THE EFFECTS OF A STRESSOR ON A SPECIFIC MOTOR TASK ON INDIVIDUALS DISPLAYING SELECTED PERSONALITY FACTORS

A Dissertation Presented to

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In Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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by

Elizabeth Yeckel Brown

August, 1973

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An Abstract of a Dissertation

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the Faculty of the College of Education

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ABSTRACT

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Purpose of the Study:

The purpose of the study was to identify selected personality traits essential for success in a stressful environment while performing a simple motor task. It was within this premise that a person possessing particular personality traits would be successful in spite of any extenuating distractor. The two personality traits investigated were emotional stability and self-confidence. Being highly skilled in a particular area can only account for a portion of success. Having the psychological components still adds another measure to becoming a successful performer.

Procedure:

The subjects for this study were selected from the San Jacinto (junior) College's Women's Physical Education program. The Cattell 16 Personality Factor Inventory was administered. Students with high (sten 7 or higher) or low (sten 4 or lower) Factor of C or O were randomly selected for this study and randomly placed in a control or experimental group. A separate sample for Factor C and O was selected with students meeting criteria for inclusion in both groups being

randomly placed in one subject pool. A pilot study conducted by the investigator indicated that a tape recording of noises such as gun shots, whistles, horns, symbols and metal dropping acted as a significant stressor. The performance measured was a hand-eye coordination task on a rotor pursuit apparatus.

After administering the 16 PF to 195 students and randomly selecting subjects who met criteria for the study, subjects performed on the rotor pursuit apparatus. Subjects in the control group executed fifteen-ten second trials on the rotor pursuit. The experimental group performed the same task except during each trial noises from a tape recorder were presented. The total testing time for each subject was eight minutes. The score for each trial was recorded.

The data were treated using a three factor mixed design with repeated measures. This allowed the investigator to study not only the relationship of personality on performance under stress, but repeated measures were considered to determine whether there were any effects during the treatment. This design permits not only the evaluation of the overall experimental effects, but also the evaluation of general changes and interactions of the variables during performance.

Findings:

The results of this study showed that selected personality factors were identifiable when performing a simple motor task in a stressful environment. Subjects with a high self-confidence or emotional stability trait out performed those subjects low in self-confidence or emotional stability whether performing under stress or not. Stress had a positive affect on the emotionally stable group as well as the self-confidence group.

Conclusions:

It was found in this study that the traits of self-confidence or emotional stability have a relationship to successful performance. The subjects high in self-confidence or emotional stability were unaffected by the stressor when compared to the subjects low in self-confidence or emotional stability.

While other subordinate conclusions were drawn, the major generalization was as follows: coaches and educators should consider very carefully the need for having players who possess self-confidence and emotional stability, and if these characteristics are not present, provide experiences to develop them. Coupled with skill, these two traits should add to the overall success of an athlete.

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CHAPTER I

INTRODUCTION

The psychological factors that enter into performance of physical education activities and sports events have held increasing attraction to physical educators for the past two decades. More attention is being placed on understanding the various human dimensions of the individual engaging in motor activity. How an individual reacts in given situations is reflected by socio-psychological influences. His activity is social-oriented when performing in the presence of others. Everyday activities are often performed in various environmental situations, which may facilitate or inhibit performance depending on personality structure of the individual.[1]

Personality has the potential for explaining the motivations for those engaging in sport. There are certain aspects of personality believed intensified in the activity experience making them particularly appropriate for study of physical education.[2] Certain sports may be chosen by an individual to participate in to satisfy his unique needs. It is also believed that people choose particular sports because of their personalities as well as change them because of experience in

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[1]Robert N. Singer, Motor Learning and Human Performance (New York: The MacMillan Company, 1968), p. 298.

[2]L. B. Hendry, "Some Notions on Personality and Sporting Ability: Certain Comparisons with Scholastic Achievement," Quest, XIII (January, 1970), p. 67.

these activities.[3]

Certain combinations of personality traits have been shown to be predictive of performance on motor tasks and various athletic endeavors. More and more coaches are attempting to understand the personalities of athletes for whom they are responsible. These coaches not only observe the obvious performance characteristics of their players, but also look more closely to discover how the players feel about sports participation, how they react to stresses of various kind and how they behave in situations other than those faced on the athletic field.[4]

The environment in which a person performs is filled with various distractors. Some of these distractors are of a stressful nature. These stressors may be defined as a temporary induced physiological or psychological imbalance, caused by an event occurring in the environment. Task inefficiency may be a result of a particular kind of event or situation. Investigators have found stress to be an intervening variable between the situation and the performance. They have also found that one situation may be stressful to one individual but will have no effect on the second. It has also been found that reactions to stressors take different forms. Studies involving stress must take into account the type of stressor and the manner in which performance is affected under stressful situations.[5]

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[3]Singer, op. cit., p. 303.

[4]Bryant J. Cratty, Psychology and Physical Activity (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1968), p. 20.

[5]Bryant J. Cratty, Movement Behavior and Motor Learning (Philadelphia: Lea & Febiger, 1964), p. 169.

The degree of proficiency in the skill when stress is introduced and the difficulty of the task are important factors in determining the effects of stress. Some investigators have reported that the introduction of stress facilitates performance, others found decrements in performance while others found no specific effect on performance. Previous research also indicates that individuals differ markedly in emotions responsive to stressful situations.[6]

Guilford considers the total personality and breaks it down into modalities and shows how each modality interacts to compose the personality. "There are two kinds of somatic traits, morphological and physiological. Traits of morphology are those relating to structure of feature, such as height, weight, and coloring. Traits of physiology relate to organic functions, such as heart rate, basal metabolic rate, and body temperature. The motivational modality takes on the needs, interests and attitudes. The aptitude modality is basically concerned with the ability to perform at given tasks. The temperament modality deals with the make up or disposition of the individual."[7]

Since each modality of personality is so complex in itself, investigators have preferred to take one aspect of personality and study its relationship to the total domain.[8]

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[6]Rainer Martens and Daniel M. Landers, "Effect of Anxiety, Competition and Failure on Performance of a Complex Motor Task," Journal of Motor Behavior, Vol. 1 (1969), p. 3.

[7]J. P. Guilford, Personality, (New York: McGraw-Hill Book Co., Inc., 1959), p. 7.

[8]Lucile Kaufman, "Recommendations for Study of Personality Traits," Journal of Abnormal and Social Psychology, Vol. 32 (1937), pp. 446-447.

Statement of the Problem

The teacher of motor skills is concerned with the improvement of increasing students' performance. Recent personality studies have identified personality variables that relate to performance and learning in selected sport skills. It is the interest of this investigator to identify which personality traits interact with performance under stressful conditions. The problem arises to identify personality traits essential for success, produce a stressful environment, and evaluate the performance.

Research Hypothesis

The underlying research hypotheses for this study are:

1. A person affected by feelings, (emotionally less stable, easily upset)will perform differently under stress as a person emotionally stable (faces reality, calm, mature).

2. An apprehensive (self-reproaching, worrying, troubled) person will perform differently under stress as a self-assured, (serene, confident) person.

Need for the Study

Determining personality characteristics which may have a relationship to athletic performance is a relatively new approach to physical education. A great amount of work has been accomplished in this personality area by Thomas A. Tutko and Bruce C. Ogilvie and Leland Lyon at the Institute for the Study of Athletic Motivation at San Jose State College. Upon investigation, it was found that a number of personality traits related to high athletic achievement have

been determined. Traits related to personality are divided into areas of emotional factors and desire factors. The emotional factors involve how a person is affected by feelings and the confidence which the players have in themselves. The desire factors relate to one's willingness to work toward accomplishing goals.

The social environment plays an important role in learning. Students frequently learn or perform skills in the presence of stressful distractors. These include the presence of other students, teachers or strangers, other physical activities, noises and interruptions to name only a few.[10] Empirical evidence indicates that some individuals do not perform well in the presence of spectators.[11] Some individuals are not affected or perform better in spite of these stressful distractors.[12]

An understanding of the psychological stress upon performance is of great theoretical and practical importance. People often are faced with the necessity of performing a skill under conditions which are highly stressful. It would seem most useful to be able to predict which people would be adversely affected by a stressful situation and those that are not affected adversely while performing a motor task.

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[9]Thomas Tutko and Jack Richards, Psychology of Coaching (Boston: Allyn and Bacon, Inc., 1972), p. 42.

[10]R. S. Lazarus, J. Deese and S. J. Osler, "The Effects of Psychological Stress upon Performance," Psychological Bulletin, Vol. 49 (1952), p. 295.

[11]Rainer Martens and Daniel M. Lancers, op. cit., p. 4.

[12]Robert N. Singer, "Effects of an Audience on Performance of a Motor Task," Journal of Motor Learning, Vol. 2, (1970), p. 88.

Personality information has many practical applications to athletics. Some of these are:

> "1. A provision of a better understanding of an individual's behavior tendencies. This information can be used to predict behaviors and to eliminate situations that will produce undesirable behaviors.
>
> 2. Coach-player interactions can be better effected by producing situations which will eliminate undesirable consequences.
>
> 3. From the above two statements, it can be asserted that player manipulation may be improved to the extent of trying to maximize training and competitive performance and participation. This would lead to a rise in the efficiency of the training system or program.
>
> 4. If a relationship between personality and physical performance exists, one could differentiate, for selective purposes, between players of equal skill.
>
> 5. Repeated testing of players gives an indication of change in athletes. The coach can then readjust his player and control procedures to these changes."[13]

Thus personality information provides a better understanding of an individual and can be used advantageously for the control of behavior. It gives some indication of individual differences and behavior tendencies within the group. This information can be used for developing motivation and desirable attitudes.

Limitations of the Study

1. The subjects were collegiate females at one school.

2. Noises taped on a recorder was used as a stressor.

3. The Cattell 16 PF was used to determine the classification of the subjects.

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[13] Brent S. Rushall, "Some Practical Applications of Personality Information to Athletes," Contemporary Psychology of Sport, ed. Gerald S. Kenyon (Chicago: The Athletic Institute, 1970), p. 167.

4. The investigation was only concerned with two trait factors.

Definition of Terms

For the purpose of this study, the following terms are defined:

16 PF: Cattell's Sixteen Personality Factor Inventory.

Emotional arousal: Those conditions in which ones "normal" physiological functions have been intensified.[14]

Factor C: "Affected by feelings emotionally less stable, easily upset vs. emotionally stable, faces reality, calm, mature. The person who scores low on Factor C tends to be low in frustration tolerance for unsatisfactory conditions, changeable and plastic, evading necessary reality demands, neurotically fatiqued, fretful, easily annoyed, active in dissatisfaction, having neurotic symptoms. Low Factor C score is common to almost all forms of neurotic and some psychotic disorders.

The person who scores high on Factor C tends to be emotionally mature, stable, realistic about life, unruffled, possessing ego strength, better able to maintain solid group morale. Sometimes he may be a person making a resigned adjustment to unsolve emotional problems.

Factor O: Placid, self-assured, confident, serene vs. apprehensive, worrying, depressive, troubled. The person who scores low on Factor O tends to be placid, with unshakable nerve. He has a mature, unanxious confidence in himself and his capacity to deal with things. He is resilient and secure, but to the point of being insensitive of when a group is not going his way, so that he may evoke antipathies and distrust.

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[14] Joseph B. Oxendine, "Emotional Arousal and Motor Performance," Quest, Vol. 13 (1970), p. 24.

The person who scores high on Factor O tends to be depressed, moody, a worrier, full of foreboding, and childlike anxiety in difficulties. He does not feel accepted in groups or feel free to participate."[15]

Modality: Class of traits.

Personality traits: A mental structure, an inference that is made from observed behavior to account for regularity or consistency in this behavior.[16]

Personologist: One who studies the person and is concerned with all the behavior of a person and not with some limited aspect of it.

Personology: Study of the person.

Personality test: Instrument used to measure one's personality traits.

Stress: A temporarily induced physiological or psychological imbalance caused by an event considered threatening by the organism.[17]

Stressor: Any disease, infection or injury, fatigue, aging, thirst, pain, as well as frustration and threat.[18]

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[15]Raymond B. Cattell and Herbert W. Ebor, Manual for Forms A and B Sixteen Personality Factor Questionnaire (Champaign: Institute for Personality and Ability Testing, 1962), pp. 3-6.

[16]P. James Gewitz, Non-Freudian Personality Theories (Belmont: Brooks/Cole Publishing Company, 1969), p. 49.

[17]Bryant J. Cratty, Movement Behavior and Motor Learning (Philadelphia: Lea & Febiger, 1964), p. 172.

[18]Hans Selye, The Stress of Life (New York: McGraw-Hill Book Co., Inc., 1956), p. 325.

