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An attempt is made to develop workable criteria of creativity which can be used in conjunction with a test battery and a biographical inventory to identify the creative scientist. The test battery consisted of six tests given to 143 chemical engineer seniors at the North Carolina State University between 1947 and 1951. Statistics are employed to relate the tests and inventory (independent variables) to the developed Supervisor Creativity Rating Form and Biographical Information Form (dependent variables). The major hypothesis is that there is a significant relationship between creative performance and personality characteristics, personal background, and specific abilities. It is found that only three of 12 characteristics in the Supervisor Rating Form were predicted significantly from the predictor variables--persistence, enthusiasm, and initiative. The biographical inventory did better in predicting than did the test battery, suggesting that creativity is best predicted from specific facts about a person, whether they be biographical facts, subjective ratings, or work history. (HW)

A PREDICTIVE VALIDITY STUDY OF CREATIVE MANAGERIAL PERFORMANCE

A Thesis

by

Susan Lee Hinman

Published By

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It is appropriate at this time to express my appreciation to those who have made it possible for me to successfully complete this thesis.

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I would like to express my gratitude to the North Carolina State Alumni Office for making its records available to me, and to Dr. J. F. Seely, who initially helped me locate the men involved.

At the University of North Carolina, I am indebted to many people. I would like to thank Dr. Richard Calhoon and Dr. Donald Hayman for their suggestions as members of my committee. The time and effort spent preparing my data by the University Computer Center are sincerely appreciated. I am most grateful to Dr. D. J. Moffie for his valuable assistance and guidance in the preparation and analysis of this material. His great enthusiasm and interest in the area of creativity have served as a primary motivation.

S. L. H.

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Chapter I

INTRODUCTION

Statement of the Problem

During the years between 1947 and 1951, 143 chemical engineers at the North Carolina State University were given a battery of six tests in their senior year. The major undertaking of this thesis was the development of criteria of creativity against which to correlate these previously administered tests. The criteria of creativity were constructed to assess "scientific" creativity rather than "artistic" creativity although some of the factors relevant to scientific creativity may be equally relevant to artistic creativity.

Hypotheses

The major hypothesis of this thesis is that there is a significant relationship between creative performance, as defined by the criteria, and personality characteristics, personal background, and specific abilities.

Several individual hypotheses will be investigated in this thesis:

1. There is a significant relationship between scientific aptitude, as measured by the Stanford Scientific Aptitude Test, and creative performance.

2. There is a significant relationship between intelligence, as measured by the Otis Mental Ability Test, and creative performance.

3. There is a significant relationship between emotional stability, as measured by the Bernreuter Personality Inventory-scale B1-N, and creative performance.

4. There is a significant relationship between self-sufficiency, as measured by the Bernreuter Personality Inventory-scale B2-S, and creative performance.

5. There is a significant relationship between dominance, as measured by the Bernreuter Personality Inventory-scale B4-D, and creative performance.

6. There is a significant relationship between understanding physical and mechanical relationships, as measured by the Bennett Test of Mechanical Comprehension, and creative performance.

7. There is a significant relationship between certain vocational interest patterns on the Strong Vocational Interest Blank, and creative performance.

Purpose of the Thesis

The purpose of this thesis was to develop workable criteria of creativity that could be used in conjunction with the test battery and biographical inventory to identify the creative scientist. Various statistical methods are employed to relate the tests and inventory (the independent variables) to the developed Supervisor Creativity Rating Form and Biographical Information Form (dependent variables). The great wealth of information obtained from these forms is used to develop predictors of creativity and to expand the knowledge available in this field.

Description of the Situation

Between 1947 and 1951, 143 seniors in chemical engineering at the North Carolina State University took a battery of tests administered by Dr. D. J. Moffie.[1] These tests were given with the understanding on the part of the faculty and students that the results were to be utilized for future research purposes.

In the fall of 1965 the Richardson Foundation, a philanthropic organization in Greensboro, North Carolina, expressed a willingness to support a study that would explore the concept of creativity. This organization is concerned with supporting and encouraging research in the area of creativity in the hope that the creative potential of the American people may be promoted. It was anticipated that by establishing legitimate and workable criteria of creativity and by studying the possibility of predicting creativity with these tests and the biographical inventory, the data might provide further enlightenment on the subject of creativity.

The research design develops criteria of creativity by two methods: (1) a supervisor rating form to measure on-the-job creativity; and (2) a self-rating biographical information form. Following the development of these two forms, the next step was to locate the 143 chemical engineers who had graduated 15 years previously. Dr. J. F. Seely, professor of chemical engineering at North Carolina State University, helped to locate the men who could not be traced from their university alumni cards. Initially, about forty self-addressed postcards were sent to check unlikely addresses and to trace those who had recently moved. The first formal communication to be

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1. Dr. D. J. Moffie was at that time a professor and head of the Psychology Department at North Carolina State University.

made with the original sample was a letter of introduction and explanation. This letter requested their cooperation and stated that a package containing the mentioned material would arrive shortly. A week later each of the chemical engineers received a full package of materials, containing the following:

1. A second letter of introduction and explanation.
2. A Biographical Inventory form and answer sheet.
3. A Biographical Information form.
4. A return-addressed, stamped envelope in which to mail the forms.
5. A brief letter of explanation and introduction to the man's supervisor asking his cooperation in filling out the rating form.
6. The Supervisor Rating form.
7. A return-addressed, stamped envelope in which the supervisor could directly mail his form.

During the last two weeks in January, 1966, this material was sent to the engineers. In the last two weeks of March, a personal letter was sent to the 74 men who had not responded to the communications. This letter urged them to complete the forms as soon as possible. Telephone calls were later placed to those who had still not responded. Samples of these letters are set forth in Appendixes A and B.

Finally, the obtained data were scored and coded so that they could be analyzed by a computer. In order to examine the hypotheses originally set forth, statistical methods were employed to relate the criteria and biographical information. The conclusions and recommendations of this thesis are based upon the statistical analyses of the data obtained in this study.

Chapter II

REVIEW OF THE LITERATURE

This thesis involves (1) the development of criteria of creativity and (2) the determination of relationships of psychological test scores to the criteria. This chapter, therefore, is divided into two sections. The first deals with a review of the literature concerning criteria of creativity; the second deals with studies on prediction of creativity.

Criteria

Researchers have developed many different approaches to the study of creativity and, consequently, the existence of multiple criteria has been recognized. At the present time a mutually agreeable definition of creativity has not been formulated. (56, 61) Ghiselin defines creativity as "the measure of the creative product considering the extent to which it restructures our universe of understanding."[1] Lacklen has stated that the amount of creativity is determined by the area of science that the contribution underlies: the more creative the act, the wider its effects.[2]

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1. C. W. Taylor, Creativity: Progress and Potential (New York: McGraw-Hill, Inc., 1964), p. 6.

2. Ibid., pp. 6, 7.

Sprecher feels that the extent of creativeness is influenced by the novelty and value of the contribution as well as the work habits involved.[3] In this thesis creativity is measured by an examination of the implications, impact, and originality of the contribution, consideration of the comprehensiveness and novelty of the solution, and determination of the degree to which the creative act has stimulated further research.[4]

Studies specifically devoted to the criterion problem are identified with fourteen investigators.[5] These researchers indicate that creativity, as intelligence, may be composed of many abilities. The research and literature suggest two approaches to the construction of a practical criterion of creativity. The criterion-seeker may choose to measure either the value, novelty, quantity of the contribution, or the behavior, skills, and characteristics of the person who made the contribution.

The more acceptable and popular approach has been to evaluate the tangible product of the creative act. (20, 22, 24, 34, 45, 47, 48) After the products are judged to be creative, this term "creative" can then be applied to the behavior that produced them, and then to the individuals who can be said to possess some degree of the trait creativity. (47) This therefore seems to be a step-by-step progression, culminating in the identification of the "creative individual."

Most validation studies are criticized because of their subjective

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3. R. E. Stolz, "Criterion dimensions in research productivity," Amer. Psy., 12 (1957), 443.

4. C. W. Taylor and R. L. Ellison, The Biographical Inventory, Form CRI. Greensboro, N.C.: The Richardson Foundation, 1964.

5. Taylor, Creativity: Progress and Potential, p. 157. These references are recorded in the bibliography: (5, 6, 12, 23, 26, 29, 44, 45, 46, 52, 53, 54, 55, 66, 67, 70, 72).

evaluation of the product or the person. (27, 48) Some studies avoid the subjectivity involved in ratings by using a numerical count of publications, patents or novel ideas as criteria, but, unfortunately, the relationship of these criteria to the psychological correlates of creativity is tenuous.[6] Since gathering the ultimate criteria, the sum total of a man's lifetime creative acts, is not feasible, several studies suggest the use of a combination of approximate criteria. (20, 34, 58) Opinion supports the hypothesis that there is an advantage to using many approximate criteria together: any distortion introduced by an instrument incompetently applied or defective in itself will tend to be reduced.

In studying scientific creativity, researchers consistently return to certain types of "objective" criteria: patents, patent disclosures, publications, unpublished research reports, unprinted oral presentations, improved processes, new instruments, new analytical methods, ideas, new products, new compounds. A numerical count of these products has not proven as effective as ratings which also consider the novelty, quality and breadth of applicability of the product. (24, 34, 45, 56) Ideally, each creative contribution should be evaluated by authorities in that particular area. Publications should be considered in the light of joint-authorship, environmental controls, and evaluation of title, length, references and content. Environmental influences complicate the use of such productive criteria since environmental controls alter the visible output of scientists and engineers. This is an important consideration when comparing the creativity of men who are employed by different companies and educational institutions. One example of the influence of the environment is the positive correlation between the

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6. John R. Hinrichs, "Creativity in industrial scientific research," AMA Bull., 12 (1961)

number of papers published and the amount of freedom the individual is allowed in choosing his own research problem.[7]

On-the-job behavior, skills, and personality characteristics of the individual who made the creative contribution have also been measured and used as criteria of creativity. Some of the most interesting research available has been obtained by examining the traits common to creative men. Researchers have obtained a tentative list of these typical traits in numerous ways. Some studies have approached the individual directly and have asked him to describe personal characteristics, behaviors, and traits responsible for his creative activities. (19, 46) Sprecher (45) and Flanaga (13) were interested in this type of approach. Sprecher discovered that creative engineers in an aircraft manufacturing firm emphasized the importance of work habits such as independence, planning work, and comprehensive answers as much as the production of unusual ideas in creative work. Flanagan suggests that creative individuals compile lists of "incidents" that are "critical" to creative performance so that men can be rated on creativity simply by using this behavior check-list. Other studies have employed psychometric devices to determine the characteristics that could differentiate the high-creatives from the low-creatives. (4, 10, 16, 19, 50, 56) Using construct validity, inferential data, long-term trends, and biographical analysis, numerous researchers have compiled what appear to be the component characteristics of the creative individual. (4, 10, 30, 37, 41, 56, 65)

Most of the available research supports the hypothesis that creativity is related to better-than-average intelligence. General intelligence seems

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7. Leo Meltzer, "Scientific productivity in organizational settings," J. Social Issues, 12 (1956), 39.

to bear the same relationship to on-the-job creativity at the professional level as weight does to ability in football. You have to have a lot of weight to be in the game at all; but among those on the team, all of whom have a great deal of weight (intelligence) to begin with, differences in performance are only slightly, if at all, related. In short, in the total population, creativity in most fields is associated with high intelligence. But, within a given group of practitioners operating at roughly the same professional level, differences in general intelligence provide no significant prediction of differences in creative performances.[8] Getzels and Jackson found that there was a difference in IQ between the very intelligent child and the very creative child, the former having an IQ of 150 and the latter having an IQ of 127, a 20 percent difference.[9] Several researchers suggest that the creative individual's rather high IQ may account for the linear relationship between creativity and the number of years of education. (10, 30, 35, 40, 43, 50) Guilford has gone so far as to break down the intellectual characteristics most likely to be valid measures of creative talent.[10] One study reports that if an intelligence test were used to select top-level scientific talent, about 70 percent of the persons who had the highest 20 percent of the scores in creativity would be missed.[11]

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8. Gary A. Steiner, The Creative Organization. Selected papers #2. Proceedings of Seminar, Graduate School of Business (Chicago, Ill.: University of Chicago Press, 1962).

