.

The second part of the test procedure was the administration of the Minnesota Multiphasic Personality Inventory. The group form of the M.M.P.I. was used, but it was given individually. The subject was asked to answer the statements as honestly as possible, and not to take too long on any one item, the assumption being that a spontaneous answer would be a more honest answer.

The M.M.P.I. scales.<sup>6</sup> The M.M.P.I. scales were considered with regard to their implications for normal individuals, and, therefore, shall be described from this standpoint. Nine of the scales were used.

The Hypochondriasis scale (Hs). The hypochondriacal individual is the type who reacts to stress by developing vague pains and disorders having no

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<sup>6</sup> S.R. Hathaway and J.C. McKinley, The Minnesota Multiphasic Personality Inventory and Manual, (The psychological Corp.:New York, 1947).



definite organic basis, in order to gain the sympathy of others. He feels sorry for himself when facing conflict.

The Depression scale (D). A high D score indicates poor morale, extreme introversion, and a lack of self-confidence, especially when under stress.

The Hysteria scale (Hy). The hysteric is the type person who develops actual physical symptoms, such as gastric and intestinal complaints, writer's cramp, or fainting spells, when confronted with emotional problems.

The Psychopathic Deviate scale (Pd). High Pd scores among normal persons indicate an unconventional attitude toward social mores. Depression is frequently experienced by these individuals following discovery of their asocial behavior.

The Paranoia scale (Pa). The paranoid individual is oversensitive, suspicious of others, and easily threatened.

The Psychasthenia scale (Pt). This scale describes the individual with phobias, obsessions, and compulsions. Here is the chronic "worrier", who finds concentration difficult, and who lacks confidence in himself.

The Schizophrenia scale (Sc). A high Sc score indicates a strong tendency to withdraw from reality in the face of conflict. This is the "daydreamer".

The Hypomania scale (Ma). The manic type person has an exaggerated amount of enthusiasm. He is always "on the go" and is forever "stirring up" something. Often he conceals a deeper depression.

The Social Interest scale. A high Si score shows a lack of interest in social group relationships.

The Taylor Scale of Manifest Anxiety.<sup>7</sup> The anxiety scale consists of fifty items on the M.M.P.I. These items were selected from a list of two hundred and twenty-five M.M.P.I. items by a group of clinicians as being most diagnostic of manifest anxiety.

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<sup>7</sup> Taylor, op. cit.

## CHAPTER IV

### RESULTS

In analyzing the results of the study, the first consideration was to see whether there was a significant change in the palmar perspiration level during exposure to the stress situation. Table I shows that the mean baseline "P.I." after stress was 9.18 for the group of thirty subjects, while during stress it was 7.53, an increase of 1.65 during stress. The "t" ratio of this difference is 2.47, which is significant at the .02 level of confidence. The mean baseline "P.I." before stress was 8.35. The difference between this baseline "P.I." and the stress "P.I." was .82, the "t" being 1.19, which is not reliable.

In Table II are given the relationships between anxiety and the three perspiration indices. On the anxiety scale the mean score for the group was 14.50. Taylor found a mean of 14.56 in a group of 1971 students.<sup>1</sup> There was a .56 correlation between the anxiety scale and the baseline "P.I." after stress, which shows a marked relationship between the two factors. The stress "P.I." correlated with the anxiety scale .49, still a definite relationship. There was a low correlation of .24 between the baseline "P.I." before stress and the anxiety scale.

In relating the perspiration indices to the M.M.P.I. scales, there was a division of the subjects into two groups of fifteen each, according to perspiration level. Group I was made up of those subjects on the upper half of the "P.I." scale (heavy perspiration). Group II contained the

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<sup>1</sup> Taylor, op. cit.

TABLE I  
MEANS AND STANDARD DEVIATIONS OF THE  
THREE PERSPIRATION INDICES AND THE  
ANXIETY SCALE (N:30)

	Mean	S.D.	"t" ratio
Anxiety scale	14.50	9.83	
Baseline "P.I." (before stress)	8.35**	2.42	1.19
Stress "P.I."	7.53**	2.84	
Baseline "P.I." (after stress)	9.18**	2.22	2.47*

\* significant at the .02 level of confidence.