CHAPTER II

REVIEW OF THE LITERATURE

The review of pertinent literature is divided into three areas: (1) Studies related to personality which include Cattell's personality theory; a description, reliability, validity of the Cattell 16 PF; and the determination of Factors C and O. (2) Studies related to stress and personality. (3) Studies validating the use of heart rate as an index of stress.

Studies Related to Personality

Tutko and Richards have established that performance under stressful conditions is an important problem facing educators. Certain distracting situations, such as stress, may benefit, disrupt or have no effect on a particular individual. Participation in physical activities present stressful situations. Distracting factors are interwoven in every performance based situation. Since each individual reacts differently in a given situation, it would be advantageous to find out which personality traits are needed to achieve success in physical activity when under stress.[19]

Successful athletes are composed of a select group uniquely activated to compete. This elite group shares a common bond of being skillfully talented. Coupled with this, many share certain traits that are indicative of athletic success. The combination of physical talent and

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[19]Tutko, op. cit., p. 42.

desirable personality traits make possible the selection of those athletes most likely to succeed in high levels of competition. It must also be considered that different sports have different requirements which in turn make special demands on particular athletes.[20] Few coaches or athletes would deny that personality is a factor of crucial significance in achieving athletic success (winning).[21]

Cofer and Johnson found that "in personality, champion athletes are a special breed and that in the last analysis, personality is the vital factor in the discriminating process which singles out the champions from amongst those who seem to have similar physical gifts."[22]

Steinhouse conjectures that self-confidence is essential for winning and should be developed early. If the young participant can develop this early, his success will be more apparent. It is with this knowledge that player and coach can work together to develop this trait needed for success.[23]

Because of the knowledge of certain personality traits becoming an indicator of superior performance in various athletic endeavors, more and more coaches are administering personality tests to their professional teams to identify the best winning combination. Players will react differently to success and failure. As a result coaches must

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[20]Tutko, Psychology of Coaching, p. 41.

[21]Walter Kroll and Kay H. Peterson, "Personality and Factor Profiles of Collegiate Football Teams," Research Quarterly, Vol. 37 (1965), p. 350.

[22]C. Cofer and W. R. Johnson, Science and Medicine of Exercise and Sport, (New York: Harper Bros., 1960), p. 18.

[23]Arthur M. Steinhaus, "Fitness Beyond Muscle," Journal of Sports Medicine and Physical Fitness, Vol. 6 (1966), pp. 191-197.

know how to handle each player when this occurs. Personality does not develop in a vacuum. Every situation the player faces contributes to his personality.[24]

Two traits that have been found to be necessary in athletic situations have been selected for investigation. They are the stability and confident factors. Crandal studied the predictability value of a trait when knowledge about a given trait is used to predict actual behavior. In this study ninety-eight graduate and undergraduate students from two universities participated pertaining to the predictive value of traits and their importance. Measures of predictive value consisted of subjects rankings of traits for their utility in predicting the behavior of others and the number of times a trait was found useful in inferring other traits. The predictive value of a trait was found to be significant at the .05 level.[25] Kaufman also recommends the study of individual traits and the predictive value of the trait.[26]

Cattell's Personality Theory

Cattell is known for his trait theory of personality. He views personality as a predictive one of what a person will do in a given situation. His theory is concerned with all behavior both overt and internal. According to Cattell, the goal of personality theory is to formulate laws which enable the predicting of behavior under many

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[24]Cratty, op. cit., p. 16.

[25]James Crandell, "Predictive Value and Confirmability of Traits as Determinants of Judged Trait Importance," Research Quarterly, Vol. 38 (1970), p. 77-91.

[26]Lucile Kaufman, "Recommendations for Study of Personality Traits," Journal of Abnormal and Social Psychology, Vol. 32 (1937), pp. 446-449.

conditions to take place. All of Cattell's interest in personality theory and the dynamics have grown out of the findings of continuous research rather than speculation writings. Trait is the most important of Cattell's concept. There is a common trait shared by all individuals with the same social experiences. Also there are unique traits that apply to a particular person that no one else shares. Only Cattell's theory has relatively unique traits that derive from a slightly different arrangement of the elements making up the trait and intrinsically unique traits of which an individual possesses a genuinely different trait which is possessed by no other person. Surface traits are overt variables that go together. They are produced by the interaction of source traits and are less stable factors. One makes generalizations from observed behavior. These surface traits appeal to the common sense because they are determined by simple observation. Source traits are underlying variables which determine and explain human behavior. They are determined by means of factor analysis. Cattell considers source traits to be more important than surface traits. There are fewer of them and they are the real structural influences underlying personality and prove to have the most utility in accounting for behavior. It is from these source traits that Cattell has constructed his personality test the 16 PFI for measuring personality.[27]

Description, Reliability and Validity of the Cattell 16 PFI

Because the Cattell 16 PFI was developed by factoring out the

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[27]Hall, op. cit., pp. 396-397.

independent traits that an individual possesses, specific traits of an individual may be studied independently of the total personality. The instrument covers a wide range of personality dimensions. They include the following sixteen factors: Factor A, reserved vs. outgoing; Factor B, less intelligent vs. more intelligent; Factor C, affected by feelings vs. emotionally stable; Factor E, humble vs. assertive; Factor F, sober vs. happy-go-lucky; Factor G, expedient vs. conscientious; Factor H, shy vs. venturesome; Factor I, tough-minded vs. tender-minded; Factor L, trusting vs. suspicious; Factor M, practical vs. imaginative; Factor N, Forthright vs. shrewd; Factor O, self-assured vs apprehensive; Factor Q_1 conservative vs. experimenting; Factor Q_2, group-dependent vs. self-sufficient; Factor Q_3, undisciplined self-conflict vs. controlled; and Factor Q_4, relaxed vs. tense. This instrument is appropriate for persons sixteen years through adult life and may be administered to groups or individuals. Split half reliability coefficients range from .71 to .93 and validity coefficients range from .72 to .96.[28] The sixteen dimensions of this personality inventory are independent having very little correlation between each other. Therefore, having a given score on one factor does not affect the person's score on any other. As a result, each of the traits gives a different view about the person.

Determination of Factors C and O

It has been suggested that participation in athletic competition favorably influences personality development and that physical educators and coaches should become more knowledgable about personality traits of

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[28] C. J. Adcock, Fifth Mental Measurement Yearbook, ed. Oscar Krisen Buros, (Highland Park, New Jersey: The Gryphon Press, 1964), pp. 196-199.

highly skilled athletes. Such information should enable those individuals responsible for the training and development of athletes to construct a better environment conducive to appropriate personality development and athletic success.[29]

At the Institute for Study of Athletic Motivation at San Jose State College it was demonstrated that a certain personality type was needed for success in sports. These personality components included how a person was affected by feelings and the confidence one has in himself.[30] The following studies support the value of trait Factors C and O of the 16 PF as a need for success in physical activity.

Biddulph, using the California Personality Inventory studied sophomore and junior high school boys and found that high level athletic groups had greater self-adjustment than the lower level group.[31] Derian using a devise projective method found high school football players to be less self-conscious and had less feelings of inferiority than non-athletes.[32]

Kane using the 16 PF compared male college physical education majors to non-majors and found that the majors were more extroverted, happy-go-lucky and toughminded, outgoing, venturesome, self-controlled

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[29]Singer, op. cit., p. 302.

[30]Tutko, op. cit., p. 43.

[31]Lowell G. Biddulph, "Athletic Achievement vs. The Personal Adjustment of High School Boys," Research Quarterly, Vol. 29 (1964), pp. 18-19.

[32]A. S. Derian, "Some Personality Characteristics of Athletes, Unpublished Master's Thesis, University of California, Berkeley, 1947.

and less anxious than other college students.[33] Kroll and Peterson using the 16 PF to study winning and losing football teams and the relationship to personality found the winning team members more intelligent, venturesome, confident and possessed greater self-control than the members of losing teams.[34] Diamond found football players to be more self-confident and assured when compared to other activity groups of junior college students.[35] Nelson and Langer using the 16 PF to compare football players to a normative sample found varsity football players had greater emotional stability, were more venturesome, self-assured and self-disciplined and had the ability to control anxiety.[36]

> "The major physiological variable relevant to performance was anxiety, and it produces differential performance effects . . . Poorer players showed either higher anxiety in both stress and non-stress test situations and/or allowed anxiety to get out of control."[37]

Using the 16 PF, Heusner compared forty-one British and American Olympic champions in various sports with the norm of the 16 PF. It was found that the champions were more emotionally stable, assertive,

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[33]John E. Kane, "Personality Profiles of Physical Education Students Compared with Others," Proceedings of International Congress of Psychology of Sport, Rome, 1965.

[34]Walter Kroll and Kay H. Peterson, "Personality and Factor Profiles of Collegiate Football Teams," Research Quarterly, Vol. 31 (1965), p. 12.

[35]A. G. Diamond, "Personality Traits in Relation to Physical Activity of Junior College Students," Unpublished Master Thesis, University of California, Berkeley, 1950.

[36]D. O. Nelson and P. Langer, "Some Psychological Implications of Varsity Football Performance," Coach and Athlete, (1966), pp. 23-25.

[37]Ibid., p. 24.

venturesome, confident and assured than the norm.[38] Kane found six areas directly related to the relationship of athletic participation and/or achievement and personality structure:

"I. High positive relationship between motor ability and emotional stability in 13 - 16 year old males.

II. Extraversion related positively to athletic skill and motor achievement.

III. Athletes tend to be toughminded, reserved and cool.

IV. Athletes tend toward free thinking and experimentation.

V. Athletes tend to have abstract rather than concrete intellectual abilities.

VI. Athletes are characterized by ruthlessness, shrewdness and persistence."[39]

Ogilvie found upon completed research that:

> "The male competitor is basically an emotionally healthy person who tends toward extraversion. He is toughminded, self-assertive, self-confident with a high capacity to endure the stress of high level competition . . . when the male competitor moves up the success ladder from amateur to professional, most of these traits intensify."[40]

Nibblock, using high school girls, found that athletes showed more ascendency, sociability, emotional stability and intelligence when compared to the non-athletes. The Guilford Zimmerman Test was used.[41]

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[38]F. M. Heusner, "Personality Traits of Champions and Former Champion Athletes," Unpublished Research Paper," University of Illinois, 1952.

[39]John E. Kane, "The Description of Sports Ability by use of the 16 PF," Paper read at the British Psychological Society Conference," Swansww, England, 1966.

[40]Bruce C. Ogilvie, "Psychological Consistencies with Personality of High Level Competitors," Journal of American Medical Association, Vol. 38 (1968), p. 8.

[41]A. G. Nibblock, "Personality Traits and Intelligence Level of Female Athletes and Non-participants from McNall High School," Unpublished Master Thesis, University of Washington, 1967.

Ogilvie completed a cross-sectional study using ten to fourteen year old swimmers of the Santa Clara Swim Club. He used the 16 PF. The following summarizes the findings and conclusions of his study:

> "There seems to be a tendency for competitive girl swimmers to become less reserved as they move up the competitive ladder, or less outgoing are eliminated.
>
> Competition increases emotional stability, or less emotionally stable are driven out of competition.
>
> Highly assertive become slightly less under the discipline of coaching, or more assertive girls are weeded out.
>
> Seems to be a dramatic change in conscience development as they move up, or a process of elimination occurs.
>
> Become more toughminded and no nonsense or they must get tough or drop out.
>
> More shrewd, calculating and worldly.
>
> Shift from extreme apprehension and worry to self-assurance and self-confidence. Weeding out or building of character.
>
> Shifting toward self-control and self-discipline.
>
> Reduction of tension and anxiety, or child of highly anxious type cannot stand pressure."[42]

Using college age students, Black used the MMPI to predict the most athletic college females. She found the most athletic were more masculine, confident, had more energy and were less self-conscious.[43]

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[42]Bruce C. Ogilvie, "Psychological Consistencies with Personality of High Level Competitors," Journal of American Medical Association, (1968), pp. 7-8.

[43]J. D. Black, "Results of Female College Students: Basic Reading on the MMPI," Health and Fitness in the Modern World, Athletic Institute, 1961.

Kane and Callaghan compared national tennis players to international players using the 16 PF. They found the world class players possessed greater emotional stability, self-confidence and low frustration.[44] Ogilvie studied selected college women varsity swimmers on the 16 PF and found them to be more reserved, tough-minded, emotionally stable, assertive and self controlled than the norm.[45]

> "It seems reasonable, therefore, that parental and educational emphasis be placed upon the following traits if our concern is with the development of physical excellence; emotional stability, tough-mindedness, conscientiousness, controlled self-discipline, self-assurance, relaxed, low tension level, trusting free of jealousy, and for males, increased out going personality."[46]

Mushier in a cross-sectional study of lacrosse players ranging from junior high teams to national teams using the 16 PF found the total competitive lacrosse group was characterized as more reserved, intelligent, assertive, happy-go-lucky, toughminded and experimenting than the norm.[47]

Cooper made a review of the literature concerning the relationship between athletics and various personality factors. General conclusions were as follows. Athletes are:

"1. More outgoing and socially confident.