9. J. W. Getzels and P. W. Jackson, "The highly intelligent and highly creative adolescent: a summary of some research findings," The 1959 University of Utah Research Conference on the Identification of Creative Scientific Talent. Edited by C. W. Taylor (Salt Lake City, Utah: University of Utah Press, 1959), pp. 46-57.

10. J. P. Guilford, "Intellectual resources and their values as seen by scientists," ibid., pp. 139-149.

11. Sidney Parnes and H. Harding. A Source Book of Creative Thinking (New York: Scribner's, 1962).

Highly creative individuals have been found to conform less than do non-creative individuals. This seems reasonable since creative scientists and engineers must be willing to try things that do not conform to the usual pattern. (17, 27, 50) Creative people consistently score higher on traits of independence and autonomy on personality scales and appear to be more independent in judgment. (2, 18, 45, 48, 50) This would suggest that a culture which stresses conformity may eventually destroy itself since innovation may be eliminated. (30, 74)

High motivation appears to be characteristic of the creative individual. (4, 30, 41, 43, 45, 48, 65, 71) These people manifest a high interest in their work. The job evokes their spontaneous enthusiasm and deep concern: "To a certain extent work becomes his religion, the most important avenue for life fulfillment, his striving for completion."[12] The creative individual is more persistent in his work even if it is difficult and time-consuming. (50, 65) He seems to be driven more by interest and involvement in the task itself than by external incentives. Steiner suggests that there may be a limit to the amount of motivation that creative endeavors can tolerate. He states that the creative process is characterized by a sense of commitment, preoccupation, and perseverance. At the same time, high motivation narrows the focus and produces a rigidity which would tend to reduce creativity. It seems possible, then, that there may be a curvilinear relationship between creativity and motivation.[13] One may need enough motivation to maintain effort but not so much that it will produce attempts at immediate, rash solutions.

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12. Eugene Raudsepp, Managing Creative Scientists and Engineers (New York: Macmillan Co., 1963), p. 33.

13. Steiner, The Creative Organization, p. 19.

High activity levels are common among highly creative individuals. (10, 17, 30, 37, 45, 46, 48, 56, 61, 65) One study tested outstandingly creative chemists and mathematicians. A significant difference between the high-creative group and the low-creative group was that the high-creatives channeled enormous amounts of energy into productive research effort.[14] Some researchers have suggested that it is this high activity level that makes them appear to be obsessed with their work.

Creative people are able to produce an abundance of ideas and suggestions rapidly and, apparently, with minimal effort. (19, 56) Because they can suggest many alternatives to a given problem, they have more opportunity to find a creative solution. This does not imply that there is a linear relationship between quantity and quality of ideas. (37) The most valuable man is the one who can produce many ideas but who can also discriminate and select the best. (25, 41, 45, 60, 65)

The creative individual perhaps has a knack for perceiving and observing the unusual. This is demonstrated by his ability to slice phenomena into fresh perspectives and to devise uncommon solutions to problems. He can take apart firmly structured and established systems, dissolve pre-existing syntheses, and use elements and concepts beyond the limitations they possess in their primary contexts. (19, 41, 45, 46, 50) This ability to penetrate beyond the obvious and immediate was thought to be of great importance in creativity by a group of highly creative scientists.[15] The creative in-

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14. B. S. Bloom, "Creativity research at the University of Chicago," The 1955 University of Utah Research Conference on the Identification of Creative Scientific Talent. Edited by C. W. Taylor (Salt Lake City, Utah: University of Utah Press, 1956), p. 188.

15. Guilford, 1959 University of Utah Research Conference, p. 139.

dividual is open to experience and can profit from it. (10, 30, 50)

Creative people are more flexible in their general work habits, capable of revising a pre-established approach to a problem when it gives evidence of being unsatisfactory. This may be due to the fact that they seem to have a less rigid personality structure. (71) The more inventive a person, the less inhibited and conventional are his actions. (10, 30, 48, 50) The creative person can delay judgment until he has considered a situation adequately. He can recombine, reverse and rearrange his present information to produce a novel approach to a situation. (37, 65)

The highly creative person possesses an active curiosity which predisposes him to inquire into anything that evokes his interest. He enjoys discovery for itself and appears to be motivated toward delving into things. Interestingly, the curiosity of the creative individual usually extends far beyond the narrow confines of one sphere of interest and into many fields and topics. Things that are taken for granted by most people are full of mystery and interest for the creative individual. (17, 19, 30, 37, 41, 50, 56, 65)

One would be inclined to make the assumption that the individual who possesses the extra ability to be creative in his field must have sufficient knowledge of his work to function adequately. Available research supports the hypothesis that high general intelligence and above-average working knowledge are usually characteristic of the creative individual. (10, 19, 30, 45, 46, 65) Creativity demands a backlog of information from which to draw and, consequently, most creative men make education and the acquisition of up-to-date knowledge a vital part of their daily work.[16]

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16. Raudsepp, Managing Creative Scientists and Engineers, p. 51.

Some interesting investigations have been made in the hope of gaining insight into the personality structure of the creative individual. Cattell obtained biographies of historic personages noted for their inventiveness and creativity. Utilizing the personality factors he had developed, he was able to assemble biographical material to arrive at a description of the creative individual. He administered the sixteen Personality Factor Tests to exceptionally productive research scientists. As compared to the average man, he found the scientist who was creatively productive to be more internally preoccupied, intelligent, dominant, and self-sufficient. (8) Barron, as part of an extensive program designed to identify individuals who consistently performed creatively, utilized the Rorschach, the TAT and his own ink-blots. He defined creativity as an "unusual response" on the task. He found that creative people were more independent in making judgments, more self-assertive, more dominant and less hesitant in considering new and unusual ideas. (2)

After examining the literature available on the criteria of creativity, it appears evident that researchers in this area have not been able to determine a conclusive list of workable criteria. All of the criteria mentioned in the previous section appear to have a definite relationship to creativity, but the determination of the extent of these relationships has been left to future research.

Prediction of Creativity

The small number of studies relevant to the prediction of creativity has produced little conclusive evidence. The most recent research data reveal that biographical information is the most promising means of identifying

creative talent.[17] It has been demonstrated to be a better predictor of creativity than high-level aptitude tests, intelligence measures, or personality test measures.

The biographical inventory used in this thesis was developed by C. W. Taylor and R. L. Ellison and is presently an important research tool for the Richardson Foundation. This inventory form contains a wide variety of questions concerning childhood activities, experiences, dissatisfactions and satisfactions, parents and family, academic experiences, attitudes, interests, value preferences, self-descriptions and evaluations. This biographical inventory form has been described as an "instrument consisting of a great many little oars, with each oar pulling only slightly in the right direction, but with all the oars in concert exerting a powerful pull. We caution people not to lean too heavily on any single oar."[18] Correlations as high as +.47 have been obtained between the biographical inventory with certain criteria of creativity. (63)

In 1961 the inventory was used at Lackland Air Force Base. This biographical inventory correlated highly with these criteria of creativity: supervisory ratings of creativity, supervisory ratings of overall performance, creativity ratings by laboratory chiefs, and ratings on originality in written work. The following list contains descriptions of the psychological characteristics of the creative scientist. The first two characteristics were valid for all four of the creativity criteria, the next five in the list were valid for only one or two of the four criteria of creativity. Using these criteria, the following description of the

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17. C. W. Taylor and R. L. Ellison, "Predicting Creative Performance from Multiple Measures," in Widening Horizons in Creativity. Edited by C. W. Taylor (New York: John Wiley and Sons, 1964), pp. 227-240.

18. Ibid., p. 231.

creative scientist was developed: creative, inner-directedness, drive, cognition, quantity of reports, theoretical contribution, desire for principles, discrimination of value, aggressiveness, affability, professional self-confidence, low sociability, high self-sufficiency, dedication to work, self-reported academic level, and intellectual thoroughness. These results indicate the complexity of the prediction problem in terms of the number of variables functioning in creative performances. "Creative performance is dependent upon a large number of relatively separate variables, each one of which accounts generally for only a small unique and frequently almost statistically insignificant part of the total variation in creative performance. The validities of the best single scores for each criterion ranged in the .40's, .30's and .20's with a sizable number of scores being valid for most of the criteria."[19]

The data from this study at Lackland Air Force Base were further analyzed at a later date. The main types of predictor measures used in the study and the number of scores for each type of test are listed in the following table. This table shows the percentage of scores valid for

Table I

PERCENTAGE OF SCORES VALID FOR EACH PREDICTOR MEASURE AGAINST THE FOUR MOST CREATIVE CRITERIA

Number of Scores per Type of Test	(Predictive Measure) Type of Test	Percent of Four Most Creative Criteria
30	Biographical inventory	63%
17	Self-ratings	26%
1	Grade point average	25%
10	Cattell's Motivational Analysis Test	7%
26	Saunders' Personality Research Inventory	7%
16	Intellectual Aptitude Test	0%

19. Ibid., p. 253.

each predictor measure against the four most creative criteria. A predictor score was considered valid each time it correlated +.19 or greater (above the .05 level of significance).[20]

Another biographical information blank was used to make predictions of creativity for chemists and physicists. Out of the 98 items presented on the blank, the following variables best identified creative men: outstanding high school work, top 10 percent of college class, absence of high school athletics, graduation from high school at 16, absence of interest in the administrative aspects of scientific work. (32)

Biographical inventories have often been avoided by researchers because they are of questionable validity when used on any population sample other than the original one. Another criticism is that this "hodgepodge of motivational and personality traits"[21] approaches the prediction of creativity in a hit-or-miss fashion. (39)

Buel and Bachner investigated the descriptive and predictive validity of several psychometric instruments for creativity. (6) Their instruments described the creative person as being intelligent, literary and extremely energetic. The authors used two different criteria of creativity with these instruments: a rather subjective measure of creativity, and a number of patents presently held by the man. They hypothesized that the number of patents would not give a true indication of creative ability unless quality was a considered factor. They support this hypothesis with the fact that the Thurstone Stability scale correlated +.21 with their general measure of creativity and -.08 with the number of patents. The Thurstone Sociability scale, however, correlated +.11 with the criteria of patents while most studies have

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20. Ibid., p. 244.

21. Ibid., p. 253.

indicated that the creative individual is generally less social than the average person. Using the Kuder Preference Record and criteria of general scientific creativity, they had the following correlations: +.15 with computational interests, +.11 with persuasive interests, +.17 with scientific interests, and +.29 with literary interests.

By using the 47 items on the Strong Vocational Interest Blank that dealt with avoiding interpersonal contact, other researchers discovered that scientists and non-scientists could be differentiated. Their other psychometric measures indicated that chemists, engineers and mathematicians do avoid interpersonal contact and are highly self-sufficient. (33)

The Aluminium Company of Canada employed both the Kuder Preference Record and the Strong Vocational Interest Inventory to predict good research workers. Certain scales on the Strong discriminated significantly between the most and least successful workers. The most successful research men scored higher on the following scores: artist, psychologist, architect, physician, dentist, mathematician, physicist, engineer, chemist. On the following scales the least successful research men scored highest: sales manager, mortician, real estate salesman, life insurance salesman, and author-journalist. (28)

The National Merit Scholarship program found that, using a sample of 649 boys, certain aptitude and personality variables could be attributed to the creative individual. Using criteria of creativity based on product output, awards, etc., the following variables correlated significantly with their criteria of creativity: +.15 with artistic performance, +.36 with creative activities, +.10 with independent judgment, +.10 with mastery of facts, +.11 with ability to defer gratification, +.09 with breadth of interest, +.11 with initiative, +.09 with self-assurance, +.18 with physical

activity, +.23 with intellectuality, -.17 with responsibility, -.07 with conformity, -.10 with verbal activity, -.18 with status drive. (28)

Both Buel (6) and Sprecher (45) used a criterion of creativity developed from their subjects' descriptions of the creative act. Buel obtained 900 definitions of creativity from a group of scientists; the supervisors of these scientists then rated them on creativity using their own definitions of creativity. These creativity criteria ratings correlated with certain personality and behavioral variables: +.62 with the ability to converse on the latest technical developments; +.58 with the habit of looking for a new way of doing things, +.55 with expressing desire to work on complex problems, +.41 with participation in professional societies in his field, +.41 with supervisory work in his area of specialization, +.38 with his ability to make new approaches to a problem, +.24 with enthusiasm for work, +.43 with energetic behavior, +.33 with willingness to work overtime, and +.32 with questioning orders of his supervisors. The creativity ratings correlated +.42 with patent disclosures, +.40 with patent applications, +.29 with patents issued, and +.13 with publication number.