\*\* the lower the densitometer reading, the higher the "P.I."

TABLE II

CORRELATIONS BETWEEN THE ANXIETY SCALE AND  
THE THREE PERSPIRATION INDICES (N:30)

"P.I."	Anxiety scale
Baseline "P.I." (before stress)	$r = .24$
Stress "P.I."	$r = .49$
Baseline "P.I." (after stress)	$r = .56$

subjects on the lower half of the "P.I." scale (light perspiration). The grouping was based on the baseline after stress, where there was the highest correlation with anxiety. Due to the large number of subjects having a "P.I." of 10.00, these subjects had to be divided between the two groups.

Table III presents the data on the relationships between the mean "P.I." of each group and the mean scores of each group on the M.M.P.I. scales. The greatest differences were found on the Schizophrenia and the Psychopathic Deviate scales. On the Sc scale the high "P.I." group (Group I) had a mean score of 62.8 (S.D.: 11.3), while the low "P.I." group (Group II) had a mean score of 52.0 (S.D.: 6.32), a difference of 10.8. The "t" ratio for this difference is 3.14, which is well below the .01 level of confidence. On the Pd scale Group I had a mean score of 62.8 also, with a standard deviation of 11.11. Group II again had a mean score of 52.0, with a standard deviation of 7.07. This difference of 10.8 had a "t" of 3.08, which is still well below the .01 level of confidence.

On the Depression scale the high "P.I." group had a mean score of 57.4 (S.D.: 13.09), the low "P.I." group a mean score of 47.7 (S.D.: 5.19). This was a difference of 9.7, with a "t" ratio of 3.78, significant below the .01 level of confidence.

Group I scored a mean of 53.9 (S.D.: 8.66) on the Social Interest scale. Group II had a mean score of 45.2, a difference of 8.7. The "t" of this difference is 2.73, slightly above the .01 level of confidence.

On the Psychasthenia scale the high "P.I." group had a mean score of 59.6 (S.D.: 8.66), the low "P.I." group a mean of 51.0 (S.D.: 7.85), a difference of 8.6, a significant difference at the .05 level, the "t" ratio being 2.42.

The mean Paranoia score of Group I was 56.9 (S.D.: 6.7) and of Group II 52.2 (S.D.: 5.92), a difference of 4.7, which is below the .10 level of confidence, with a "t" ratio of 1.96.

Group I had a mean of 60.9 on the Hypomania scale, with a standard deviation of 11.35. Group II had a mean of 55.1, the standard deviation being 7.75. This difference of 5.8 is not a significant difference.

Differences on the Hysteria and Hypochondriasis scales were not significant. On the Hy scale Group I had a mean of 57.7 (S.D.: 8.12), Group II had a mean of 56.5 (S.D.: 9.58). The "t" ratio here was .36. On the Hs scale Group II had a slightly higher mean, 53.7 (S.D.: 7.48), than Group I, 52.8 (S.D.: 6.29). The "t" on this difference was only .35.

TABLE III  
MEANS, STANDARD DEVIATIONS, AND "t" RATIOS  
OF "P.I." GROUP I (N:15) AND "P.I." GROUP II (N:15)  
ON THE M.M.P.I. SCALES

	Sc	Pd	D	Si	Pt
Group I (high "P.I.")					
Mean	62.8	62.8	57.4	53.9	59.6
S.D.	11.33	11.11	13.09	8.66	10.66
Group II (low "P.I.")					
Mean	52.0	52.0	47.7	45.2	51.0
S.D.	6.32	7.07	5.19	8.42	7.85
"t" ratio	3.14*	3.08*	3.78*	2.73**	2.42***

\* significant at the .01 level of confidence.

\*\* significant at the .02 level of confidence.



TABLE III (cont'd)

	Pa	Ma	Hy	Hs
Group I				
(high "P.I.")				
Mean	56.9	60.9	57.7	52.8
S.D.	6.70	11.35	8.12	6.29
Group II				
(low "P.I.")				
Mean	52.2	55.1	56.5	53.7
S.D.	5.92	7.75	9.58	7.48
"t" ratio	1.96****	1.30	.36	.35

\*\*\* significant at the .05 level of confidence.