2. More outgoing and socially aggressive, dominant and leading.

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[44]John E. Kane and John Callaghan, "Personality Traits of Tennis Players," British Lawn Tennis, (1965), p. 32.

[45]Ogilvie, op. cit., p. 12.

[46]Ibid., p. 14.

[47]Carole L. Mushier, "A Cross Sectional Study of the Personality Factors of Girls and Women in Competitive Lacrosse," Unpublished Doctoral Dissertation, University of Southern California, 1970.

3. Higher in social adjustment as rated by both teachers and peers. Higher in prestige and social status and self-confidence.

4. Stronger competitors.

5. Less anxious and more emotionally stable.

6. Less compulsive.

7. Greater tolerance for physical pain.

8. Lower feminine interests and higher masculine ones."[48]

Malumphy using college women found that team and team individual participants were more alike when compared to individual participants and gymnasts. She found that each sport area had its own unique characteristics that differed from any other group.[49] Peterson studied United States Olympic women and also found a difference between individual and team sport participants. The individual participants were more dominant, venturesome, self-sufficient, experimental and introverted while the team sport participants were toughminded and shrewd.[50]

Studies Related to Motor Performance Under Stress

The effects of psychological stress on the organism during learning and performance of motor skills are far from clear. The degree of

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[48]Lowell Cooper, "Athletics, Activity and Personality: A Review of the Literature," Research Quarterly, Vol. 40 (1969), pp. 17-32.

[49]Theresa Malumphy, "Personality of Women Athletes in Inter-Collegiate Competition," Research Quarterly, Vol. 39 (1968), pp. 610-620.

[50]Sheri L. Peterson, Jerome C. Weber and William W. Trousdale, "Personality Traits of Women in Team Sports vs. Women in Individual Sports," Research Quarterly, Vol. 38 (1967), pp. 686-690.

proficiency in the skill when stress is introduced and the relative difficulty of the task are important factors on the effects of stress. Some investigators have reported that the introduction of stress facilitates performance, others found decrements in performance while others found no significant effect on performance. Previous research also indicates that individuals differ markedly in emotions responsive to stressful situations. Knowing which individuals perform better under stressful conditions would be a great aid.

The response to stressful situations varies with the particular motor task. Different tasks require different levels of stress for most effective performance. This arousal state varies from person to person. "According to the Yerkes-Dodson Law, complex tasks are performed better when one's drive is low while simple tasks are performed better when drive is high. Therefore, drive which is either too great or too low for a particular task may result in impaired performance. It is assumed here that drive is somewhat related to motivation or arousal or stress."[51]

Carron found that the effects of high emotional arousal appeared to have greater detrimental effects on tense or highly anxious persons when compared to those less anxious. A shock stressor was used to determine its effect on students performing on a balancing task. The shock stressor had a detrimental effect on high anxious male students whereas low anxious students were unaffected. Carron concluded that in tasks of

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[51]Joseph B. Oxendine, "Emotional Arousal and Motor Performance," Quest, Vol. 13 (1970), p. 24.

low difficulty, high anxious students were found to be superior to low anxious students. However, in tasks of high difficulty, low anxious students proved superior. Stress also plays an important role when students are unacquainted with a particular activity. Low anxious students proved to be superior when performing a new task.[52]

Bergstrom reported that experienced airplane pilots performed less effectively on a complex motor task during stressful conditions. The stressful condition used was distracting flashing lights. It was found that the human pilot can perform extremely difficult and complex tasks in a calm laboratory situation. When the system is airborne, however, the pilot's performance seriously deteriorates as a result of the stress.[53]

Martens and Landers used the Manifest Anxiety Scale to determine the effect of anxiety on learning and performance. Competition and failure were the two stressors used. Students low in anxiety performed significantly better than those high in anxiety during the initial learning of a complex motor task. No difference was found between subjects once the task was well learned.[54] Back, Wilson, Bogdnoff and Troyer found that the newness of an activity in the presence of

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[52]A. B. Carron, "Complex Motor Skill Performance Under Conditions of Externally Induced Stress," Master of Arts Thesis, University of Alberta, 1965.

[53]B. Bergstrom, "Complex Psycho Motor Performance During Difficult Levels of Experimentally Induced Stress in Pilots," Emotional Stress (New York: American Eiserier Publishing Co., 1967).

[54]Rainer Martens and Daniel M. Landers, "Effect of Anxiety, Competition, and Failure on Performance of a Complex Motor Task," Journal of Motor Behavior, Vol. 1 (1969), pp. 1-10.

observers produced stress.[55]

In Lazarus, Deese and Osler's study, it was found that an understanding of the effect of psychological stress upon skilled performance is of great theoretical and practical importance. People are often faced with the necessity of performing skilled work under conditions which are highly stressful. Such is obvious in athletics. On the other hand, it would be most useful to be able to predict which people will be adversely affected by a stressful situation. The concept of stress is:

> "Stress is built upon the relationship between a primary concept, motivation, and the situation in which motivated behavior appears. Stress occurs when a particular situation threatens the attainment of some goal."[56]

The psychologist has no adequate way of defining the psychological condition that corresponds to stress. Instead most experimenters who have studied the responses of groups under stress have had to produce situations which are thought to thwart the motives of most people. In the following study Lazarus, Deese, and Osler used a realistic and stressful situation. Stress was induced by failure of not completing a task and false norms.[57] Also pressure on the subject may be induced by manipulating the situation in various ways as to produce excessive demands upon him. Various forms of distractors may be used in this

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[55]Kurt W. Back, Stephen R. Wilson, and Morton D. Bogdnoff and William G. Troyer, Journal of Personality, Vol. 34 (1966), p. 457.

[56]R. S. Lazarus, J. Deese, and S. J. Osler, "The Effects of Psychological Stress Upon Performance," Psychological Bulletin, Vol. 49 (1952), pp. 293-317.

[57]Ibid., p. 297.

category as rapidly pacing the subject, flashing lights, electric shock, noise and others.[58] This investigation produced the following:

> "The more individuals are motivated to achieve a goal, the more likely they are to perceive the goal as threatened when potentially threatening stimuli are directed toward it."[59]

Ulrich found that motivation produces a stressful situation and the process of resolving that stress produces greater effort which results in improved performance.[60]

Elementary school children with defensive and anxious traits were selected for a study based on the Defensive Scale for Children and the Test Anxiety Scale. Groups were placed in low anxious-low defensive, high anxious-low defensive and low anxious-high defensive groups. Mothers and strangers served as testors. Three tasks were administered: simple repetitive motor task and two perceptual tasks. It was found that the testor made a big difference on the high anxious children's performance as it decreased their performance.[61]

Burwitz and Newell, using male undergraduates, studied the effect of an audience on learning a motor skill. Subjects were assigned one, two or three observers while performing the task. It was found that one

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[58]Margaret G. Herman, "Testing a Model of Psychological Stress," Journal of Personality, Vol. 34 (1966), p. 381.

[59]Ibid., p. 295.

[60]Celeste Ulrich and Roger Burke, "Effect of Motivation Upon Physical Performance," Research Quarterly, Vol. 28 (1957), pp. 403-412.

[61]Britton K. Ruebush and Harol W. Stevenson, "The Effects of Mothers and Strangers on the Performance of Anxious and Defensive Children," Journal of Personality, Vol. 32 (1967), p. 587.

or two observers had no effect on the learning process. However, there was a difference in the performance of the subjects observed by three people.[62]

Freeman and Manson were interested in assaying the personality structure in terms of reactions made under conditions which are relatively favorable (non-stress) and unfavorable (stress) to the individual. That is, some persons can maintain high-order control of their overtly directed behavior in spite of a high degree of internal excitation. Whereas, other persons with this same degree of internal tension exhibit a breakdown of control over the external expressions of emotionality. "A stress interview was designed to select those individuals, who, when highly aroused internally, are able to maintain such intelligent control over their behavior as to be judged poised, master of the situation, resourceful and well adjusted."[63] The stress occurred during the interview situation in which the subject, highly motivated to be successful, is placed on the defensive and deliberately confused as to his progress. These interviews are designed to reveal the extent to which a candidate for a job possesses the qualities and relationships deemed essential to success.[64]

Ryan, using male college students hypothesized that externally

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[62]L. Burwitz and K. M. Newell, "The Effects of the Mere Presence of Coaches on Learning a Motor Skill," Journal of Motor Behavior, Vol. 4 (1972), p. 99.

[63]G. L. Freeman and C. E. Manson, "The Stress Interview," Journal of Abnormal Social Psychology, Vol. 37 (1942), p. 428.

[64]Ibid., pp. 427-447.

induced tension will facilitate performance on a relatively easy motor task but impair performance on a more difficult task. Subjects were tested on balancing on a stabilometer. One of the groups had a more difficult balancing task. Stress was produced in the experimental groups by an irregular series of unavoidable shocks. The task varied by increasing the difficulty of the task for one experimental group. Two groups received no shock but differed in difficulty of the task. The results of the study support the hypothesis that increased tension impairs performance of a difficult performance task. However, this study fails to support that tension in the form of electric shock improves performance of an easy task.[65]

Selye reports that stress has an effect on our body in many complex ways. Stress could be the common denominator for most illnesses. A study exposing rats to many stressful situations as cold, fatigue, frustration, and noise resulted in damage to internal organs. It was also reported by Selye that not all stress is harmful. Stress is involved in such diverse activities as a game of tennis, or viewing a mystery movie. The effect arises when stress is applied over long periods of time. A distance runner covers a mile with no difficulty, however, this encounter would be detrimental to an elderly person. Selye concluded by stating that since stress plays such a vital role in our lives, measures should be taken to minimize its effects.[66]

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[65]E. Dean Ryan, "Effects of Stress on Motor Performance and Learning," Research Quarterly, Vol. 33 (1962), pp. 111-119.

[66]J. D. Ratcliff, "How to Avoid Harmful Stress," Today's Health, Vol. 48 (1970), pp. 42-44.

Cattell points out that "the basic physiological anxiety pattern is not the same as that associated with stress."[67] Cattell gives a psychological problem to distinguish stress from anxiety. When a person is faced with a difficult problem, stress symptoms are demonstrated. However, anxiety is displayed when the person retreats or utilizes other escape mechanisms.[68]

A study was conducted to determine the significance of noise as a producer of stress. Continuous cardiac measures by the use of a physiograph were taken in a resting position, a standing position and during the stress (noise present) and nonstressful (absence of noise) trials while performing a hand-eye coordination task on a rotor pursuit. Noise was found to be a significant producer of stress at the .01 level.[69]

Studies Related to Heart Rate Measurement

The emotional states of an individual result from different situations. However, the physiological response to emotional arousal within the individual is often similar.

> "Since it is not yet possible to establish distinct lines of demarcation between the various terms describing emotion, perhaps the most useful approach is to describe emotions on the basis of level of arousal or activation.

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[67] Raymond B. Cattell, "The Nature and Measurement of Anxiety," Scientific American, Vol. 208 (1963, p. 96.

[68] Ibid, p. 103.

[69] Elizabeth Y. Brown, "The Effects of Noise as a Stressor," Unpublished Paper, University of Houston, 1973.

> In this way the emotional state may be placed on a continuum from high to low activation as follows: excited, alert and attentive, relaxed, drowsy, light sleep, deep sleep, coma, death. Different levels are reflected in physiological changes which are controlled by the autonomic nervous system . . . Heart rate, blood pressure, muscle tension, respiration, galvanic skin response and many other bodily functions have been identified as being sensitive to changes in emotional arousal."[70]

Gantt's study revealed that "heart rate is easily measured and has been reported to serve as a reliable means of measuring the degree of emotional stress in individuals."[71] Gantt's research included the degree to which heart rate changes after producing various stimuli as pain, food, stress and other stimuli. The experiments included gradually increasing the degree of the stimulus while heart rate was monitored. While experimenting on dogs, Gantt found that the slightest change in environment and stimuli affected heart rate. As the intensity of the stimulus increases, so did heart rate. Gantt concludes that "the heart more than any other organ reveals the real thoughts and feelings of man."[72]

Burgess, Johnson and Silverman conducted a study to determine the relationship between reading performance and cardiac response patterns in young children. Continuous cardiac measures by use of a polygraph were taken on second and fourth grade boys and girls per-

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[70]Joseph B. Oxendine, "Emotional Arousal and Motor Performance," Quest, Vol. 13 (1970), p. 23.

[71]W. Horsley Gantt, "Cardiovascular Component of the Conditional Reflex to Pain, Food, and Other Stimuli," Physiological Reviews, Vol. 40 (1960), pp. 266-291.