Sprecher (45) developed a creativity rating form by obtaining descriptions of behaviors that were considered to indicate creativity, phrasing them neutrally, and putting 72 of these statements into six separate, but equal, sets. Raters were asked to decide whether each of the statements was, in their personal opinion, characteristic of creativity, and to mark it accordingly. Results over a period of time proved that dissimilar occupational groups considered different aspects of behavior to be important in the creative process. Sprecher thought that this finding emphasized the importance of carefully defining "creative" when asked for subjective ratings on this trait. By describing all the behaviors characteristic of creativity, the rater simply

had to check the behaviors that could be identified with the ratee. Using this system of rating, there would be less chance of making individually subjective determinations based on personal definitions of creativity.

Flanagan's use of "critical incidents" (13) is also directed toward eliminating the subjectivity of ratings by describing behaviors rather than working with semantic images. Sprecher discovered that certain work habits were considered part of the creative act: independence, the production of many novel and valuable ideas, a liking for problems, the ability to analyze, technical competence, the ability to plan ahead, energetic work, perseverance, and the ability to communicate and participate in good personal relations.

Cattell's Sixteen Personality Factors questionnaire and Thurstone's Primary Mental Abilities Test were used at the University of Nebraska. The only significantly different factor between the creative and non-creative groups on the Thurstone was "verbal meaning." On the Cattell Personality Factors, the creative group scored higher on "self-sufficiency versus lack of resolution." (11)

An extensive study using Navy personnel yielded interesting results on the relationship between certain tests and behavior variables, and creative research work. (68) Taylor developed a check-list creativity rating scale for scientific researchers consisting of 206 statements describing originality. Later, a panel of 45 judges carefully selected from these 206 statements the 79 that statistically showed the least dispersion and ambiguity. Using these 79 statements, 103 men were rated on creativity by their supervisors. Several months later Taylor developed a descriptive rating form scale using several variables considered to be important in research work. These were quality of work, quantity of work, initiative, originality, attitude toward work and skill in getting along with people. Each separate variable was

first defined and then followed by a seven-step scale with each step on the scale being defined by a series of descriptive phrases. The same sample of 103 men was rated by this scale. These men had taken the following tests: the Strong Vocational Interest Blank which was scored for the engineering scale, the Terman Concept Mastery Test developed for use with gifted children, the Owen-Bennett Mechanical Comprehension Test, the Test for Productive Thinking by the Psychological Corporation, and the Test for Selecting Research Personnel developed by the American Institute for Research. When these tests were related to the descriptive and check-list rating forms, the following statistical correlations were obtained:

Table II

CORRELATIONS BETWEEN TESTS AND CHECK-LIST RATING FORM AND DESCRIPTIVE RATING FORM

	Strong Vocational Interest Blank	Terman Concept Mastery Test	Owen-Bennett Mechanical Comprehension Test	Productive Thinking	Selective Research Personnel
Check-List Rating Form	+.03	+.20	+.29*	+.24*	+.36*
Descriptive Rating Form					
Quality of work	+.16		+.20		+.24
Quantity of work					
Initiative	+.16		+.21	+.11	+.20
Originality			+.15	+.25	+.19
Attitude toward work				+.14	
Skill-with-people		+.22	+.10	+.19	+.26

*.05 significance

In order that tests might be employed to predict creativity in physical scientists, an extensive study was conducted to measure general and creative

contributions. Only the first part of this study has been completed. Two hundred and fifty scientists listed numerous scientific contributions and measurements that could be made to detect creativity in their field. From these, 56 criterion items were selected as representative of productivity and creativity. The findings revealed that creativity ratings from supervisors, peers and monitors often correlated significantly: correlations between subjectively and objectively obtained data were negligible; correlations between supervisor and peer ratings for creativity and scores for research reports and publications were zero. Generally, each one of the 56 criteria correlated significantly with only 20 percent of the other criteria. The data were further analyzed by factor analysis to determine the relationships and clusterings of the contribution scores for 166 scientists. The main categories of 52 contribution scores proved to be largely unrelated. Statistically, they formed 15 relatively independent categories into which the contribution scores were classified; no more than 13 scores were sorted into any one category. Six of these categories were related to creativity. The first of these categories was "originality of work and thought." It was composed of the following items: rated originality of reports, rated significance of reports, number of suggestions made, and patent rate. (65) Examination of these categories and contributing scores is thought-provoking and demonstrates the complexity of the creativity criteria problem.

It is interesting to note that simple self-ratings on creativity have had a moderate validity for a variety of creative performances. The National Merit Scholarship study found evidence that self-ratings correlate as well as their other predictors with the various criteria of creativity. (28, 50) In this study self-ratings on creativity correlated +.15 with the criteria of creativity. Taylor and Ellison (63) also mention that the self-ratings are valid

for every criterion possessing creative features in their study of Air Force scientists. These self-ratings were the best all-around predictors of creativity for all of the 17 criteria.

The studies cited have accepted validities between tests and their criteria of creativity as low as +.20. When it has been impossible to obtain validities even in this range, researchers have thought it best to gather together as many of the low validities as possible. Creative performances are extremely complex and no single test, no single theory of creativity will account for much of the total phenomena unless the single variable is, itself, very complex. Available information indicates that creativity is a complex multivariable phenomenon, demanding, perhaps, as many as twenty dimensions of human performance to account for creative behavior. This is undoubtedly why the biographical inventory has had the most success in predicting creative performance. (42, 63)

Conclusion

Generally speaking, the literature available on the prediction of creativity is neither extensive nor conclusive. All research indicates that creativity is a multivariate characteristic. No one criterion of creativity has been proven successful and not one predictor variable can consistently detect the creative person. Although researchers have been able to establish that the three most reliable predictor variables are biographical information, specific tests, and self-ratings on creativity, the small size of the correlations between these and the criteria of creativity have made results extremely tenuous. It is the purpose of this thesis to contribute additional information to this area by examining the relationship between test scores, personality traits, and biographical information.

Chapter III

METHODS AND PROCEDURES

General Design of the Study

A battery of psychological tests was administered to 143 graduating chemical engineers at the North Carolina State University during the years 1947-51. The purpose of this study was to assess the creative performance of these engineers some fifteen to twenty years after graduation and to relate the performance to test data secured at the time of graduation.

Independent and Dependent Variables

The supervisor rating form. The chemical engineers received this form directly and were asked to forward it to their immediate supervisor. A return-addressed, stamped envelope was included so that the form was sent directly back to the investigator. The form requested the supervisor to grade his colleague on the following traits: creativity, enthusiasm for work, persistance, independence, fluency of ideas, ability to perceive and observe, flexibility in work habits and procedures, initiative, knowledge of work, tendency toward conformity, and curiosity. These traits were selected after an extensive examination of the literature and consultation with men in scientific areas. They were the ones consistently chosen to be related to

creativity. Each supervisor had to rank his individual colleague in a group of one hundred on the basis of his professional creative performance.

This form was constructed to minimize the semantical difficulties inherent in any type of rating form. The instruction page was followed by thirteen different-colored pages, each of which presented one of the traits. The characteristics were initially defined to provide the 76 supervisors with singular working definitions. A scale ranging from 1 through 11 followed each trait except the first: this was scored on a scale of 1 through 15 because it had been previously validated on the original Richardson form for Scientific Productivity. The even numbers on each scale were further defined in order to specify the degree of the trait that each number represented. The supervisor was to consider the trait as it was defined, find the scale number that best described the man in question, and then insert this number in the box provided at the upper left of the page.[1] A sample form is set forth in Appendix C.

The scores obtained from these forms were individually related to the predictor variables. The over-all ranking on creativity was used both as a predictor and a criterion variable in this study.

Biographical information sheet. This form was sent directly to each member in the study. Specific information was requested about his job, professional work, society memberships, awards, etc. Numerical estimates of the number of creative productions and descriptions of these were used. The man was required to rank himself on creativity as compared to 100 men in his

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1. The design of this rating form is based upon the same theory supported in Flanagan's "Critical Incident" technique. He found that a description of behavior, rather than the definition of a trait, made it possible for independent observers to make comparable reports. J. C. Flanagan, "Critical Incident Technique," Psy. Bull., 51 (1954), 327.

field. The information obtained in this form was primarily intended to supply tangible evidence of a man's creative productivity. The number of patents per year, the number of ideas produced, etc., were used as part of the dependent variable. Some of the biographical information gathered in this form was not used in the study. A sample form is set forth in Appendix D.

The scaling procedure on this form was difficult to construct. All of the questions demanding numerical estimates were multiplied by ten and tallied, giving each chemical engineer a single score for his tangible creative work. The self-rating score was used separately as a dependent and independent variable.

Biographical inventory of C. W. Taylor and R. L. Ellison. This form was supplied and scored by the Richardson Foundation. Since biographical information had been proven to be a possible predictor of creativity in previous studies, this form was included in the hope of further substantiating this knowledge. This inventory was sent directly to the engineers with the other two forms. A sample form is set forth in Appendix E.

The form itself contained 160 multiple-choice questions pertaining to all aspects of human experience. Four scores were derived from it. Score #1 was Professional Self-Confidence--the person's own assessment of his professional competence. Score #2 was Over-all Creativity--all items scored here were keyed against the creativity criteria. Score #3 was the Correction Score--above 50 indicated false modesty on the part of the individual completing the inventory, while below 50 indicated exaggeration. Score #4 was a Total Score figured from the other three.

This inventory was used as part of the predictor variables.

Tests Used[2]

Otis Self-Administering Test of Mental Ability. This test is purported by its author to measure mental ability, general thinking and intelligence. It is the easiest of the ability tests to administer and the most economical. The validity and reliability of the Otis have been computed from large and varied norm groups. The reliability of the test is consistently about +.90. The validity is +.50 and +.60, using the rate of school progress as the major criteria. A twenty-minute time limit was used in the sample.[3]

Stanford Scientific Aptitude Test. This test was intended to be an index of scientific aptitude and is concerned with detecting a combination of basic traits which enter into what may be called an aptitude for science or engineering. Buros states that the test's validity is questionable and the ability of this instrument to predict scientific performance or achievement remains to be demonstrated. Buros states that "the test is one of early vintage and cannot be recommended for the measurement of scientific aptitude." Using a criterion of scholastic grades, the results of the Stanford Scientific Aptitude Test correlated with these grades in the following courses: +.77 using chemistry students, +.95 using physics students and +.89 using electrical engineers. Unfortunately only 50 men were in this norm group.[4] The exercises contained in the test are descriptive of it. They are: experimental bent, clarity of definition, suspended versus snap judgment,

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2. Oscar K. Buros (ed.), Mental Measurements Yearbook, 5th Ed. (Highland Park, N.J.: Rutgers University Press, 1935).

3. Arthur S. Otis, Otis Mental Ability Test (New York: Harcourt, Brace and World, Inc., 1954).

4. D. L. Zyve, Stanford Scientific Aptitude Test (Palo Alto, Calif.: Consulting Psy. Press, 1937).

reasoning, inconsistencies, fallacies, induction-deduction, generalization caution, thoroughness, discrimination and arrangement of experimental data, accuracy of observation and interpretation. This test was administered with no time limit but normally requires about an hour and a half to administer.

Bernreuter Personality Inventory. The Bernreuter Personality Inventory deals primarily with personality evaluation. It tends to identify general personality inadequacies better than it evaluates individual suitability for particular jobs or life situations. Three scales were used in this study.

B1-N. This score is a measure of neurotic tendencies. Persons scoring high on this scale tend to be emotionally unstable. Extremely high scores indicate a need for psychiatric examination, while those scoring low tend to be emotionally well balanced.