\*\*\*\* significant at the .10 level of confidence.

## CHAPTER V

### DISCUSSION

The reliable difference between the baseline level after stress and the frustration level of palmar perspiration in the group of thirty subjects used in this study lends strong support to the perspiration index as a measure of emotional tension. In all but four of the thirty subjects tested there was an increase in perspiration level either during the test or just prior to taking the test, when compared to the baseline level fifteen minutes after the test was completed. These four exceptional subjects all had anxiety scores below the mean, and three of them had very low scores on the M.M.P.I. scales. Therefore, it would seem that they were not threatened by the test situation.

Seventeen of the subjects showed a perspiration increase just before taking the test. This was evidently an "anticipation sweating". In fact, four of the subjects had a heavier sweat before the test than during the test. They were evidently more tense while anticipating the test (expecting the worst) than while taking it.

It was felt that the baseline measure taken fifteen minutes after the end of the test may not have been a baseline for all the subjects. Some might not have been completely relieved of tension within that short a time. A longer time interval might have produced lower baseline levels, making a greater difference between the baseline "P.I." and the stress "P.I." Also, if the period of anticipation had been longer, the "P.I." before stress might have been higher.

It is possible that there are physiological differences among individuals as to perspiration level. There were three subjects for whom there

seemed no other explanation than this. One of these individuals had a high "P.I.", but showed no change at any time. On both the Anxiety scale and the M.M.P.I. her scores were among the lowest in the group. The other two subjects had low "P.I.'s", again with little or no change, although they were visibly nervous during the test. They had very high M.M.P.I. scores. It is possible that these individuals have some other means of releasing tension than "sweating it out".

It was interesting to note that the heavy sweaters did not have a significantly greater increase in sweating due to stress than did the light sweaters, the mean difference between the two groups being only .23. In several cases low "P.I." subjects showed greater increases than any of the high "P.I." subjects. These might be persons who are ordinarily calm, but experience "normal" anxiety when exposed to stress situations. Here may be one of the important aspects of the perspiration index. If it is a sufficiently sensitive measure, it might be a means of predicting an individual's frustration tolerance.

These exceptional cases had a great effect upon the correlation between the perspiration index and the anxiety scale. Also, the lack of a correction factor for the anxiety scale allowed some subjects with high K scores on the M.M.P.I. to show a low level of anxiety, and, therefore, having anxiety scores far out of line with their M.M.P.I. scores. Considering these influences upon the correlation coefficient, as well as the high chances for error in both the "P.I." measure and in personality inventories, the .56 correlation is high indeed.

The purpose of using the M.M.P.I. in the study of the palmar perspiration index was to attempt to find trends toward a personality pattern that

could be linked with heavy perspiration. For this reason the subjects with high "P.I.'s" (Group I) were compared with those with low "P.I.'s" on the M.M.P.I. scales. Some very reliable differences in scores revealed interesting personality differences between the two groups. The high "P.I." group showed much stronger neurotic tendencies on the M.M.P.I. than did the low "P.I." group.

To try to establish a definite cluster of personality factors for the high "P.I." group would be beyond the scope of this study. However, an attempt was made to reconcile the factors on which the high "P.I.'s" were significantly different from the low "P.I.'s". Their high Schizophrenia score indicates that they are highly introverted persons, who tend to keep conflicts within themselves. This seems reasonable, since palmar sweating is a means of releasing tension in a way that is not easily visible to others. Their lack of interest in social relationships, indicated by their high Social Interest score, probably means that they are easily threatened by social pressure. The high Depression score reveals a lack of self-confidence and poor morale, which would certainly contribute to a feeling of anxiety in facing problem situations. The high Psychasthenia score, which is correlated with a high Schizophrenia score on the M.M.P.I., shows fearfulness, accompanied by tension. This fearfulness must find some release, probably through some involuntary sympathetic channel such as palmar sweating. Their rather high Paranoia score implies a tendency to be oversensitive and easily threatened by frustrating experiences.