[72]Ibid., p. 278.

forming a reading task under stress or no stress conditions. Stress was introduced in order to manipulate cardiac level. Results showed that cardiac rate was correlated with performance in that change in cardiac rate affects one's performance. That is two subjects having the basal and performance cardiac rates similar to each other may perform at different levels under stress.[73]

Hnatiow in a study of the review of the heart rate literature found that orderly and psychologically meaningful relations exist between accelerated heart rate responses and experimental manipulations. Autonomic changes are important in the control of sensitivity to stimulation. Findings further suggest that change in heart rate may be a particularly useful response in psychological investigations.[74]

Lacey found that specific heart rate changes associated with complex situations involving attention and interval problem solving.[75] Skolov reported changes in heart rate when there was a variation in the environment.[76] Lang and Hnatiow found that heart rate accelerated in

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[73]Michael M. Burgess, Jacqueline R. Johnson, and Joel S. Silverman, "Relationship Between Cardiac Patterns and Reading Performance in Second and Fourth Grade Children," Perceptual and Motor Skills, Vol. 33 (1971), pp. 723-731.

[74]Michael Hnatiow, "Learned Control of Heart Rate and Blood Pressure," Perceptual and Motor Skills, Vol. 33 (1971), pp. 219-226.

[75]J. I. Lacey, "Psychophysical Approaches to the Evaluation of Psychotherapeutic Process and Outcome," Perceptual and Motor Skills, Vol. 34 (1972), pp. 701-704.

[76]E. N. Skolov, "Higher Nervous Functions: The Orienting Reflex," Annual Review of Physiology, Vol. 25 (1963), pp. 1545-1580.

response to a simple auditory stimulus.[77]

Stress is usually more disruptive for the learning and performing of a complex task, whereas simple task performance may be facilitated by stress. Garvie using sixty male university students studied the effect of low and high ability students under stress. The stress induced was electric shock by use of an electrode placed on the nonactive wrists. The task was a pursuit rotor task. Electrocardiogram recorded heart rate to determine whether the subjects were in fact stressed. Chest electrodes were placed on all subjects and heart rate was monitored. It was assumed that the subjects were sufficiently stressed immediately after being shocked as indicated by the heart rate. However, there was no difference in scores on those in the shock group when compared to the no shock group.[78]

Emotional and psychological factors have well known effects on resting heart rate. Painful or threatening stimuli produce increases in heart rate. Antel and Cumming had subjects perform on an electronic bicycle ergometer while two types of stimuli were used to evoke surprise or fear. Surprise element was an electric shock and fear was produced by showing the subjects a hypodermic needle. Subjects included nine healthy male subjects age thirteen to fifteen years of age and one eight

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[77]P. J. Lang and M. Hnatiow, "Stimulus Repetition and the Heart Rate Response," Journal of Comparitive and Physiological Psychology, Vol. 55 (1962), pp. 781-785.

[78]Gordon T. Garvie, "Stress and Motor Performance and Learning by Subjects of Low and High Initial Ability," Perceptual and Motor Skills, Vol. 34 (1972), pp. 819-824.

year old girl labeled emotional. It was found that heart rate increased four to seven beats per minute while exposed to stress in the emotionally stable boys but over twenty-five beats per minute in this one emotional girl.[79]

In summary, the review of the literature supports these conclusions:

1. Most studies related to personality and sport indicated that the successful competitors do possess personality factors high in emotional stability and self-confidence.

2. Psychological stress does have an effect on performance.

3. Stress may increase or decrease performance.

4. There is a difference between stress and anxiety.

5. Any factor of the 16 PF may be studied independently.

6. Accelerated heart rate may be used as a significant indicator of stress.

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[79] Jack Antel and Gordon R. Cumming, "Effect of Emotional Stimulation on Exercise Heart Rate," Research Quarterly, Vol. 40 (1969), pp. 6-10.

CHAPTER III

METHODOLOGY

This section of the study is discussed under the headings of (1) sample description; (2) treatment conditions; (3) pilot study; (4) research design; and (5) experimental design.

Sample Description

The Cattell 16 Personality Factor was administered to one hundred and ninty-five females enrolled in physical education classes at San Jacinto College between the ages of seventeen and twenty-two. Preliminary instructions appearing on the test booklet were read to these junior college students before taking the test. Prior to the administration of the test, students were screened to eliminate those on academic probation. The inventory was then hand scored and raw scores were then converted to standard scores called stens. Sten scores are distributed over ten equal-interval standard score points from one to ten with a mean fixed at sten 5.5. Stens 5 and 6 extend, respectively a half standard deviation below and above the mean, constituting the solid center of the population, while the outer limits for stens 1 and 10 are $2\frac{1}{2}$ standard deviations above and below the mean. Stens of 5 and 6 are average, 4 and 7 slightly deviant, 2, 3, 8, and 9 strongly deviant and 1 and 10 extreme.[80]

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[80]Raymond B. Cattell and Herbert W. Eber, Manual for Forms A and B Sixteen Personality Factor Questionnaire, (Champaign: Institute for Personality and Ability Testing, 1962), pp. 3-6.

Those that obtained scores which were slightly deviant, strongly deviant and extremely deviant from the normal distribution on Factor C (stability) or Factor O (self-confidence) served as the population, Figures 1 and 2. The subjects selected were randomly assigned to the following groups.

1. Thirty subjects with a high score on Factor C were randomly assigned to a stress situation (experimental group) or a non-stressful situation (control group).

2. Thirty subjects with a low score on Factor C were randomly assigned to a stress situation (experimental group or a non-stressful situation (control group).

3. Thirty subjects with a high score on Factor O were randomly assigned to a stress situation (experimental group or a non-stressful situation (control group).

4. Thirty subjects with a low score on Factor O were randomly assigned to a stress situation (experimental group) or a non-stressful situation (control group).

Treatment Conditions

The subjects performed a hand-eye coordination task on a rotary pursuit apparatus at forty cycles per minute. This apparatus was connected to a pair of Standard Electric Model S - 5608 - 1 clocks which

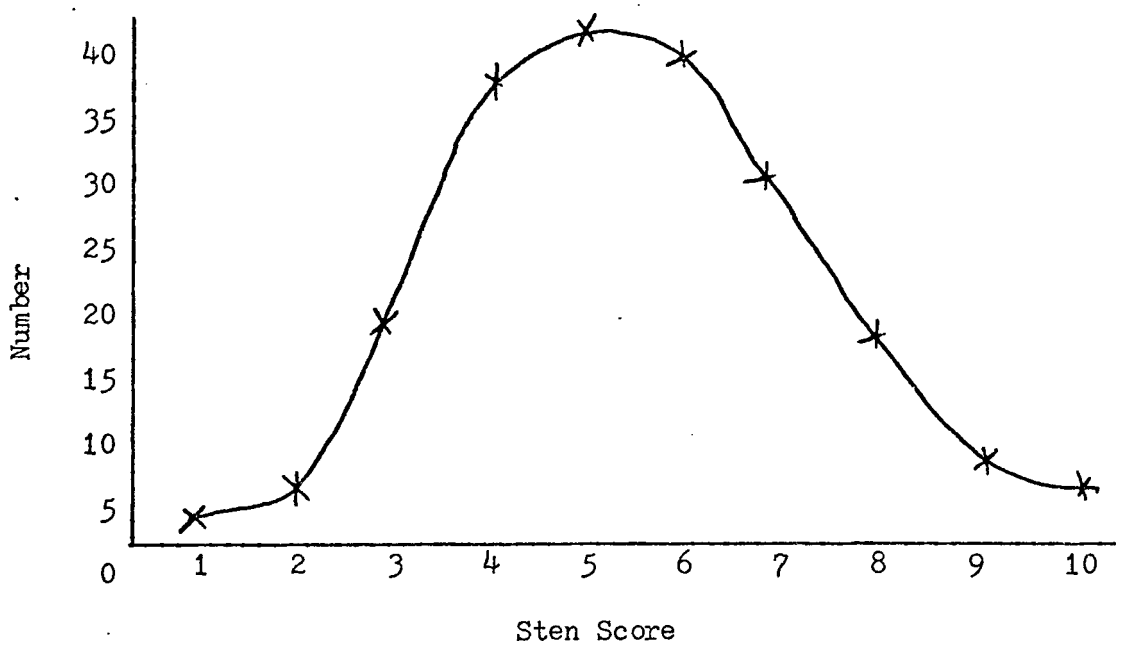


Figure 1. Distribution for Factor C

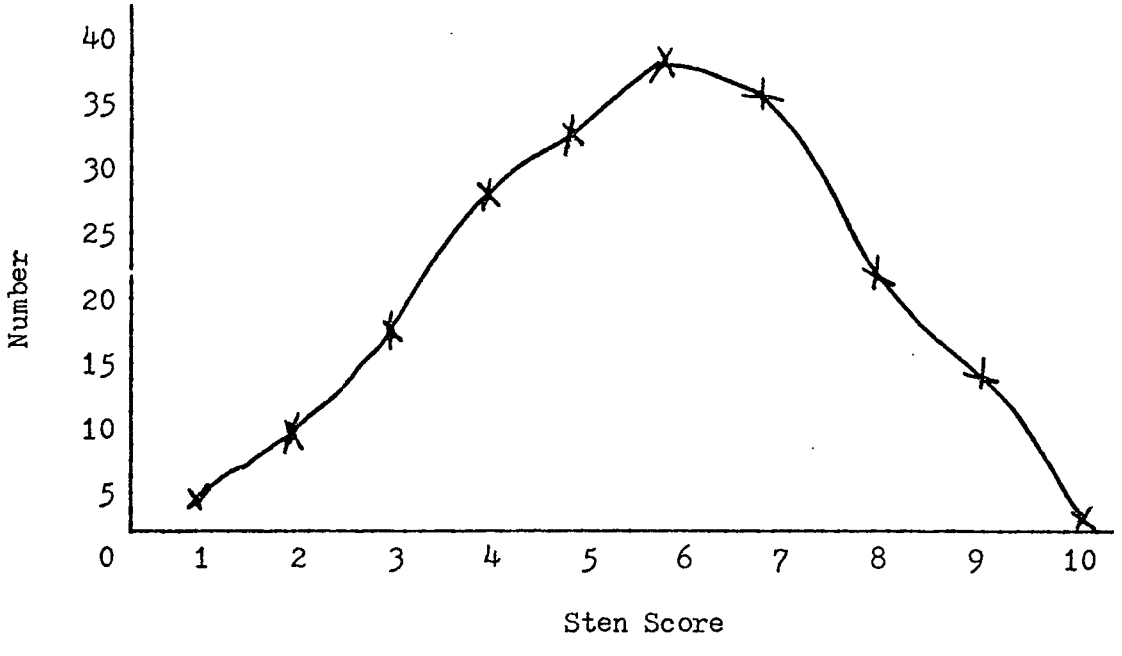


Figure 2. Distribution for Factor O.

were arranged with a Hunter's Model 124 S interval cycle so as to run for ten second periods. This arrangement permitted each subject's performance to be measured in terms of the length of time in a 10-second period during which the subject was on target on the rotor pursuit task. Both the control and experimental groups received the following instructions on a tape recorder.

> This task that you will perform is to measure your hand-eye coordination. It is called a rotor pursuit task. A light will be turned on and move in a clockwise manner. With your dominant hand you will place the stylus on the light and as accurately as you can remain on that light until I tell you to stop. When I say "ready" you will place the stylus on the light and remain on the light as accurately as you can.
>
> When I say go, I will start recording how accurately you remained on target.
>
> When I say stop, remove the stylus from the light and wait for the next ready signal.
>
> There will be fifteen, ten-second trials.
>
> Disregard any sounds coming from the machine recording your accuracy.

A table of random numbers with outside limits of one to five was used to determine the length of time between the ready signal and the go signal to prevent an established pattern. During the experimental groups' performance period, a series of fifteen distracting noises served as the stressors. The noises included symbols, whistles, horns,

gun shots, and the dropping of a metal waste paper basket. The performance data required eight minutes per subject; all performance data were collected in one session, for each subject. A testing schedule was arranged for each subject to be tested individually. A room was provided for subjects to wait for their scheduled testing time. The investigator brought each subject into the testing room, instructed each subject to stand with feet shoulder distance apart and face the rotor pursuit. The subjects were then told that the tape recorder would provide the rest of the details.

Pilot Study

A pilot study involving the above procedures was conducted to determine the effect and significance of the stressor. The subjects consisted of forty women from the University of Houston's physical education program. The control group of twenty women performed the task on the rotor pursuit without the stressful noises involved. The experimental group of twenty women performed the same task on the rotor pursuit while distracting noises were played on the tape recorder during each of the fifteen trials. All instructions were recorded on a tape recorder so that each subject received the same instructions. The experimental group received the same instructions as the control group only the noises were presented in process into the tape recorder. All subjects' heart rates were monitored by the use of a desk model physiograph, number DMP-4A, distributed by Narco Bio-Systems of Houston. The physiograph is capable of adapting to four rectilinear or curvilinear Recording Channels, a Time and Event Channel, plus an optional Servo Channel. A 12-fixed speed chart drive controls chart speed in twelve

steps from 0.0025 to 10 centimeters per second. Four compartments are provided for plug in amplifiers or accessories. The Time and Event Channel allows 1, 5, 30, or 60 second timing pulses which are recorded on the chart. The physiograph used in this study was equipped with a channel that records EKG. This was used to obtain an accurate heart rate reading.