B2-S. This is a scale of self-sufficiency. Persons scoring high on this scale prefer to be alone, rarely asking sympathy or encouragement, and tend to ignore the advice of others. Those scoring low on this scale dislike solitude and often seek advice and encouragement.

B4-D. This is a measure of dominance-submission. Persons scoring high on this scale tend to dominate others in face-to-face situations. Those scoring low tend to be submissive.

The reliability of the test is between +.85 and +.92. Information on the validity of this test is scarce. The weights on scoring keys were computed on the basis of the extent to which each question differentiated between the criterion groups composed of these extreme individuals.[5]

The Strong Vocational Interest Blank. The interest blank compares

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5. Robert Bernreuter, Bernreuter Personality Inventory (Stanford, Calif.: Stanford University Press, 1935).

the similarity or dissimilarity of an individual's interest pattern with those people who are successfully employed in the occupation. The blank itself contains 400 test items listing occupations, school subjects, hobbies, etc. to which persons respond by expressing like, dislike, or indifference. The men's scores are available for more than 50 occupations and these are divided into groups. The sample of engineers was scored on the following groups: (1) Biological sciences, (2) Engineering and physical sciences, (5) Social service and welfare occupations, (8) Business detail and administration, (9) Sales or business contact, (10) Verbal or linguistic occupations, Engineer scale, Chemist scale, Production Manager scale, Personnel Manager scale, and Occupational level. The reliability of the test using the odd-versus-even technique gives a coefficient of .877. Extremely high validities are presented.[6]

Bennett Test of Mechanical Comprehension. This test was designed to measure the ability to understand the relationship of physical forces and mechanical elements in practical situations. It contains 60 items which include a picture exhibiting one or more objects, or physical or mechanical relationships about which a question permitting a categorical answer is asked. Using concepts of light, sound, force, etc., examples used are those that arise in common experience of physical phenomena rather than from technical training. The reliability of this test is given as +.84. The validity of the Bennett has been found using several different criteria: final grades in technical courses, performance on the job of tool operators, aircraft mechanics, 1834 students' performance in their final examinations. This is an untimed test which takes about 25 minutes and has been used successfully for

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6. Ed. K. Strong, Jr., Strong Vocational Interest Blank (Palo Alto, Calif.: Consulting Psy. Press, 1959).

years in vocational and educational guidance.

It is interesting to note that the Bennett Test of Mechanical Comprehension correlates rather highly with some other tests. Correlations of +.45 were obtained using the Otis Intelligence Test and the Bennett Test in an introductory engineering course. Correlations between +.51 and +.44 were obtained when the Revised Minnesota Paper Form Board was related to the Bennett Test.[7]

Description of Sample

During the years from 1947 to 1951, 143 chemical engineers took the battery of tests. Replies to the first communication numbered 136. In the final analysis, 76 men completed all of the forms.

It became obvious as forms were returned that a great number of the engineers were no longer in chemical engineering. Some of these men were in sales, administration, teaching, and management. Table III presents these

Table III

MANAGERIAL LEVEL ATTAINED BY RESPONDENTS

Position	Number
Top management	4
Middle management	41
Senior engineer	21
Engineer	3
Professor	3
High school teacher	1
Unaccounted for	3
Total	76

7. George K. Bennett, Bennett Test of Mechanical Comprehension (New York: Psy. Corp., 1956).

data. The use of a scientifically oriented criterion of creativity would place those men who had branched into occupations unconnected with scientific research at a disadvantage. Tangible creative evidence was not measurable, due to occupational limitations. A less scientifically oriented criterion might have allowed for more accurate creativity ratings.

Chapter IV

RESULTS

Means and Standard Deviations of the Predictor Variables

The means and standard deviations for the predictor (independent) variables are shown in Table IV. The mean score for the Otis Self-Administering Test was 55.57 with a standard deviation of 7.49. When translated into an intelligence quotient (IQ) this mean score converted to 114. The average IQ of the sample falls in the "high-average" category when compared to people in general.

The mean score on the Stanford Scientific Aptitude Test was 59.04 with a standard deviation of 11.70. When compared with the mean score of a group of college students, it falls in the 50th to 69th percentile. The standard deviation for every norm group was also large. The test manual suggests that while a 50 percentile score may indicate success in chemical engineering, research or college teaching requires a score above the 70th percentile.

The range of scores on the Bennett Mechanical Comprehension Test was one through sixty. The mean score in this study was 49.71 with a standard deviation of 7.63. Using percentiles computed from large numbers of engineers, this group mean would fall in the 65th percentile. This appears to be a low percentile for chemical engineers or those with an engineering background.

Table IV

MEANS AND STANDARD DEVIATIONS OF PREDICTOR (INDEPENDENT) VARIABLES

Variable	Mean	Grade Rating	Standard Deviation
Otis Self-administering Test	55.57		7.49
Stanford Scientific Aptitude Test	59.04		11.70
Bennett Mechanical Comprehension Test	49.71		7.63
Bernreuter Personality Inventory			
B1-N neuroticism	29.16		25.04
B2-S self-sufficiency	49.09		24.86
B4-D dominance	65.49		23.82
Strong Vocational Interest Blank			
Group I Biological Sciences	35.36	B	8.75
Group II Engineering and Physical Sciences	44.57	A	11.26
Group V Social Service	35.57	B	9.11
Group VIII Business Detail	35.54	B	8.41
Group IX Sales	34.29	B-	9.09
Group X Verbal	30.93	B-	5.85
Engineer	40.74	B+	11.09
Chemist	40.62	B+	12.44
Production Manager	45.63	A	7.94
Personnel Manager	34.24	B-	10.66
Grade Point Ratio	17.76		4.60
Occupational Level	52.57		4.93

Three scales of the Bernreuter Personality Test were used. The mean score on the Neuroticism scale (B1-N) was 29.16 with a standard deviation of 25.04. Since this mean score falls in the 84th percentile of a norm group, it would appear that the behavior of these chemical engineers is not maladaptive. The mean score for Self-sufficiency (B2-S) is 49.09 with a standard deviation of 24.86. This sample tends to be self-sufficient, independent and self-reliant according to a ranking in the 67th percentile of the norm group. The third scale, Dominance (B4-D), has a mean score of 65.49 with a standard deviation of 23.82. This score puts the sample into the 72nd percentileof the norm group. The sample is rather dominant in face-to-face situations. The variability in all of these mean scores is great.

The Strong Vocational Interest Blank measures the occupations a person would enjoy. An A rating means that the individual has the interests of persons engaged successfully in that occupation; a C rating means that the person does not have such interests; and ratings B+, B and B- indicate that the person probably has those interests but it is not as certain as in the case of A ratings. The sample was graded on the scales indicated in Table IV. The mean raw scores and corresponding letter grades are also included. The outcome of these scores does not seem unusual. It appears normal that chemical engineers would be less interested in verbal and business occupations and more involved with engineering, the physical sciences and production. The occupational level scale is also included. This scale indicates whether one's interests are similar to workmen (a low score) or similar to business and professional men (high score). This scale indicates "aspiration" level or "drive." It would seem normal that college men would have interests similar to professional men. The variability is small.

The grade point average at the North Carolina State University is a

3-point system, where C equals 1, B equals 2, and A equals 3. The mean grade average for the 76 chemical engineers is 1.776, or B-, with an average variability of 0.4.

Means and Standard Deviations of the Criterion Variables

The means and standard deviations for the criterion variables are shown in Table V. Each of these criterion variables (dependent) was rated on an 11-point scale, except the first, which was scaled on a pre-run scale of 15 points. Frequency distribution charts for the criterion values are included to demonstrate that the data are distributed normally. The slight elevation of the "over-all creativity" criterion chart is due to the given higher scale value.

Inter-correlations of the Independent and Dependent Variables

The inter-correlations of the predictor variables are shown in Table VI. The Otis Self-Administering Test, the Stanford Scientific Aptitude Test and the Bennett Mechanical Comprehension Test are significantly related to one another. Correlations between the Stanford Scientific Aptitude Test, the Bennett Mechanical Comprehension Test and the grade point ratio indicate that scientific orientation will predict grades in a science curriculum more accurately than intelligence. Neuroticism correlated negatively with self-sufficiency and dominance, but positively with biological science interests. Dominance correlates negatively with interests in the biological sciences but positively with both production and personnel management scales. High occupational strivings were positively correlated

Table V

MEANS AND STANDARD DEVIATIONS OF CRITERION (DEPENDENT) VARIABLES

Variable	Mean	Standard Deviation
1. Rating Forms		
Creativity over-all	9.16	2.34
Persistence	8.22	1.69
Enthusiasm	7.86	1.89
Independence	7.61	1.57
Fluency	7.37	1.55
Perception	7.01	1.68
Activity	7.76	1.68
Flexibility	7.38	1.80
Initiative	7.87	1.86
Knowledge	8.11	1.35
Conformity	7.09	1.72
Curiosity	7.25	1.66
2. Over-all Ranking on Creativity	66.32	17.04
3. Self-ranking on Creativity	61.97	17.59