The high Psychopathic Deviate score seems at first incongruous with the other trends. Since this was a normal group, the high Pd score may be interpreted to mean that the persons have asocial, unconventional attitudes

and/or behavior. Such attitudes and behavior might result in strong guilt feelings, which, in turn, would bring about feelings of anxiety. By this interpretation, the Pd score could be reconciled with the other high scores of the high "P.I." group.

It was interesting to find that on the Hypomania (Ma), Hysteria (Hy), and Hypochondriasis (Hs) scales there were no significant differences between the two groups. On these three scales the low "P.I." group made its highest scores. This data seems very significant, in view of the nature of these scales. Manic tendencies are associated with outward expressions of anxiety - activity and emotional display. Hypochondriacal and hysterical symptoms are characteristically accompanied by a low degree of anxiety, the anxiety having been converted into the symptoms. It seems likely that persons with these neurotic tendencies would have a low level of palmar perspiration, since they have found other ways of releasing tension - namely, through outward emotional expression or through somatic symptoms. Individuals who have not developed such means of getting rid of their anxiety have to release tension in some way, probably through an involuntary sympathetic channel such as palmar perspiration. These, then, are the individuals who have devised no satisfactory solution to their conflicts.

## CHAPTER VI

### SUMMARY AND CONCLUSIONS

This study concerned the palmar perspiration index as a measure of emotional tension, with an investigation of its relationship to anxiety and personality factors.

Perspiration indices were taken from thirty subjects, heterogeneous as to age and occupational background, under normal and stress conditions. The colorimetric technique was used in recording the perspiration indices, which were then measured on a densitometer. An experimentally produced stress situation was used in obtaining a stress perspiration level. The Taylor Scale of Manifest Anxiety, consisting of fifty items on the Minnesota Multiphasic Personality Inventory, was used to rate anxiety of the subjects. The anxiety scale scores were correlated with three perspiration indices - "before stress", "during stress", and "after stress".

It was found that there was a .56 correlation between anxiety and the "after stress" perspiration index. There was a .49 correlation between anxiety and the "stress" perspiration index. The stress level was significantly greater than the level after stress (.01 level of confidence).

The Minnesota Multiphasic Personality Inventory was administered to each of the subjects individually. M.M.P.I. scales used were the Schizophrenia, Psychopathic Deviate, Depression, Psychasthenia, Paranoia, Social Interest, Hysteria, Hypomania, and Hypochondriasis scales.

The subjects were divided into two groups, according to perspiration level. The fifteen subjects on the lower half of the perspiration scale (heavy perspiration) and the fifteen on the upper half (light perspiration)

of the scale were compared as to differences in scores on the M.M.P.I. The high "P.I." group was found to have significantly higher scores than the low "P.I." group on the Schizophrenic, Social Interest, Depression, Psychasthenia, Psychopathic Deviate, and Paranoia scales. There were no significant differences between the two groups on the Hypomania, Hysteria, and Hypochondriasis scales. The high "P.I." group had a much higher number of scores above 70 on the nine scales.

It was concluded that the palmar perspiration index is a reliable measure of emotional tension due to exposure to a stress situation. However, there may be physiological differences in some individuals as to perspiration level. Baseline level of palmar perspiration was concluded to be related markedly to the presence or absence of manifest anxiety.

Persons with high levels of palmar perspiration are more likely to show neurotic tendencies than are persons with low levels. In general, the high "P.I." individual tends toward extreme introversion, seclusiveness, asocial attitudes and/or behavior, feelings of insecurity, lack of self-confidence, and oversensitiveness. These are all associated with anxiety. This type person is less likely to show manic tendencies or hysterical and hypochondriacal symptoms.

Hysteria, Hypochondriasis, and Hypomania are the most likely neurotic tendencies to be found in persons with low perspiration levels. Such symptoms, to some extent, give relief from anxiety, and, therefore, eliminate the need for releasing tension through palmar sweating. Hence, it was concluded that persons with low perspiration levels probably have found other satisfactory means of getting rid of their anxiety, while persons with high perspiration levels have not been able to do so.

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