It was then necessary to place electrodes on the subject in such a manner as to obtain an accurate heart rate reading. Electrodes were placed on both subjects prior to the beginning of the test in order to save time between trials. The electrodes were of the type distributed by the Narco Bio-Med Systems of Houston. A single ground wire was placed centrally. One electrode was placed below and interior to the heart just below the base of the sternum. The second electrode was placed about two inches above the heart. Care was taken not to place the electrodes directly on top of excess adipose tissue. Once the electrodes were in place a resting and standing heart rate was monitored for sixty seconds each on both the control and experimental groups. Means and standard deviations were computed for the two groups resting and standing heart rates, Table I. A t-Test for a difference between two independent means was computed to determine whether the two groups were equal. At the .01 level of significance, it was established that there was no significant difference between the control group and experimental groups' resting and standing heart rates, thus the groups were determined to be equal.

While the experimental and control groups performed on the rotor pursuit task, heart rates were monitored during each fifteen ten-second

TABLE I

MEANS AND STANDARD DEVIATIONS OF HEART RATE

SOURCE	NO STRESS		STRESS	
	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION
Group I				
Resting	78.0	11.6		
Standing	89.4	14.1		
Performing	91.9	14.9		
Group II				
Resting	76.5	10.5		
Standing	89.0	11.8		
Performing			120.0	15.5*

*Significant at .05 level.

trials. Means and standard deviations were computed for the two groups' resting and standing heart rates, Table I. A t-Test for a difference between two independent means was computed to determine if the recorded noises had an influence on heart rate. The heart rates of the two groups were found to be significant at the .01 level. Therefore, it was concluded that the recorded noises used in this study is a producer of stress.

Research Design

The research design used was a three-factor mixed design of repeated measures to determine whether there are certain personality factors resistant to stress.

1. A person affected by feelings, (emotionally less stable, easily upset) will perform differently under stress as a person emotionally stable (faces reality, calm, mature).

2. An apprehensive person, (self-reproaching, worrying, troubled) will perform differently under stress as a person who is self-assured (serene and confident).

These two hypotheses meet the assumptions, including randomization, of the following three-factor mixed design of repeated measures. Tables II and III illustrate the design used.

TABLE II

THREE FACTOR MIXED DESIGN FOR FACTOR C AND FACTOR O

Treatment

	No Stress			Stress		
	Trial I	II	III	Trial I	II	III*
Factor C High						
Factor C Low						

* Each trial includes five scores.

Treatment

	No Stress			Stress		
	Trial I	II	III	Trial I	II	III*
Factor O High						
Factor O Low						

*Each trial includes five scores.

TABLE III

EXPERIMENTAL DESIGN

SOURCE	DEGREES OF FREEDOM
Between groups	59
Treatment	1
Personality Trait	1
Personality Trait X Treatment	1
Error	56
Within groups	119
Trials	2
Trials X Personality Factor	2
Trials X Treatment	2
Trials X Treatment X Personality Factor	2
Error	111

CHAPTER IV

REPORT AND ANALYSIS OF DATA

This study was undertaken to determine if selected personality traits were indicative of individuals ability to withstand stressful occurrences while in the act of performing. This information would contribute to the prediction of success of an individual engaging in a performance task. An effort to make an additional contribution to understanding the personality of performers under stress was undertaken. Two personality factors have been found by numerous investigators to be an indicator of probable success while performing a motor task. They are Factor C (stability) and Factor O (self-confidence) as ascribed by the Cattell 16 Personality Factor Inventory. For this reason these two factors were studied to determine their relationship to performance in relation to stress.

Collegiate students from San Jacinto (junior) College's Women's physical education program between the ages of seventeen and twenty-two were used as subjects. The Cattell 16 PF was given to identify subjects with a high or low intensity of Factor C or Factor O. Through randomization subjects were placed in a control (no stress) or experimental (stress) situation. The subjects performed a hand-eye coordination task on a rotor pursuit apparatus. Noises served as distractors to provide a stressful situation while the experimental groups performed. A preliminary study to determine the effect of the stressor

demonstrated at the .01 level of significance that noises were stressful.

Results of the study will be presented in two parts. In the first part the results related to Factor C will be presented and in the second part results related to Factor O will be presented.

Factor C

Definition. Factor C of the Cattell 16 PFI is the emotional stability factor. A person who possesses a high intensity of Factor C tends to be emotionally mature, stable, and realistic about life. A low intensity of Factor C is characteristic of a person who is easily frustrated by unsatisfactory conditions, easily annoyed and evading necessary reality demands.

Raw Data. A table of the raw data appears in the Appendices A through D. From the raw data it can be observed that the high Factor C group when stressed had an overall performance superior to any other group. Both groups high in Factor C outperformed the two groups low in Factor C whether stress was applied or not.

The fifteen trials obtained from each subject were arranged in three separate groups, Table IV. Trials 1 - 5 were treated as one unit. Trials 6 - 10 were treated as one unit. Trials 11 - 15 were treated as one unit. All units progressively increased with each trial. The increase from Unit I to Unit II was the greatest for the Low C groups when compared to the high C groups.

Summary of findings. The statistical analysis employed in this study was a three-factor mixed design of repeated measures. The .05 level of significance was accepted for all analyses. The results of the three-factor mixed design of repeated measures is shown for Factor C

TABLE IV

SUM OF SCORES FOR ALL TRIALS OF ALL SUBJECTS OF FACTOR C PRESENTED IN GROUPS OF FIVE

	Unit I Trials 1 - 5	Unit II Trials 6 - 10	Unit III Trials 11 - 15
Low Factor C No Stress	232.82	311.79	323.00
Low Factor C Stress	174.70	241.63	251.39
High Factor C No Stress	268.22	309.84	336.90
High Factor C Stress	442.93	465.40	483.98

in Table V. The mean performance scores of all subjects of Factor C on the pursuit rotor task grouped in trials of five are shown in Table VI. Table VI illustrates the interaction of personality factor X trials X stress.

The first order interaction of personality, the second order interaction of stress, and the two-way interaction of stress and personality were significant at the .05 level. The interaction of trials by stress was nonsignificant. However, the interaction of trials X stress X Factor C was significant at the .05 level.

In Table VII, the mean of all performance scores of Factor C on the pursuit rotor task for ten second trials are given. The observed mean of 6.28 for the emotionally stable (faces reality, calm, mature) group under stress was higher than the emotionally stable group not under stress. The total mean score of the stable (high trait) group was higher than for the unstable (low trait) group.

It is under this assumption that the hypothesis that a performer affected by feelings, (emotionally less stable, easily upset) will not perform as well under stress as a performer emotionally stable (faces reality, calm, mature) be accepted.

Factor O

Definition. Factor O of the Cattell 16 PFI is the self-confident factor. A person who possesses a high intensity of Factor O tends to be depressed, moody, a worrier, full of foreboding and childlike anxiety in difficulties. He does not feel accepted in groups or feel free to participate. A low intensity of Factor C is characteristic of a person who

TABLE V

THREE FACTOR MIXED DESIGN: REPEATED MEASURES ON ONE FACTOR FOR THE SIXTY SUBJECTS OF FACTOR C

SOURCE	SS	DF	MS	F
Between groups	12,858.44	59		
Factor C	3,344.72	1	3,344.72	58.04*
Treatment	472.66	1	472.66	7.64*
Factor C X Treatment	2,514.03	1	2,514.03	44.89*
Error	3,227.31	56	57.63	
Within subjects	3,698.10	119		
Trials	694.66	2	347.33	15.73*
Trials X Factor C	252.79	2	126.39	5.72*
Trials X Treatment	25.34	2	12.67	.57
Trials X Treatment X Factor C	251.76	2	125.88	5.70*
Error	2,473.45	111	22.08	
Total	16,556.54	178		

* Significant at .05 level.

TABLE VI

INTERACTION OF PERSONALITY FACTOR C X TRIALS X STRESS

	Unit I Trials 1 - 5	Unit II Trials 6 - 10	Unit III Trials 11 - 15
Low Factor C No Stress	3.08	4.19	4.33
Low Factor C Stress	2.89	3.23	3.31
High Factor C No Stress	3.58	4.13	4.52
High Factor C Stress	5.89	6.15	6.43

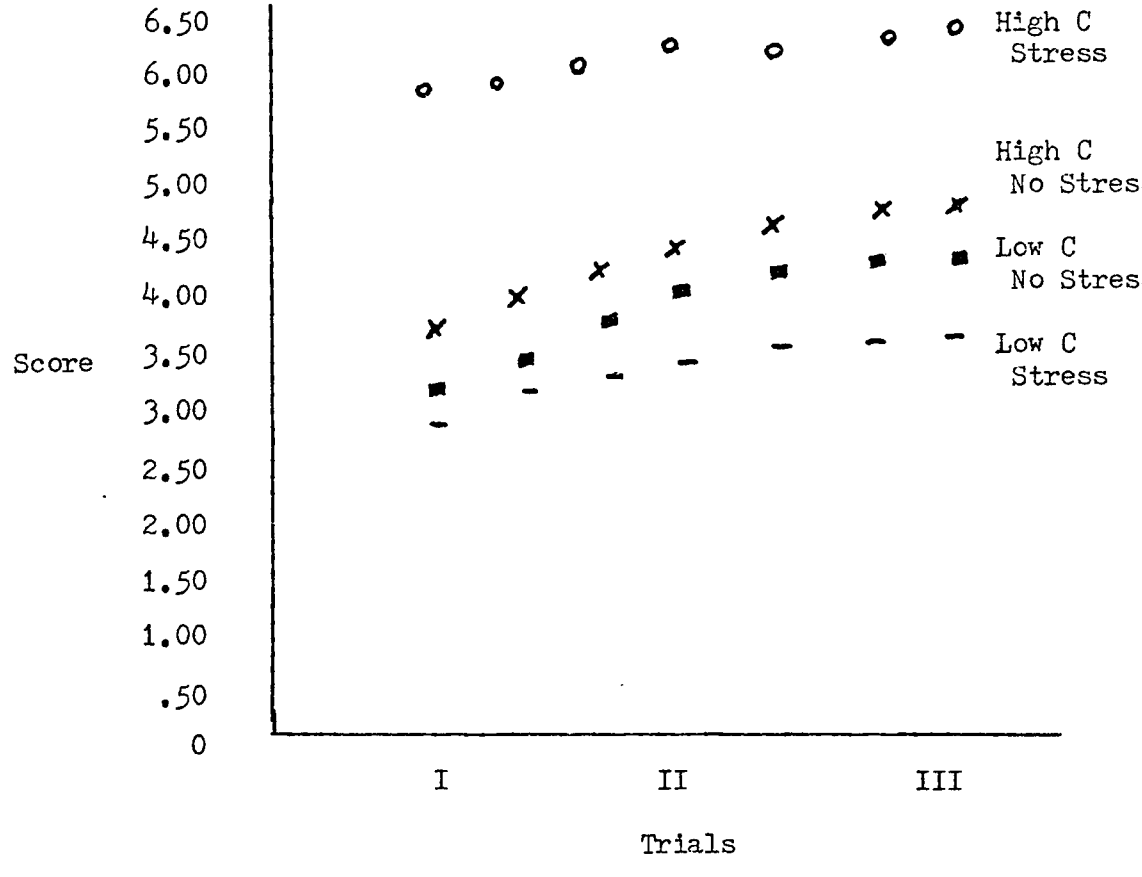
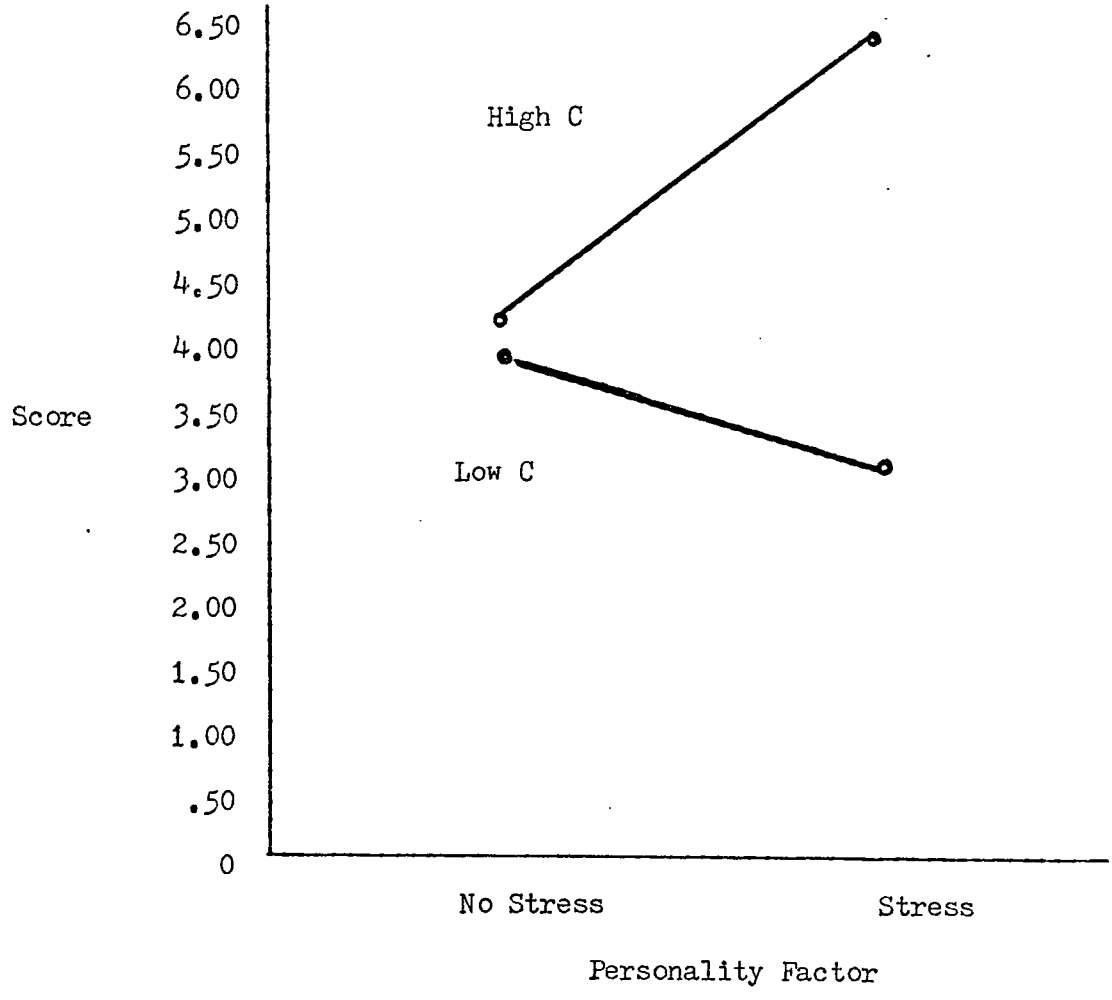