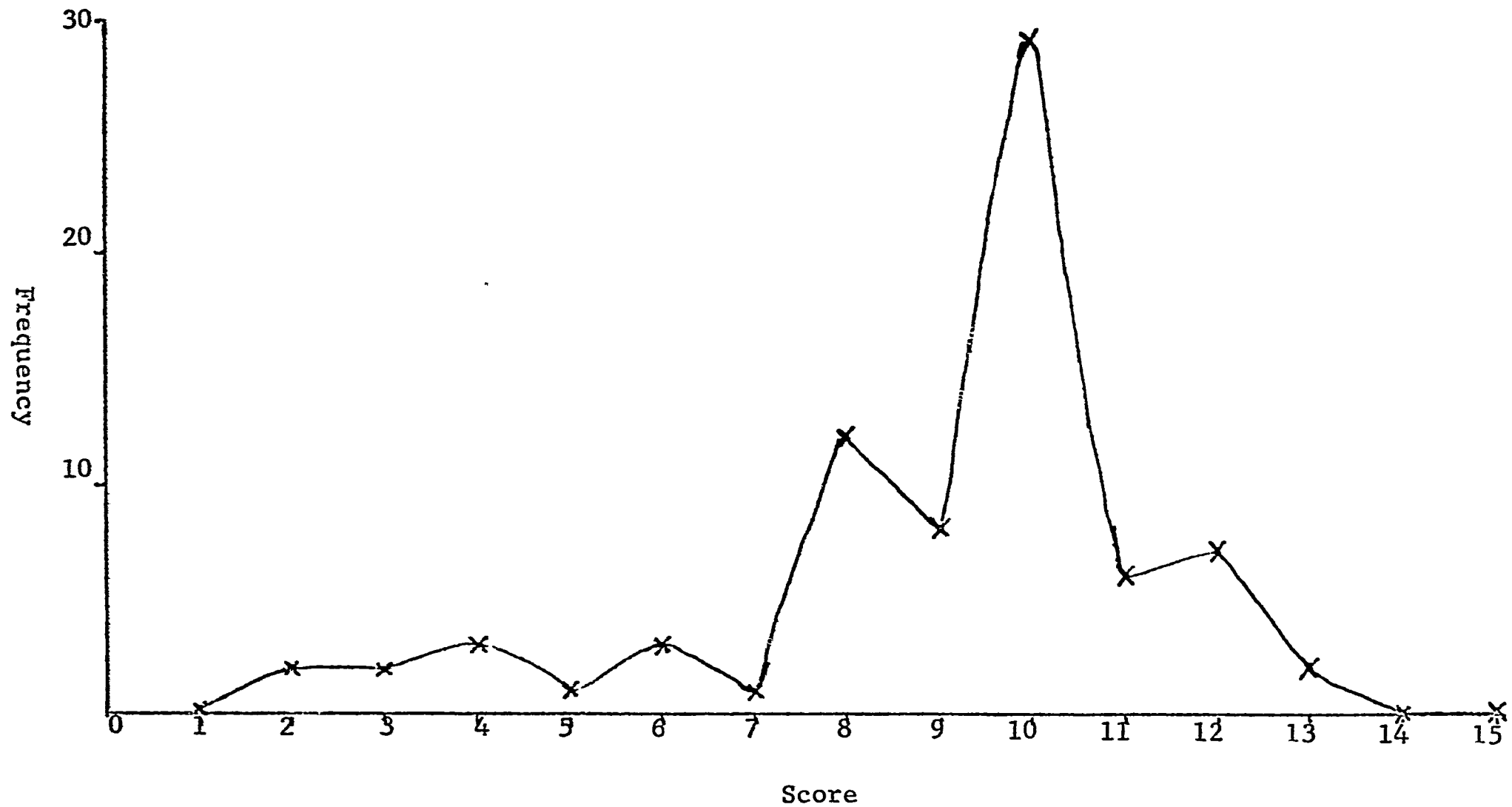

Chart 1. Distribution of the Creativity Scores

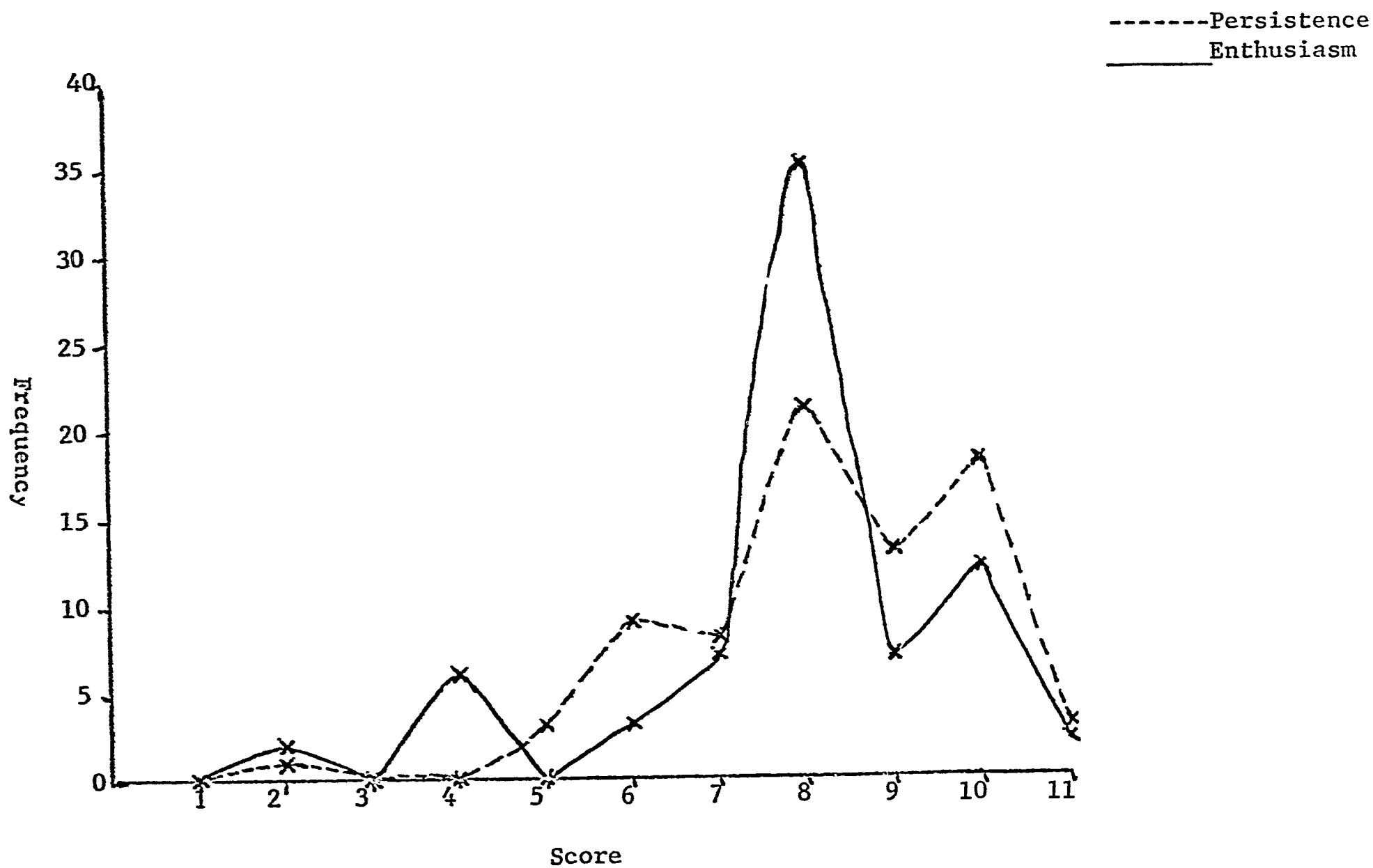

Chart 2. Distribution of the Persistence and Enthusiasm Scores

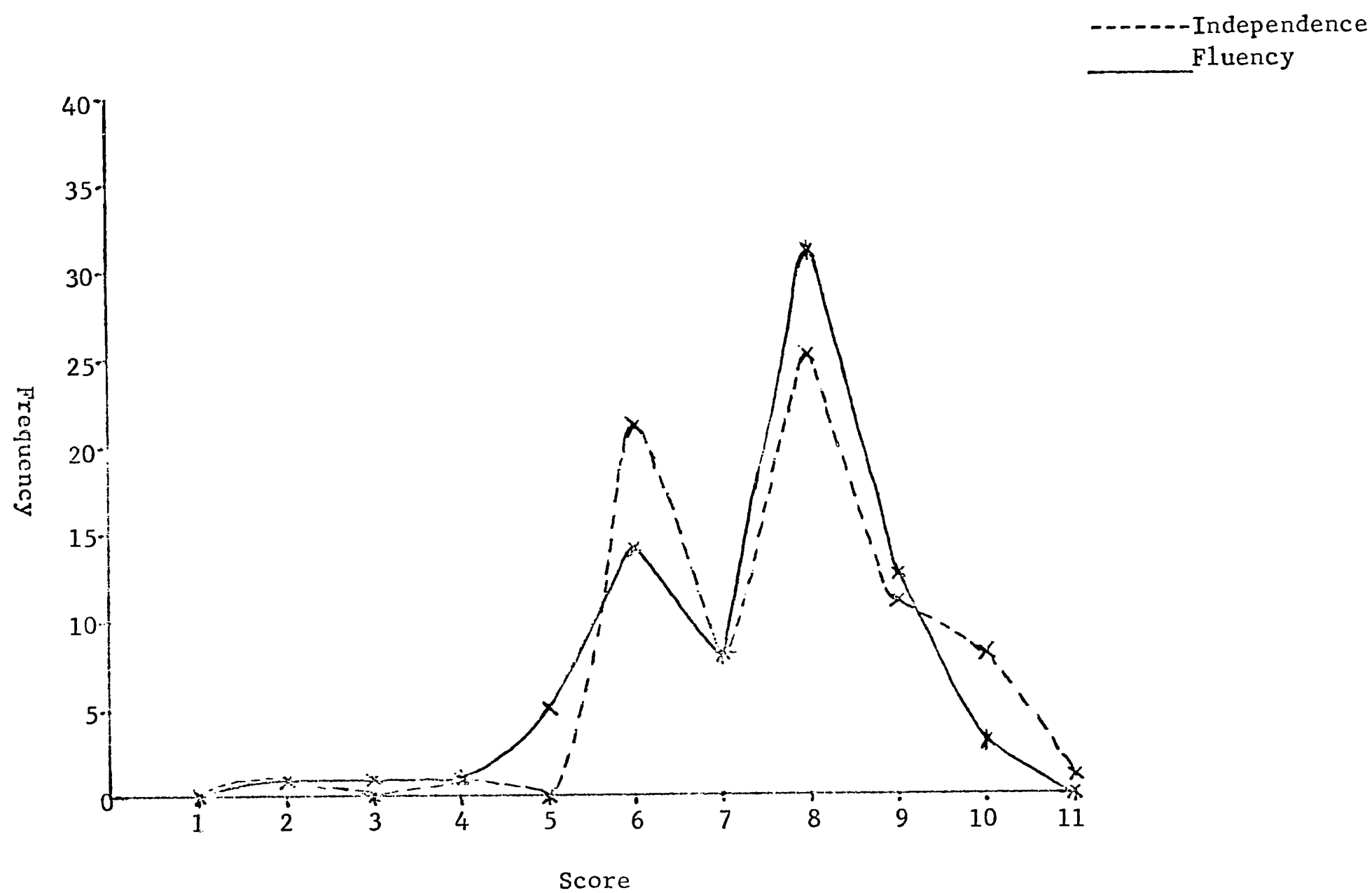

Chart 3. Distribution of the Independence and Fluency Scores

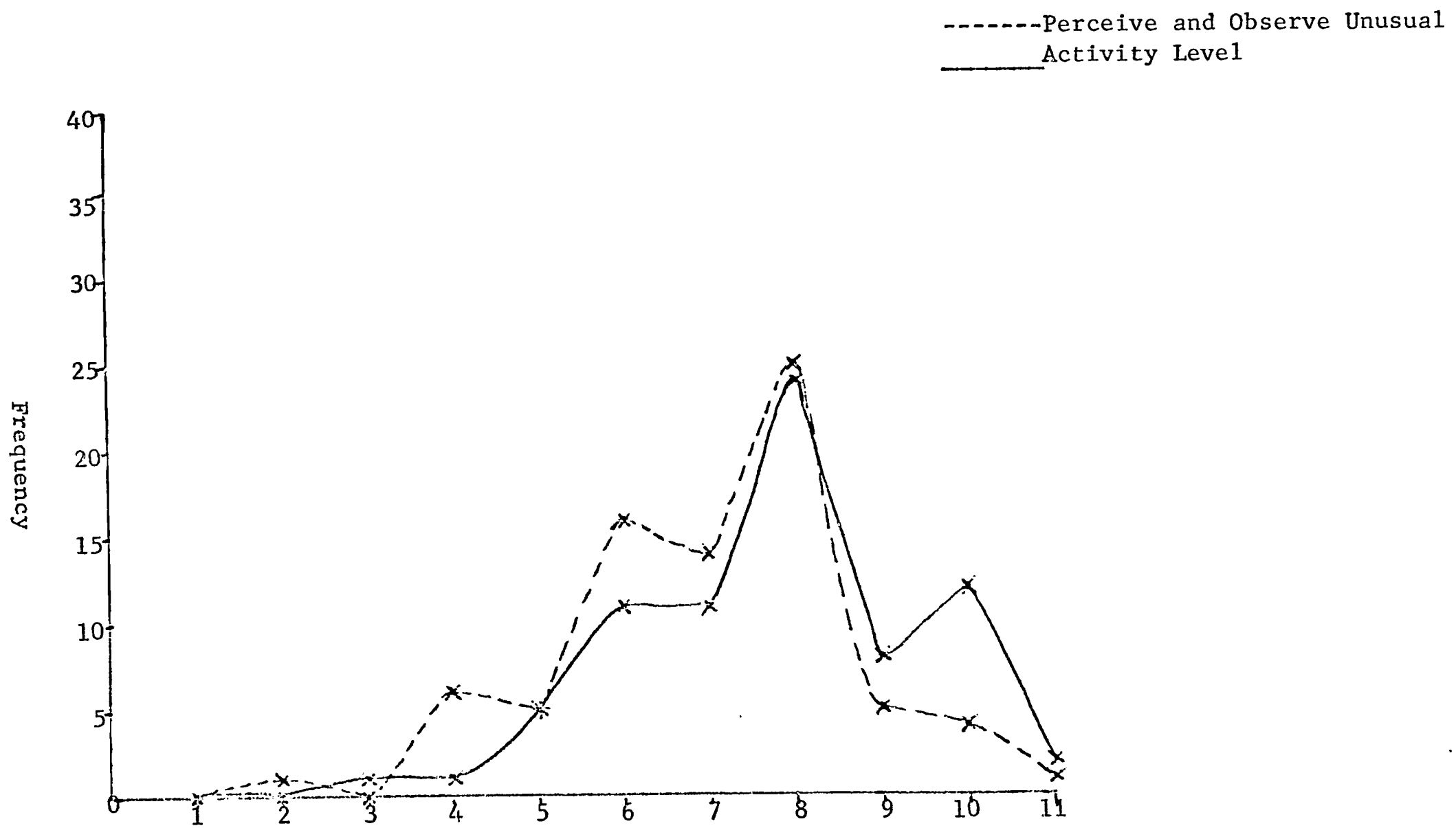

Chart 4. Distribution of the Perception and Activity Scores

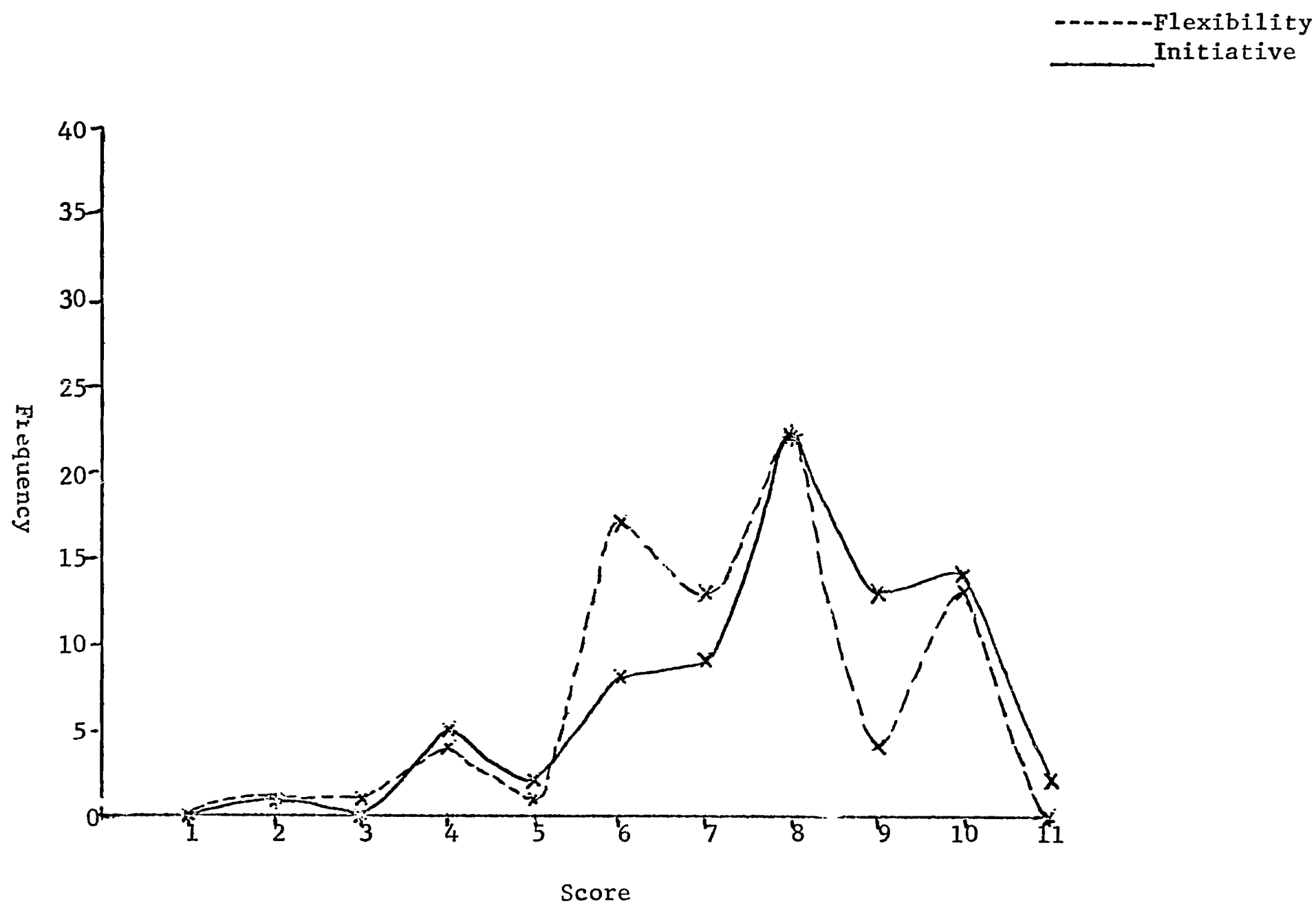

Chart 5. Distribution of the Flexibility and Initiative Scores

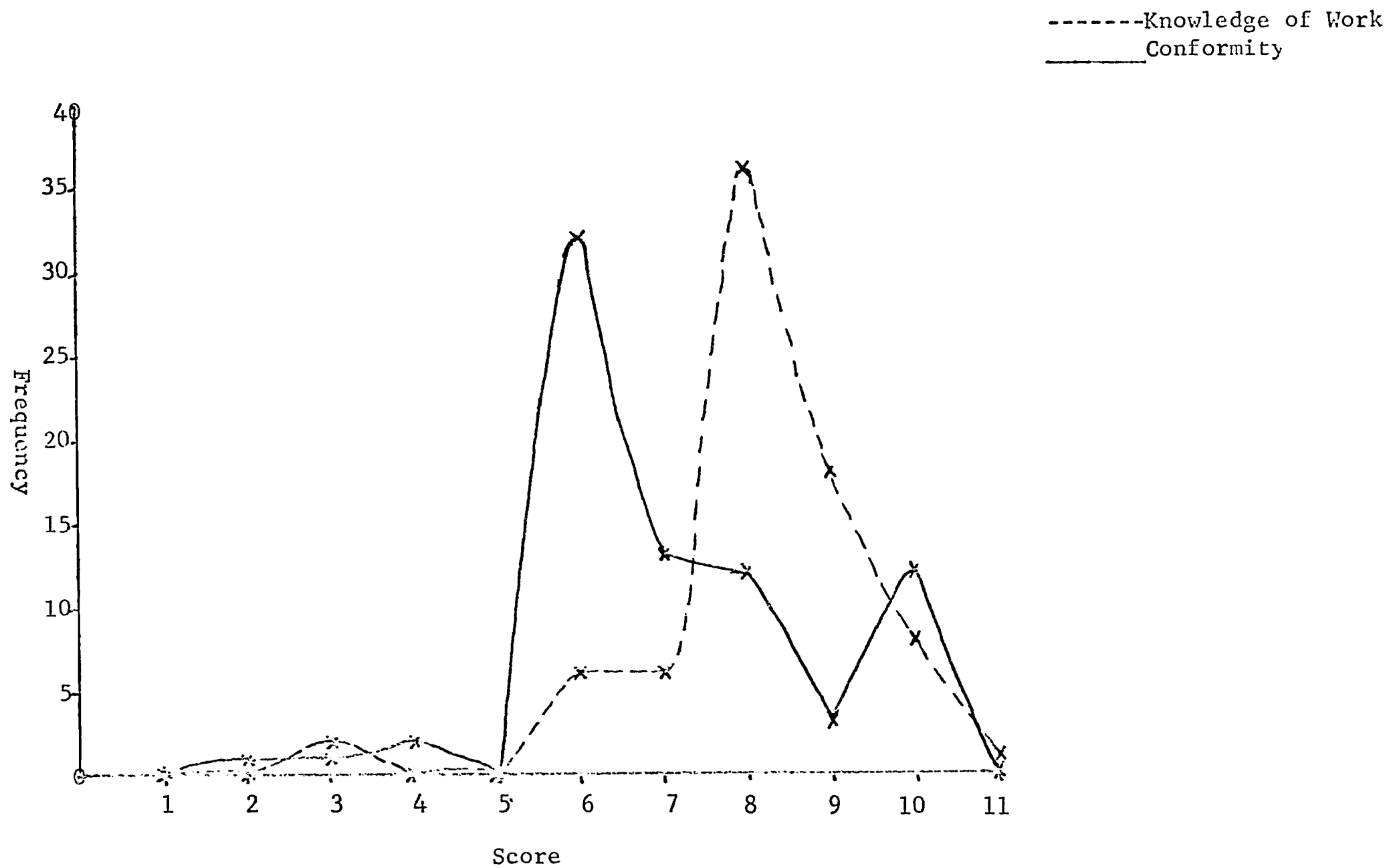

Chart 6. Distribution of the Knowledge and Conformity Scores

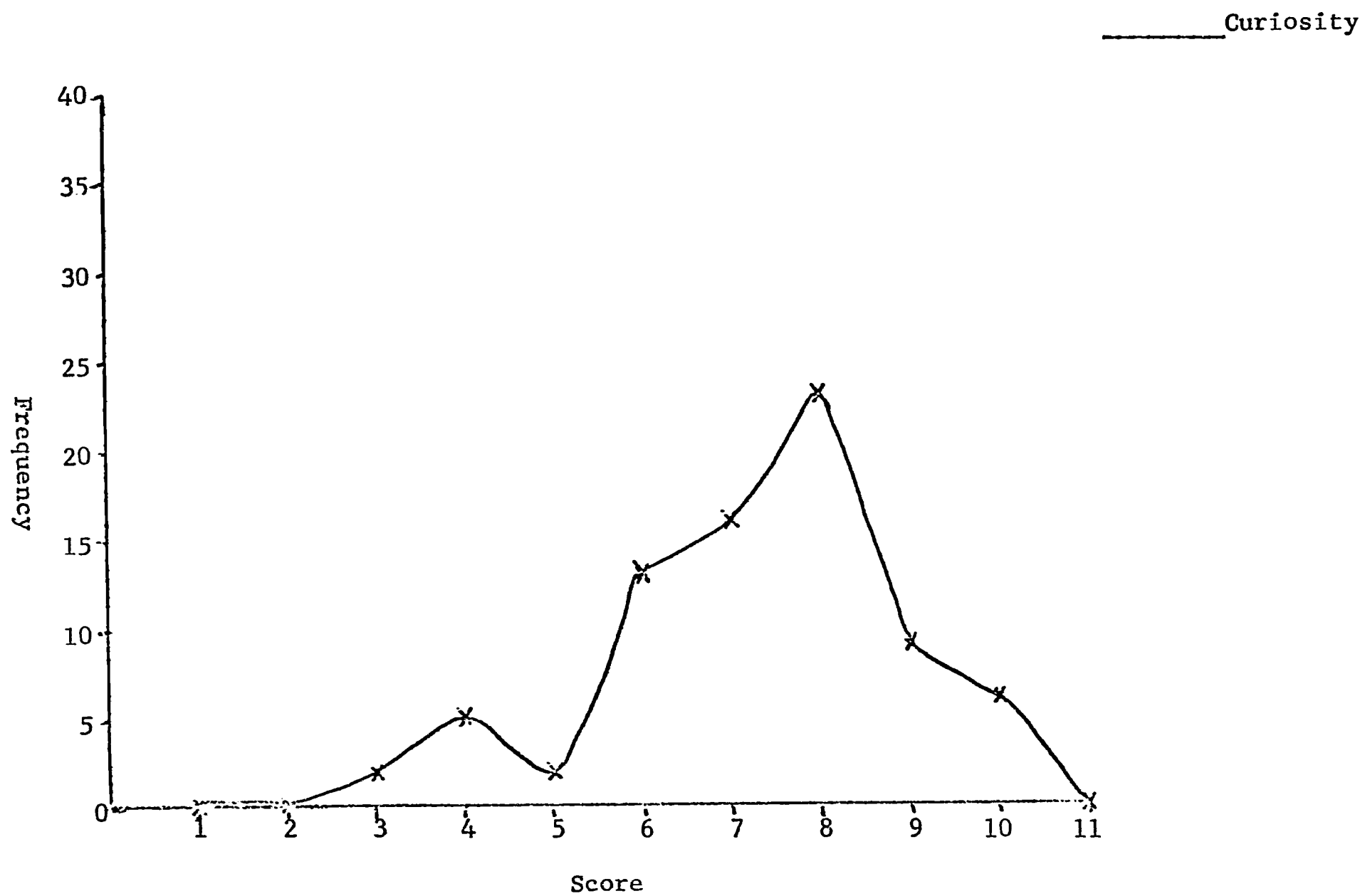

Chart 7. Distribution of the Curiosity Scores

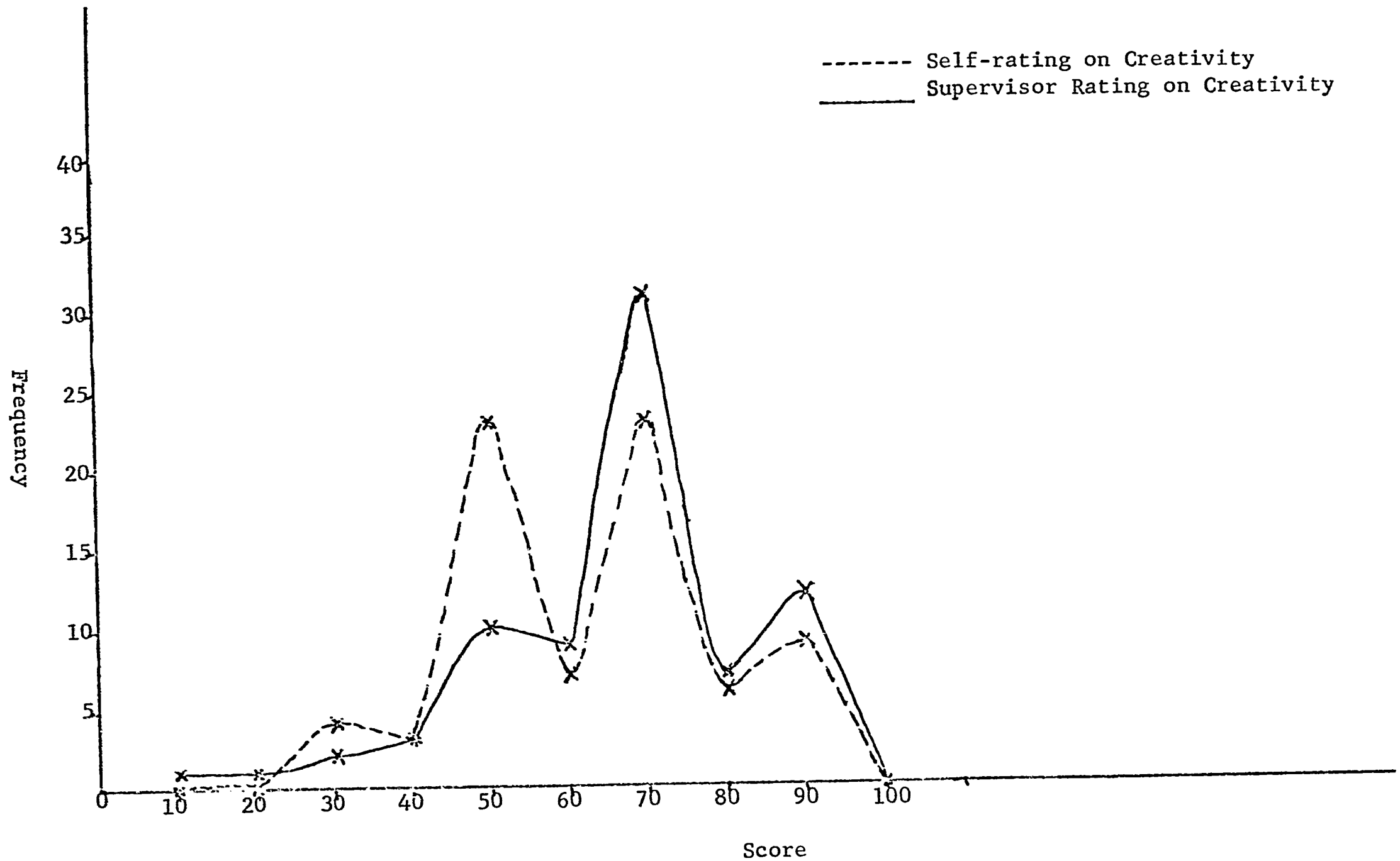

Chart 8. Distribution of the Self Rating and Supervisor Rating Scores

Table VI

INTERCORRELATIONS OF PREDICTOR VARIABLES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Otis	1000																
2. Stanford Sci. Apt.	.310																
3. Bennett	.051	.462															
4. B1-N	.025	.009	.214														
5. B2-S	.013	.049	.037	-.342													
6. B4-D	-.075	-.109	-.236	-.782	.494												
7. Strong I	.156	.206	.433	.385	-.029	-.334											
8. Strong II	.018	.191	.323	.126	.216	-.094	.780										
9. Strong V	.088	.068	-.016	-.117	.024	.175	-.293	-.509									
10. Strong VIII	-.016	-.172	-.461	-.199	-.102	.131	-.562	-.332	.009								
11. Strong IX	.014	-.192	-.294	-.167	-.173	.196	-.733	-.765	.172	.419							
12. Strong X	.088	.009	.153	.173	-.079	-.164	.310	-.062	-.103	-.415	.122						
13. Engineer	-.001	.189	.275	.041	.185	-.022	.680	.927	-.570	-.243	-.680	-.125					
14. Chemist	.143	.280	.377	.176	.182	-.175	.830	.930	-.349	-.380	-.785	.043	.834				
15. Production Mgr.	-.180	-.013	.007	-.100	.132	.257	.016	.400	-.300	.184	-.123	-.414	.540	.212			
16. Personnel Mgr.	.091	.142	-.035	-.238	.062	.261	-.369	-.448	.786	.058	.308	.021	-.442	-.334	-.101		
17. Grade point	.212	.266	.206	-.096	.193	.079	.066	.197	.033	.108	-.019	-.173	.190	.162	.169	.025	
18. Occupational level	-.064	-.030	-.089	-.050	.071	.174	-.127	-.129	-.179	-.003	.364	.389	-.081	-.197	.031	-.010	-.082
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

"t"$_{.05}$ with df of 74 .223

"t"$_{.01}$ with df of 74 .2906

to sales, business and linguistic interests. People in these professions appear to be more success-oriented than are those in scientific professions.

The intercorrelations of the criterion variables are shown in Table VII. All of these variables are significantly related to each other, indicating that they are not separate characteristics measuring different aspects of creativity. It might have been as effective to have each supervisor rate each man on the "Over-all Creativity" scale alone. Since a maximal R is obtained when intercorrelations among the variables are small, R may be reduced in significance.