TABLE VII

PURSUIT ROTOR SCORES OF FACTOR C

		No Stress Mean	Stress Mean	Total
High Factor C		4.07	6.29	5.17
Low Factor C		3.85	3.02	3.43
	Total	3.96	4.60	



is mature, unanxious confidence in himself and his capacity to deal with things. He is resilient and secure, but to the point of being insensitive of when a group is not going his way, so that he may evoke antipathies and distrust.

Raw data. A table of raw data appears in the Appendices E through H. From the raw data it can be observed that the low Factor O group when stressed had an overall performance superior to any other group. Both groups high in Factor O were higher in performance than those low in Factor O. Both groups low in Factor O out performed the two groups high in Factor O whether stress was applied or not.

The fifteen trials obtained from each subject were arranged in three separate groups, Table VIII. Trials 1 - 5 were treated as Unit I. Trials 6 - 10 were treated as Unit II. Trials 11 - 15 were treated as Unit III. All trials increased from Unit I to Unit II. Only in the low Factor O groups did the trials increase in Unit III.

Summary of findings. The statistical analysis employed in this study was a three-factor mixed design of repeated measures. The .05 level of significance was accepted for all analyses. The results of the three-factor mixed design is shown for Factor O in Table IX. The mean performance scores for all subjects of Factor O on the pursuit rotor task grouped in trials of five are shown in Table X. Table X illustrates the interaction of personality factor X trials X stress.

The first order interaction of personality was significant at the .05 level. However, the interaction of stress and the interaction of personality X stress were nonsignificant. The within subjects interactions were as follows. The interaction of trials by Factor O was

TABLE VIII

SUM OF SCORES FOR ALL TRIALS OF ALL SUBJECTS OF FACTOR O
PRESENTED IN GROUPS OF FIVE

	Unit I Trials 1 - 5	Unit II Trials 6 - 10	Unit III Trials 11 - 15
Low Factor O No Stress	296.19	346.56	349.89
Low Factor O Stress	309.20	379.73	402.03
High Factor O No Stress	280.81	338.02	334.74
High Factor O Stress	218.08	240.33	235.08

TABLE IX

THREE FACTOR MIXED DESIGN: REPEATED MEASURES ON ONE FACTOR FOR THE SIXTY SUBJECTS OF FACTOR O

SOURCE	SS	DF	MS	F
Between subjects	12,377.81	59		
Factor O	1,058.71	1	1,058.71	5.57*
Treatment	145.37	1	145.37	
Factor O X Treatment	713.61	1	713.61	
Error	10,450.20	56	186.61	
Within subjects	2,398.45	119		
Trials	487.37	2	243.69	28.01*
Trials X Factor O	47.78	2	23.89	2.12
Trials X Treatment	381.82	2	190.91	17.04*
Trials X Factor O X Treatment	327.00	2	163.00	14.55*
Error	1,254.48	111	11.20	
Total	14,776.26	178		

*Significant at .05 level.

TABLE X

INTERACTION OF PERSONALITY FACTOR O X TRIALS X STRESS

	Unit I Trials 1 - 5	Unit II Trials 6 - 10	Unit III Trials 11 - 15
Low Factor O No Stress	3.44	4.89	4.66
Low Factor O Stress	4.16	5.05	5.32
High Factor O No Stress	3.74	4.63	4.49
High Factor O Stress	2.92	3.20	3.13

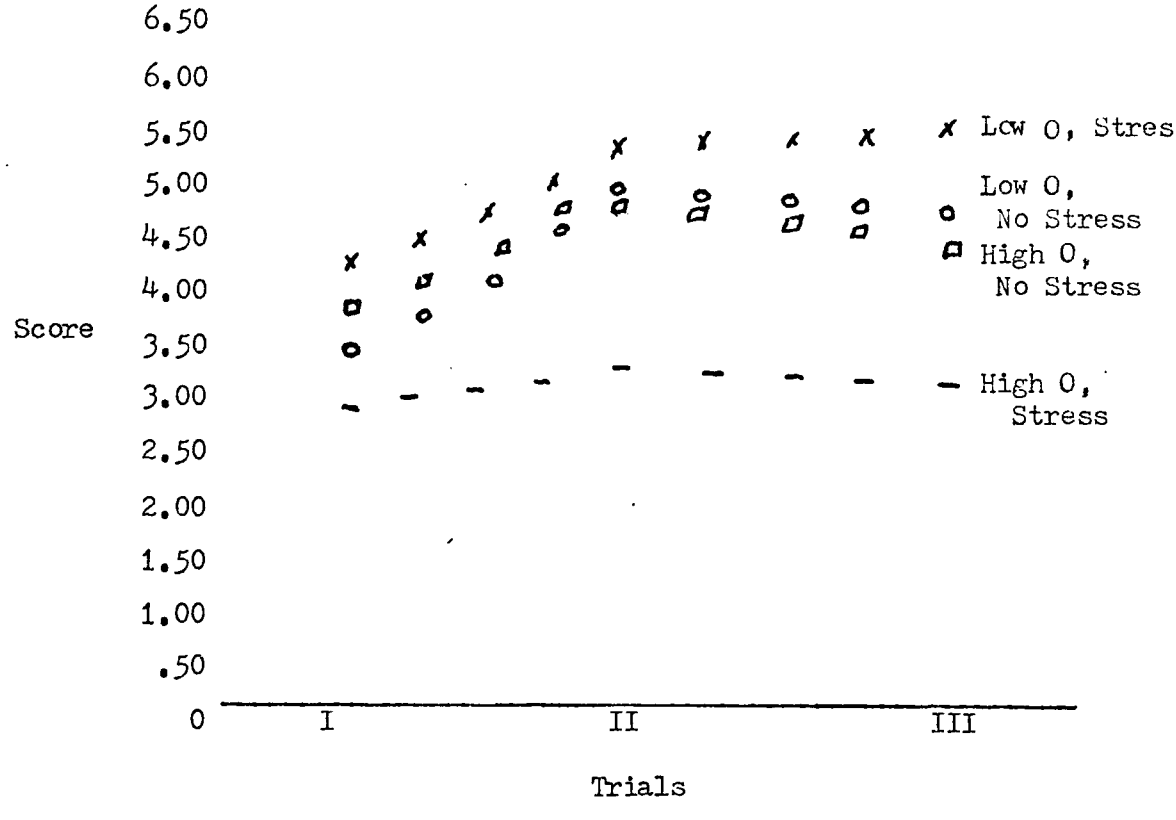
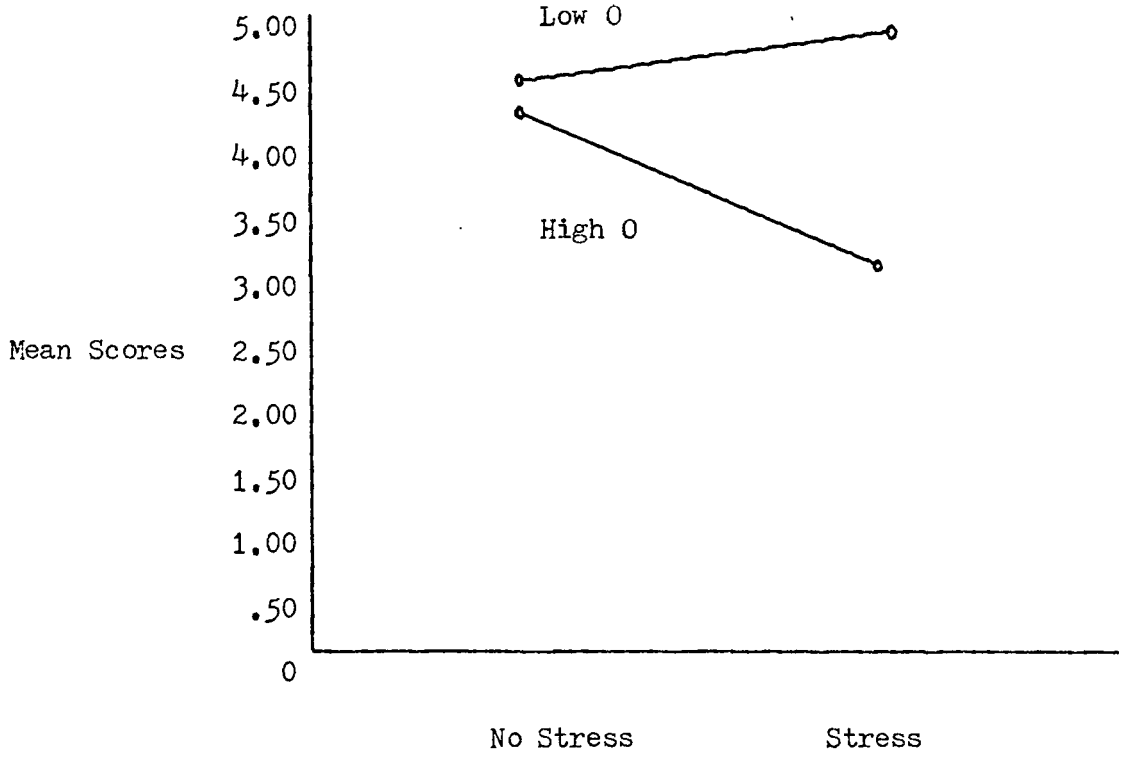


TABLE XI

PURSUIT ROTOR SCORES FOR FACTOR O

		No Stress Mean	Stress Mean	Total
High Factor O		4.23	3.09	3.66
Low Factor O		4.40	4.86	4.63
	Total	4.31	3.97	



nonsignificant. However, the interaction of trials X stress, trials X stress X Factor O was significant at the .05 level.

In Table XI, the mean performance scores of the pursuit rotor task for ten second trials are shown for Factor O. The observed mean of 4.86 for the self-assured serene, confidence group under stress was higher than the apprehensive, self-reproaching, worrying, troubled group under stress. The confident group collectively had a higher total performance of 3.66.

On the basis of the data revealed in this study, the hypothesis that an apprehensive (self-reproaching, worrying, troubled) performer will not perform as well under stress as a self-assured, (serene, confident) performer is accepted.

CHAPTER V

SUMMARY, RECOMMENDATIONS, CONCLUSIONS

The study was designed to determine if two personality factors, as measured by Cattell's Sixteen Personality Factor Inventory were useful in predicting an individual's response to a specific motor task performed under stressful conditions. It was assumed that highly skilled motor performance accounted for only a portion of success under stressful conditions. The possibility that the presence or absence, in varying degrees, of selected personality traits would influence performance results might indicate that the psychological components are aspects of a successful performer.