The intercorrelations of the dependent and independent variables are shown in Table VIII. There are several significant correlations in this table. The Otis Self-Administering Test correlations indicate that there is a slight negative relationship between IQ and creativity. The Stanford Scientific Aptitude Test correlates negatively with five criteria: enthusiasm, fluency, activity, flexibility and initiative. The Bennett Mechanical Comprehension Test is negatively related to activity. The self-sufficiency scale is positively correlated with persistence, enthusiasm, independence and initiative. A high dominance score is positively related to creativity and enthusiasm. Interests in the biological sciences are negatively related to activity, while interests in business detail and administration are related in a positive direction. Interests in sales and business contacts correlate positively with fluency and activity. This is also true for the aspiration level scale. It is interesting to note that grade point average is related to only one criterion--persistence. Occupational level is correlated to "over-all creativity," enthusiasm, fluency, activity and flexibility.

Table VII

INTERCORRELATIONS OF CRITERION VARIABLES

1.	Creativity	1.000	.604	.718	.545	.735	.778	.604	.693	.776	.661	.510	.719
2.	Persistence	.604	1.000	.619	.395	.543	.487	.656	.405	.613	.449	.217	.516
3.	Enthusiasm	.718	.619	1.000	.418	.602	.624	.624	.591	.676	.539	.414	.642
4.	Independence	.545	.395	.418	1.000	.435	.433	.319	.367	.384	.353	.434	.403
5.	Fluency	.735	.543	.602	.435	1.000	.727	.598	.687	.724	.484	.497	.577
6.	Perception	.778	.487	.624	.433	.722	1.000	.498	.653	.700	.546	.489	.732
7.	Activity	.604	.656	.624	.319	.598	.498	1.000	.463	.633	.528	.264	.553
8.	Flexibility	.693	.405	.591	.367	.687	.653	.463	2.000	.620	.444	.480	.612
9.	Initiative	.776	.613	.676	.384	.724	.700	.633	.620	1.000	.540	.502	.697
10.	Knowledge	.661	.449	.539	.353	.484	.546	.528	.444	.520	1.000	.374	.541
11.	Conformity	.510	.217	.414	.434	.497	.489	.266	.480	.502	.374	1.000	.571
12.	Curiosity	.719	.516	.642	.403	.577	.732	.553	.612	.697	.541	.571	1.000

"t" $_{.05}$ with df of 74 $\geq$ .223

"t" $_{.01}$ with df of 74 $\geq$ .2906

Table VIII

INTERCORRELATIONS OF INDEPENDENT AND DEPENDENT VARIABLES

	Self-Ranking	Over-all Creativity	Persistence	Enthusiasm	Independence	Fluency	Perception	Activity	Flexibility	Initiative	Knowledge	Conformity	Curiosity	Over-all Ranking on Creativity
Otis	-.017	-.074	-.132	-.119	.173	.000	.065	-.165	-.042	-.145	-.032	.015	-.105	-.003
Stanford Sci. Apt.	.055	-.213	-.157	-.230	-.012	-.320	-.147	-.354	-.231	-.263	-.214	-.002	-.076	-.179
Bennett	.049	-.069	-.083	-.147	.016	-.195	-.052	-.238	-.035	-.158	-.169	-.014	.025	-.078
B1-N	-.125	-.055	-.063	-.162	-.150	-.098	-.037	-.102	-.087	-.115	-.036	-.157	-.062	-.052
B2-S	.071	.176	.334	.265	.233	.132	.146	.152	.130	.246	.061	.068	.216	.120
B4-D	.323	.102	.124	.269	.108	.208	.097	.166	.108	.118	.096	.132	.038	.064
Strong I	.002	-.064	-.067	-.189	.012	-.126	-.084	-.264	-.012	-.184	-.072	-.074	-.123	-.060
Strong II	.050	-.009	.093	-.022	-.011	-.140	-.099	-.089	-.004	-.100	-.000	-.111	-.137	-.027
Strong V	.136	-.112	.046	-.079	.042	.021	-.072	-.046	-.063	-.096	-.127	.107	.020	-.062
Strong VIII	-.052	-.002	.141	.024	-.123	.080	-.009	.268	-.065	.039	.076	-.109	-.042	.015
Strong IX	.085	.114	.036	.187	-.081	.224	.186	.223	.038	.212	.125	.058	.146	.078
Strong X	.018	.185	-.063	.062	.048	.150	.158	-.090	.108	.242	.055	.195	.248	.157
Engineer	.056	-.057	.017	-.003	.013	-.175	-.138	-.106	-.061	-.169	-.064	-.098	-.205	-.106
Chemist	-.032	-.052	.061	-.105	.009	-.137	-.110	-.196	-.033	-.147	-.088	-.125	-.170	.060
Production Mgr.	.180	-.033	.047	.141	-.105	-.113	-.034	.105	-.019	-.116	.053	-.138	-.146	-.133
Personnel Mgr.	.159	-.075	-.018	-.055	+.006	-.017	-.031	-.055	-.077	-.031	-.023	.151	.089	-.057
Grade point average	.166	.002	.223	-.015	.196	-.048	-.008	.036	-.144	-.089	.017	-.019	-.043	-.061
Occupational level	.150	.239	.136	.436	.028	.250	.209	.229	.231	.220	.205	.154	.204	.166

"t"$_{.05}$ df of 74 $\geq$ .223

"t"$_{.01}$ df of 74 $\geq$ .2906

Analysis of the Relationships of Predictor with Criteria Data

The multiple correlation between the 18 predictor variables and the criterion dimension of "Creativity" is 0.428. This is shown in Table IX. Of the total variance in this criterion 18.4 percent is accounted for by the predictor variables. The F index is 0.711, which is not significant even at the .10 level. None of the predictor variables was significantly related, suggesting lack of any singular relationship between the predictor variables and creativity. The relationship between creativity and intelligence and/or scientific aptitude is slightly negative once an average level of intelligence is a given. There is evidence that interests in engineering and physical sciences may prove to be predictors of creativity, as may be linguistic interests. This may be due to the fact that those chemical engineers who communicate their findings in reports, or verbally, are most likely to be rated creative by their supervisors.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Persistence" is 0.584. This indicates that 34.1 percent of the variance in this criterion is accounted for by the predictor variables. This is shown in Table X. The F index is +1.638, which is significant only at the .10 level of confidence. This indicates that predictor variables can, to some extent, select persistent individuals. Two predictor variables are significant. The Bernreuter self-sufficiency score is significant at the .05 level, suggesting that the self-sufficient individual is persistent. Interests in social service and welfare are significant at the .10 level.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Enthusiasm" was 0.6070. This indicates that 36.8