The task was to design a situation that would measure the relationship of personality traits under stressful conditions and interpret the results of the findings. Personality studies were examined to determine if there was a trend that outstanding athletes possessed common personality traits. Two personality traits repeatedly were found to be a common denominator in the majority of successful male and female athletes. These two traits were the emotional stability and self-confidence traits. Additional supporting evidence that emotional stability and self-confidence were needed in the make up of one's personality was substantiated at the sports institute in San Jose State College by Thomas Tutko and Jack Richards. As a result, emotional stability and self-confidence were selected as meaningful traits to

examine, while performing a motor task under stressful conditions.

The Cattell Sixteen Personality Factor Inventory was selected as the instrument to measure one's personality. It has an established validity and reliability that merited its use. It has a uniqueness of factoring out independent, isolated traits. The feasibility and ease of administration were also major considerations.

A significant stressor was then selected. A pilot study conducted by the investigator verified the use of noise as a significant stressor. The performance to be measured was a hand-eye coordination task on a pursuit-rotor apparatus. This instrument was selected to allow the investigator to control all the variables involved. Because of these controls, a true relationship of personality and stress could be investigated.

Subjects consisted of students at San Jacinto College from the Women's Physical Education program. After the administration of the Cattell 16 PF, students with high or low Factors of C or O were randomly selected for the study and randomly placed in a control or experimental group.

The initial testing lasted four consecutive days. The procedure consisted of students in the control group executing fifteen-ten second trials on the rotcr pursuit. The experimental group performed the same task except during each trial noises from a tape recorder occurred. The total testing time for each subject was eight minutes. The score in seconds on target for each trial was recorded. All performance data on each subject were collected in one session.

The data collected were treated by a three factor mixed design

statistical analysis. This allowed the investigator to study not only the relationship of personality on performance under stress, but repeated measures were considered to determine whether there were effects occurring during treatment. This design permits not only the evaluation of the overall experimental effects, but also the evaluation of general changes and interactions of the variables over the passage of time.

Conclusions

The results from the three-factor mixed design showed the interaction of Factor C on performance as well as stress on performance and the two-way interaction of stress X personality to be significant at the .05 level. It must be concluded that the personality a subject had affected the overall performance. Those with a high intensity of emotional stability out performed those low in emotional stability. Those high in emotional stability also had an overall high performance while under stressful conditions. Stress had a positive affect on the emotionally stable group while stress had a negative affect on those subjects low in emotional stability. In the former case the performance improved while in the latter the performance declined.

The self-confidence group Factor O had a first order interaction of stress significant at the .05 level. Again the personality trait was related to overall performance. The group scoring low on Factor O out performed all other groups whether stressed or not. However, the interaction of stress and the two-way interaction of stress X personality had no significant effect on performance.

These findings imply that the emotionally stable person is more

likely to successfully perform a motor task under stress than a less stable person. Although self-confidence is a major contribution of success, emotional stability under stressful conditions appeared to be more significant.

The repeated measure analysis revealed that in both cases of Factor C and Factor O that the subjects' performance was a function of practice. As the trials increased for Factor C, performance level was dependent upon personality type as the significant interaction of trials X treatment X personality. For Factor O performance level was dependent on treatment and the three-way interaction of trials X treatment and personality. These interactions were significant at the .05 level. These findings show that high intensity of Factor C, when compared to a low Factor O, is the superior trait needed for success.

A limitation of the study may be that the conditions under which this study was conducted were so highly controlled that when placed in a realistic performance situation the same results may not occur.

It was the purpose of this study of personality to make an additional contribution toward understanding the psychological effects that enter into successful motor performance. Findings of this study support previous studies in which personality traits were identifiable in determining physical skill ability was held constant.[76] It was found in this study that the traits of self-confidence and emotional stability have a relationship to successful performance. This also supports the findings

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[76]Cofer, Ibid, p. 18.

of Tutko and Richards[77] and Cooper.[78]

The practice effect played an important role in this study. Carron found that the newness of an activity affected students who were highly anxious while the low anxious students were unaffected.[79] This study also found that the subjects high in self-confidence and emotional stability were unaffected by the stressor when compared to the low intensity self-confidence and emotional stability groups.

This study substantiates Freeman and Manson's study in that the high intensity self-confidence and emotional stability groups when under stress out performed the low intensity groups.[80] The high intensity groups maintained high-order control of their performance in spite of the external distractions.

Recommendations

Although the findings of this study are based upon the results of novice subjects performing a simple motor task under varing conditions, the results have significance for educators and coaches. If, as research and theory indicate, individual personality is modifiable, educators and coaches should consider methods for developing self-confidence and emotional stability in their students and athletes. It is further recommended that personality assessment techniques be used

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[77]Tutko, Ibid., p. 43

[78]Cooper, Ibid., p. 17.

[79]Carron, Ibid., p. 181.

[80]Freeman, Ibid., p. 428.

to assist in determining the need for trait development or the presence of traits which indicate the potential for successful motor performance.

Recommendations for Further Study.

Persons interested in pursuing the relationships of personality traits and motor performance may direct their attention to the effects of stressors, motivation factors, environmental conditions and practice conditions of gross motor skill acquisition and performance.

Previous research in the area of personality has been conducted to establish personality profiles for performers in selected sports as well as establishing unique and definable personality attributes of athletes when comparing them to non-athletes. Continuous efforts in the area of psychology of sport must take on a more specific outlook by considering the physical fitness factors, drive and motivation factors. Consideration must also be given to determine which personality attributes represent an important success factor in some sports and not in others, or at some quality levels but not at others. Instead of taking a global look at personality and sport, future research must be directed toward studies more specific to the task by isolating the variables that are pertinent to athletic psychology. The unaccounted for variables in competitive spirit, motivation, athletic anxiety, sportsmanship and stress warrants need for additional research for further advancement in athletic personality.

Perhaps the most perplexing problem must be approached through longitudinal studies wherein personality assessments are made periodically as persons participate in gross motor skills over long periods of time.

Such studies may give insight into the problem of the effects of personality modification on acquisition and performance of motor skills and the effects of skill acquisition and performance on personality modification.

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APPENDIX

Subjects	Trials														
1.	1.25	1.18	1.24	0.55	2.08	2.50	4.11	2.51	2.01	2.19	2.34	3.16	3.42	2.32	5.27
2.	1.45	3.15	2.20	2.10	3.49	3.30	3.06	3.12	3.24	3.17	3.22	3.24	3.18	3.00	3.07
3.	7.15	7.52	7.04	7.16	7.08	8.56	8.18	7.19	7.10	7.53	7.18	6.50	7.08	7.00	6.37
4.	2.00	2.18	2.24	1.26	2.00	3.18	3.28	4.14	4.48	3.12	2.56	3.00	3.49	3.09	2.55
5.	0.25	1.30	1.24	0.53	2.18	2.45	4.15	2.18	1.58	2.08	3.18	3.16	3.21	2.18	5.18
6.	4.37	6.43	7.21	5.35	6.18	8.03	6.31	7.12	6.15	6.11	8.31	8.32	9.02	7.26	8.00
7.	2.02	3.05	3.13	2.08	2.19	2.47	2.35	2.59	4.08	3.37	3.07	3.16	4.04	4.19	3.31
8.	3.52	6.14	5.43	7.23	5.47	6.37	8.12	6.22	8.00	7.23	7.20	6.09	8.48	6.16	6.59
9.	3.23	5.18	4.01	3.53	6.26	6.55	5.00	6.43	6.04	5.30	5.56	5.37	6.46	7.49	5.23
10.	1.12	2.48	3.20	2.58	2.50	3.12	3.43	4.41	4.14	3.13	3.40	3.20	3.31	4.00	3.15
11.	1.29	3.16	1.28	3.46	3.06	2.20	3.44	3.19	3.30	3.26	3.42	2.40	3.01	3.37	1.30
12.	0.34	0.22	0.47	0.30	1.08	0.47	0.41	1.27	1.30	1.21	1.18	1.41	2.41	2.27	1.46
13.	1.45	3.15	2.20	2.10	3.49	3.30	3.06	3.12	3.24	3.17	3.22	3.24	3.18	3.00	3.07
14.	1.10	2.36	3.08	2.58	2.56	3.00	3.31	4.29	4.02	3.22	3.18	3.08	3.01	4.00	3.30
15.	4.05	2.51	3.33	5.07	5.42	4.37	6.44	5.19	7.00	4.53	5.29	7.03	7.23	4.49	5.13

APPENDIX A

Time in seconds of low Factor C subjects performing under no stress were on target in ten second trials.

Subjects															
16.	1.01	2.44	2.02	3.20	2.58	1.02	2.41	3.08	2.40	3.46	3.25	3.55	4.07	2.02	3.41
17.	1.55	3.08	3.00	3.02	3.18	4.28	4.28	4.37	5.23	5.52	5.29	5.43	5.00	4.11	3.22
18.	2.29	1.52	2.28	2.58	3.47	2.28	4.43	2.48	4.00	3.48	4.07	3.52	3.06	3.45	3.32
19.	0.34	0.52	1.13	1.06	1.03	1.24	0.58	0.46	1.22	1.34	1.04	1.07	2.01	2.11	1.58
20.	1.12	2.52	4.53	5.05	5.09	3.48	5.12	3.54	5.58	5.31	4.35	4.09	4.14	4.42	3.21
21.	0.04	0.54	2.23	4.11	2.51	3.25	3.00	3.59	3.49	3.36	4.13	2.39	1.52	4.01	4.17
22.	2.16	3.29	5.07	4.07	5.26	4.39	5.26	4.46	3.10	5.55	5.12	2.30	4.10	6.54	4.31
23.	2.29	1.52	2.28	2.58	3.47	2.28	4.43	2.48	4.00	3.48	4.07	3.52	3.06	3.45	3.32
24.	0.18	0.04	0.52	0.11	0.48	1.01	1.17	0.58	0.49	1.07	1.12	2.52	1.16	2.24	1.16
25.	2.01	3.45	3.44	4.20	3.09	3.36	5.37	4.29	5.34	3.30	3.12	4.03	3.49	5.05	5.21
26.	1.34	1.42	3.00	0.55	0.26	0.43	2.46	1.43	3.07	4.09	4.32	2.01	2.24	4.00	4.41
27.	2.43	4.37	7.55	4.32	5.14	6.00	4.00	5.45	6.19	4.32	6.21	6.20	5.22	5.25	6.27
28.	1.20	1.29	1.03	1.01	0.58	2.13	2.41	2.08	1.58	2.03	2.02	1.59	3.04	2.37	2.42
29.	0.34	0.42	2.04	0.57	2.36	1.43	3.45	1.09	3.12	4.12	4.41	2.09	2.37	4.19	4.41
30.	1.09	4.04	3.10	3.35	4.15	3.58	3.34	3.21	4.26	4.01	3.26	3.18	4.43	4.14	3.16

Trials

APPENDIX B

Time in seconds of low Factor C subjects performing under stress were on target in ten second trials.

Subjects															
31.	4.09	3.30	3.36	5.00	5.13	5.43	5.22	3.11	4.08	3.36	4.03	7.02	5.00	3.28	4.32
32.	2.48	4.04	4.12	3.18	4.35	4.32	4.54	4.09	5.00	4.54	4.42	4.43	5.54	5.36	3.17
33.	2.04	4.58	3.18	3.55	6.38	4.33	5.54	5.00	6.30	6.33	6.18	7.40	6.00	6.06	7.00
34.	2.19	6.30	5.52	4.06	7.34	6.24	4.40	6.18	7.22	7.27	8.02	6.53	7.24	8.08	8.07
35.	3.05	5.43	8.00	4.36	2.53	4.15	3.31	2.42	3.06	5.27	3.51	3.17	5.26	5.35	5.30
36.	1.37	1.25	1.23	1.00	1.45	1.37	1.38	2.26	2.17	1.46	1.16	2.00	1.03	1.19	1.14
37.	2.57	3.19	3.17	3.02	4.24	4.00	4.27	4.49	3.42	5.17	4.28	5.21	6.37	4.13	4.41
38.	2.18	2.16	3.12	4.18	3.48	3.24	4.01	2.13	3.14	4.18	3.58	3.15	4.16	4.01	3.45
39.	2.17	3.18	4.49	4.40	4.45	1.47	4.40	4.41	5.00	5.12	4.01	4.11	5.13	5.32	5.06
40.	2.37	2.35	4.45	4.29	5.52	3.41	4.40	3.46	3.53	4.14	4.46	3.31	5.55	5.29	5.17
41.	3.13	3.38	4.00	3.25	5.19	4.32	7.19	6.11	6.17	3.09	4.32	4.30	4.30	5.07	6.00
42.	4.41	5.08	3.52	6.45	4.55	4.22	4.50	4.11	4.18	3.34	5.30	4.57	4.12	4.35	3.24
43.	1.18	1.58	2.00	1.51	1.29	2.46	2.59	3.08	3.15	2.00	3.19	2.43	2.52	3.33	3.48
44.	2.44	2.52	4.47	3.01	3.14	2.30	3.16	2.58	3.34	2.54	2.12	2.18	3.31	2.59	2.39
45.	4.56	3.50	2.56	4.29	4.46	6.17	5.53	6.40	4.19	5.36	5.30	6.00	5.48	5.59	5.00

Trials

APPENDIX C

Time in seconds of high Factor C subjects performing under no stress were on target in ten second trials.

Subjects															
46.	5.54	6.32	7.45	6.01	6.30	6.45	6.23	5.12	7.33	7.17	6.14	7.13	6.18	8.13	7.11
47.	6.30	7.20	7.26	7.29	6.38	4.18	7.04	5.38	4.25	7.53	5.07	6.15	5.17	6.18	6.39
48.	4.00	6.17	7.24	5.39	5.51	5.43	5.41	6.26	6.00	5.28	5.48	5.34	5.35	5.27	5.03
49.	7.45	7.50	7.30	7.15	7.04	7.26	7.07	7.48	7.45	8.18	8.24	7.40	7.18	8.12	8.14
50.	6.16	7.48	5.58	6.12	7.40	7.04	6.18	6.45	7.20	8.18	6.17	6.14	8.30	8.10	7.48
51.	7.17	7.27	7.26	7.15	7.15	7.59	7.41	7.03	7.38	7.22	7.39	7.33	7.00	7.41	7.04
52.	8.12	9.16	8.27	8.48	8.32	8.31	8.40	7.22	9.27	9.00	8.30	8.50	8.14	9.13	9.03
53.	4.40	3.12	4.32	5.50	5.59	5.25	5.28	5.46	5.03	5.08	5.10	5.24	5.25	5.11	5.30
54.	2.12	3.25	3.45	2.35	4.37	3.17	3.36	3.23	4.00	4.56	4.57	4.27	4.59	5.17	7.19
55.	4.48	4.45	2.24	4.52	2.54	3.02	4.06	4.23	4.45	4.30	6.40	4.11	4.11	4.45	5.52
56.	6.45	7.50	7.30	7.15	6.05	7.26	7.07	6.48	7.45	6.18	7.24	7.40	6.18	5.12	6.14
57.	4.23	9.16	8.29	8.46	8.34	8.33	8.38	7.24	9.29	9.13	8.37	8.53	10.00	8.47	9.17
58.	2.18	2.32	4.54	4.26	7.45	4.23	5.20	4.25	4.49	7.10	5.18	4.21	5.48	6.32	5.25
59.	4.13	2.17	4.14	3.44	4.54	4.37	5.52	4.38	4.19	4.09	4.14	4.47	4.54	5.00	7.00

Trials

APPENDIX D

Time in seconds of high Factor C subjects performing under stress were on target in ten second trials.

Subjects															
1.	2.46	4.04	4.12	3.18	4.35	4.32	4.54	4.09	5.00	4.54	4.42	4.43	5.54	5.36	3.17
2.	2.04	4.58	3.18	3.55	6.38	4.33	5.54	5.00	6.30	6.33	6.18	7.40	6.00	6.06	7.00
3.	1.19	6.30	5.52	4.06	7.34	6.24	4.40	6.18	7.22	7.27	8.02	6.53	7.24	8.08	8.07
4.	3.05	5.43	8.00	4.36	2.53	4.15	3.31	2.42	3.06	5.27	3.51	3.17	5.26	5.35	5.30
5.	0.37	0.25	0.23	0.00	0.45	0.37	0.38	1.26	1.17	0.46	0.52	1.44	1.00	1.19	1.02
6.	2.57	3.19	3.17	4.24	4.00	4.27	4.49	3.42	5.17	4.28	5.21	6.37	4.13	6.37	4.41
7.	2.25	3.00	3.13	1.47	2.47	0.56	2.13	2.48	2.03	1.53	2.12	2.39	2.25	2.59	2.43
8.	6.34	5.45	9.15	9.28	9.07	8.28	9.02	8.56	9.32	9.01	8.00	6.38	5.28	6.24	8.05
9.	3.27	5.59	4.22	4.17	6.15	3.52	5.01	4.10	4.51	5.05	4.42	4.42	3.45	3.32	3.32
10.	2.05	5.52	5.46	5.27	5.37	6.31	5.24	6.32	7.19	6.22	5.52	5.15	7.34	6.52	5.49
11.	2.46	4.04	4.12	3.18	4.35	4.32	4.52	4.09	5.00	4.54	4.42	4.43	5.54	5.36	3.17
12.	2.12	1.54	1.58	1.05	0.33	0.58	2.57	2.34	2.20	1.47	1.58	2.27	2.18	2.39	2.25
13.	2.15	2.19	3.32	3.13	3.32	3.25	4.50	5.00	5.07	5.32	3.45	4.40	5.02	4.40	3.15
14.	2.46	7.34	6.01	7.17	7.01	8.28	8.15	6.06	8.13	6.22	6.10	7.02	7.49	7.23	7.18
15.	3.27	5.59	4.22	4.17	6.15	3.52	5.01	4.10	4.51	5.05	4.42	4.42	3.54	3.23	3.32

Trials

APPENDIX E

Time in seconds of low Factor O subjects performing under no stress were on target in ten second trials.

Subjects															
16.	1.54	1.32	3.45	3.01	2.30	2.45	2.23	4.12	3.33	2.17	4.14	2.13	4.18	3.13	5.11
17.	4.01	3.44	6.02	6.20	6.58	7.02	5.41	8.08	7.40	7.25	5.55	7.40	6.07	8.02	7.41
18.	2.30	4.20	2.26	2.29	2.38	4.18	2.04	5.38	4.25	3.53	5.07	6.15	5.17	6.18	4.39
19.	2.00	2.17	3.24	5.39	5.51	5.43	5.41	6.26	6.00	5.28	5.48	5.24	5.45	5.27	5.03
20.	2.16	2.48	2.58	3.12	3.40	3.04	3.18	1.45	3.20	3.18	2.17	2.14	2.30	3.10	3.48
21.	3.33	2.38	3.24	2.36	2.16	2.10	4.22	2.16	3.05	2.00	3.17	4.13	3.04	2.04	3.13
22.	5.46	6.30	5.13	5.18	5.55	6.29	6.21	6.52	6.21	6.42	8.12	5.08	6.22	5.45	6.04
23.	4.40	3.12	4.32	5.50	5.59	5.25	5.28	5.46	5.03	5.08	5.15	5.24	5.25	5.18	5.30
24.	4.55	3.08	4.00	6.02	3.18	5.28	5.28	4.37	5.23	5.52	5.29	5.43	5.00	4.11	7.22
25.	2.27	5.12	5.10	5.50	6.02	5.35	6.25	7.13	5.23	6.25	5.59	5.26	6.00	5.17	4.44
26.	3.42	2.47	1.43	5.52	3.27	4.47	4.34	4.18	5.44	2.16	6.49	5.31	5.41	3.20	4.19
27.	4.18	6.12	7.31	7.07	7.00	5.48	6.15	7.23	8.16	8.01	7.17	7.02	8.01	7.58	6.12
28.	2.58	2.42	4.12	5.00	4.26	3.32	4.03	5.43	4.36	4.12	6.07	5.13	4.59	6.24	5.18
29.	4.16	5.23	4.16	6.18	6.47	7.02	6.58	7.16	6.59	7.24	7.36	7.14	7.07	6.43	6.07
30.	4.10	4.32	5.22	5.47	6.51	5.19	4.39	6.17	6.38	6.52	7.31	6.27	6.17	7.29	7.56

Trials

APPENDIX F

Time in seconds of low Factor O subjects performing under stress were on target in ten second trials.

Subjects															
31.	4.09	3.30	3.36	5.00	5.13	5.43	5.22	3.11	4.08	3.36	4.03	7.02	5.00	3.28	4.32
32.	3.46	4.52	6.02	5.44	6.17	4.08	7.49	5.48	7.59	6.22	4.49	5.48	6.31	6.50	5.43
33.	2.00	2.18	2.24	1.26	2.00	3.18	3.28	4.14	4.48	3.12	2.36	3.00	3.49	3.09	2.55
34.	0.25	1.30	1.24	0.53	2.18	2.45	4.15	2.18	1.58	2.08	3.18	3.16	3.21	2.18	5.18
35.	4.56	3.50	2.56	4.29	4.46	6.17	5.55	6.40	4.19	5.36	5.30	6.00	5.48	5.59	5.00
36.	3.48	4.54	6.00	5.46	6.19	4.06	7.51	5.50	8.01	6.20	4.47	5.46	6.33	6.48	5.41
37.	1.09	2.16	1.55	2.00	2.11	2.14	2.08	2.17	2.05	2.46	2.22	3.27	2.31	2.19	3.24
38.	0.00	0.19	1.54	0.58	2.42	1.58	3.35	2.58	2.15	2.01	2.49	2.32	3.07	3.01	2.17
39.	4.03	4.27	9.21	10.00	9.12	8.13	9.13	7.33	7.52	7.33	6.20	5.38	7.04	7.34	7.03
40.	3.10	3.12	2.32	4.00	4.00	4.15	3.20	3.11	3.20	3.27	2.34	3.37	4.20	4.32	3.55
41.	2.01	2.53	3.46	3.19	3.10	4.42	3.10	3.35	2.32	3.34	2.57	4.35	3.22	3.36	3.08
42.	4.47	8.14	6.46	8.19	5.07	8.12	7.53	6.44	8.51	8.28	7.52	8.51	8.19	8.37	8.24
43.	4.15	4.38	8.42	9.02	7.32	8.03	8.02	7.38	7.32	7.03	6.20	5.16	7.00	7.12	6.32
44.	3.10	3.12	2.23	4.09	4.00	4.15	3.20	3.11	3.20	3.27	2.34	3.37	4.20	4.32	3.55
45.	0.51	1.26	1.59	1.44	2.04	1.46	2.00	2.46	2.47	2.09	3.00	1.43	2.48	2.55	2.37

Trials

APPENDIX G

Time in seconds of high Factor O subjects performing under no stress were on target in ten second trials.

Subjects															
46.	0.48	1.45	2.24	1.52	2.54	3.02	1.06	1.23	1.45	1.30	3.40	1.55	2.11	2.45	2.53
47.	3.04	3.27	2.10	3.32	4.32	1.56	2.42	3.07	2.36	3.54	1.00	2.32	1.22	3.24	3.22
48.	2.01	2.43	2.16	1.58	2.03	1.04	3.12	1.02	2.13	3.04	2.58	2.16	2.48	1.58	2.07
49.	1.12	2.52	4.53	5.05	5.09	3.48	5.12	3.54	5.58	3.31	4.35	4.09	4.14	4.42	4.21
50.	2.18	2.52	2.58	2.45	2.49	2.58	3.04	3.46	3.58	3.03	2.08	3.28	3.33	2.38	3.30
51.	3.14	2.31	1.07	4.52	4.40	2.00	2.46	3.26	2.38	3.57	1.56	1.08	1.42	3.34	3.46
52.	1.45	6.50	8.15	8.19	8.59	7.01	7.42	7.43	7.06	6.55	7.48	6.40	6.36	4.48	5.15
53.	1.54	2.42	1.49	2.47	3.13	1.26	1.22	3.18	2.36	1.33	1.12	1.37	1.45	2.32	2.53
54.	2.03	2.10	1.17	2.34	3.42	3.43	3.13	3.17	4.52	4.12	3.32	2.52	1.44	3.22	3.19
55.	0.30	0.07	0.06	0.30	1.23	1.25	3.06	2.12	2.27	2.59	1.51	1.13	2.20	1.13	2.25
56.	2.34	3.20	3.31	2.10	2.06	2.42	3.58	1.37	0.24	2.26	1.19	2.16	3.51	3.17	3.05
57.	1.24	2.17	3.49	2.58	4.17	3.01	3.04	2.38	2.50	3.24	3.40	2.54	3.32	3.42	3.15
58.	2.27	3.41	3.31	3.12	2.04	4.13	2.07	4.34	4.49	2.00	4.40	3.25	4.42	4.06	3.47
59.	3.51	5.21	6.40	6.03	4.30	4.03	4.55	4.48	6.57	5.17	5.50	4.13	6.22	5.20	4.55
60.	2.32	2.38	3.47	2.51	3.03	3.12	4.05	4.38	3.42	3.08	4.27	4.42	4.18	4.08	4.38

Trials

APPENDIX H

Time in seconds of high Factor O subjects performing under stress were on target in ten second trials.