Table X

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE OF PERSISTENCE

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	-0.141	0.129	-1.096	Not significant
2. Stanford Scientific Apt.	-0.172	0.139	-1.236	Not significant
3. Bennett	-0.042	0.147	-0.287	Not significant
4. B1-N	-0.054	0.195	-0.275	Not significant
5. B2-S	0.320	0.146	2.183	t .05 ≥ 1.9926**
6. B4-D	-0.224	0.219	-1.024	Not significant
7. Strong I	-0.234	0.350	-0.668	Not significant
8. Strong II	0.828	0.555	1.490	Not significant
9. Strong V	0.510	0.293	1.743	t .10 ≥ 1.6657***
10. Strong VIII	0.181	0.159	1.141	Not significant
11. Strong IX	0.288	0.250	1.151	Not significant
12. Strong X	0.069	0.207	0.333	Not significant
13. Engineer	-0.221	0.380	-0.583	Not significant
14. Chemist	0.077	0.423	0.183	Not significant
15. Production manager	-0.074	0.178	-0.413	Not significant
16. Personnel manager	-0.254	0.225	-1.131	Not significant
17. Grade point average	0.155	0.131	1.185	Not significant
18. Occupational level	0.185	0.142	1.304	Not significant

R = 0.584 F = 1.638 Significant at the .10 level

** .05 significance level *** .10 significance level

Table IX

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE OF CREATIVITY

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.019	0.143	0.133	Not significant
2. Stanford Scientific Apt.	-0.217	0.155	-1.398	Not significant
3. Bennett	0.053	0.163	.323	Not significant
4. B1-N	-0.018	0.217	-0.084	Not significant
5. B2-S	0.139	0.163	0.850	Not significant
6. B4-D	-0.022	0.244	-0.091	Not significant
7. Strong I	-0.270	0.390	-0.694	Not significant
8. Strong II	0.628	0.618	1.015	Not significant
9. Strong V	0.006	0.326	0.019	Not significant
10. Strong VIII	0.032	0.177	0.182	Not significant
11. Strong IX	0.006	0.278	0.020	Not significant
12. Strong X	0.234	0.231	1.013	Not significant
13. Engineer	-0.344	0.423	-0.815	Not significant
14. Chemist	-0.104	0.470	-0.221	Not significant
15. Production manager	-0.013	0.198	-0.068	Not significant
16. Personnel manager	-0.071	0.250	-0.284	Not significant
17. Grade point average	0.047	0.146	0.325	Not significant
18. Occupational level	0.140	0.158	0.889	Not significant

R = 0.428 F = 0.711 Not significant

Table X

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE OF PERSISTENCE

	Variable	Beta	Standard Error	"t"	Significance Level
1.	Otis	-0.141	0.129	-1.096	Not significant
2.	Stanford Scientific Apt.	-0.172	0.139	-1.236	Not significant
3.	Bennett	-0.042	0.147	-0.287	Not significant
4.	B1-N	-0.054	0.195	-0.275	Not significant
5.	B2-S	0.320	0.146	2.183	t .05 ≥ 1.9926**
6.	B4-D	-0.224	0.219	-1.024	Not significant
7.	Strong I	-0.234	0.350	-0.668	Not significant
8.	Strong II	0.828	0.555	1.490	Not significant
9.	Strong V	0.510	0.293	1.743	t .10 ≥ 1.6657***
10.	Strong VIII	0.181	0.159	1.141	Not significant
11.	Strong IX	0.288	0.250	1.151	Not significant
12.	Strong X	0.069	0.207	0.333	Not significant
13.	Engineer	-0.221	0.380	-0.583	Not significant
14.	Chemist	0.077	0.423	0.183	Not significant
15.	Production manager	-0.074	0.178	-0.413	Not significant
16.	Personnel manager	-0.254	0.225	-1.131	Not significant
17.	Grade point average	0.155	0.131	1.185	Not significant
18.	Occupational level	0.185	0.142	1.304	Not significant

R = 0.584 F = 1.638 Significant at the .10 level

** .05 significance level *** .10 significance level

percent of the total variance here can be accounted for by the predictor variables. This is shown in Table XI. The F index was +1.851. The predictor variables are able to predict enthusiasm to the .05 level of confidence. The independent variables that contribute the most are the Occupational scale, the personnel manager interest scale, the Strong V scale, and the Strong I scale. Occupational level, or "aspiration level, of the engineer will best predict his enthusiasm for his work to the .01 level of confidence.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Independence" is 0.469. This accounts for 21.9 percent of the total variance in this criterion by the predictor variables. The table for this criterion is XII. The F index is 0.891, which is not significant at the 01, .05, or .10 level of confidence. Only grade point average is a significant predictor of independence. Those young men who were getting the higher grades were more independent than their classmates.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Fluency" is 0.505. This would indicate that 25.5 percent of the total variance in this criterion is accounted for by the predictor variables. This is shown in Table XIII. The F index is 1.083, which is not significant at any accepted level. Scientific aptitude is significant at the .05 level. The individual with the most chemical aptitude in school is not necessarily the most fluent, the most communicative in the field. Occupational striving or aspirational level correlates relatively high with this criterion. The most fluent individuals, the most communicative, would probably verbalize his aspirations the most, even if his were no greater than the next man's.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Perception" is 0.452. This would indicate that 20.4

Table XI

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE OF ENTHUSIASM

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.049	0.126	0.385	Not significant
2. Stanford Scientific Apt.	-0.204	0.136	-1.495	Not significant
3. Bennett	-0.005	0.144	-0.032	Not significant
4. B1-N	0.009	0.190	0.049	Not significant
5. B2-S	0.143	0.143	0.997	Not significant
6. B4-D	-0.027	0.214	-0.124	Not significant
7. Strong I	-0.624	0.343	-1.821	t .10 ≅ 1.6657***
8. Strong II	0.550	0.544	1.011	Not significant
9. Strong V	0.474	0.286	1.655	t .10 ≅ 1.6657***
10. Strong VIII	-0.093	0.155	-0.602	Not significant
11. Strong IX	0.134	0.245	0.550	Not significant
12. Strong X	0.186	0.203	0.919	Not significant
13. Engineer	0.186	0.372	0.502	Not significant
14. Chemist	-0.057	0.414	-0.138	Not significant
15. Production manager	0.049	0.174	0.283	Not significant
16. Personnel manager	-0.353	0.220	-1.608	Not significant
17. Grade point average	-0.027	0.128	-0.212	Not significant
18. Occupational level	0.375	0.139	2.705	t .01 ≅ 2.6440*

R = 0.6070 F = 1.851 Significant at the .05 level

* .01 significance level *** .10 significance level

Table XII

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE OF INDEPENDENCE

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.188	0.140	1.339	Not significant
2. Stanford Scientific Apt.	-0.181	0.151	-1.139	Not significant
3. Bennett	0.008	0.160	0.052	Not significant
4. B1-N	-0.173	0.212	-0.818	Not significant
5. B2-S	0.188	0.159	1.176	Not significant
6. B4-D	-0.099	0.238	-0.417	Not significant
7. Strong I	-0.074	0.381	-0.193	Not significant
8. Strong II	-0.660	0.604	-1.092	Not significant
9. Strong V	-0.058	0.319	-0.183	Not significant
10. Strong VIII	-0.164	0.173	-0.951	Not significant
11. Strong IX	-0.358	0.272	-1.316	Not significant
12. Strong X	0.015	0.225	0.065	Not significant
13. Engineer	0.370	0.413	0.896	Not significant
14. Chemist	0.005	0.460	0.012	Not significant
15. Production manager	-0.119	0.194	-0.615	Not significant
16. Personnel manager	-0.022	0.244	0.091	Not significant
17. Grade point average	0.265	0.143	1.863	t .10 $\geq$ 1.6657***
18. Occupational level	0.101	0.154	0.653	Not significant

R = 0.469 F = 0.891 Not significant

*** .10 significance level

Table XIII

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE OF FLUENCY

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.060	0.137	0.437	Not significant
2. Stanford Scientific Apt.	-0.311	0.148	-2.102	t .05 = 1.9926**
3. Bennett	-0.001	0.156	-0.009	Not significant
4. B1-N	0.035	0.207	0.169	Not significant
5. B2-S	0.088	0.156	0.567	Not significant
6. B4-D	0.188	0.233	0.806	Not significant
7. Strong I	0.002	0.372	0.006	Not significant
8. Strong II	0.041	0.591	0.070	Not significant
9. Strong V	0.115	0.311	0.369	Not significant
10. Strong VIII	0.068	0.169	0.404	Not significant
11. Strong IX	0.178	0.266	0.669	Not significant
12. Strong X	0.057	0.220	0.260	Not significant
13. Engineer	-0.243	0.404	-0.603	Not significant
14. Chemist	0.314	0.449	0.699	Not significant
15. Production manager	-0.068	0.189	-0.358	Not significant
16. Personnel manager	-0.164	0.239	-0.685	Not significant
17. Grade point average	0.015	0.139	0.108	Not significant
18. Occupational level	0.192	0.151	1.275	Not significant

R = 0.505 F = 1.083 Not significant

** .05 significance level

percent of the total variance in this criterion is accounted for by the predictor variables. This is shown in Table XIV. The F index is 0.813, which is not significant at any accepted level. It is interesting to note that the only significant predictor variable is the Otis Intelligence Test.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Activity" is 0.564. According to this, 31.8 percent of the total variance in this criterion is accounted for by the predictor variables. This is shown in Table XV. The F index is not of acceptable significance although it comes close. Scientific aptitude is related to the criterion at the .05 level of significance. An interest in physical science and engineering is significantly related to the criterion, as are interests in social work and business. The criterion may simply be tapping "interest" manifestations rather than activity level. Understandably, a high aspiration level is related to activity level. The higher one's aspirations, the more energy likely to be expended toward this goal.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Flexibility" is 0.451. Therefore 20.3 percent of the total variance in this criterion is accounted for by the predictor variables. This is shown in Table XVI. The F index is .808, which is not significant at any acceptable level of confidence, but three of the predictor variables were significant to the .10 level of significance. The variables indicate that the individuals who had the most scientific aptitude and the deepest interest in engineering would be the least flexible and, therefore, the least likely to leave given facts for creativity. Men who have the highest occupational aspirations are flexible, perhaps in the effort to get ahead.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Initiative" was 0.588. Therefore 34.6 percent of

Table XIV

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE PERCEPTION

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.260	0.141	1.841	t .10 ≥ 1.6657***
2. Stanford Scientific Apt.	-0.198	0.153	-1.293	Not significant
3. Bennett	0.080	0.161	0.494	Not significant
4. B1-N	0.020	0.214	0.095	Not significant
5. B2-S	0.178	0.161	1.106	Not significant
6. B4-D	0.058	0.241	0.243	Not significant
7. Strong I	0.065	0.385	0.170	Not significant
8. Strong II	0.156	0.610	0.255	Not significant
9. Strong V	-0.276	0.322	-0.859	Not significant
10. Strong VIII	-0.051	0.174	-0.293	Not significant
11. Strong IX	0.018	0.275	0.067	Not significant
12. Strong X	0.024	0.228	0.105	Not significant
13. Engineer	-0.637	0.417	-1.526	Not significant
14. Chemist	0.075	0.464	0.163	Not significant
15. Production manager	0.176	0.196	0.900	Not significant
16. Personnel manager	0.026	0.247	0.104	Not significant
17. Grade point average	0.009	0.144	0.060	Not significant
18. Occupational level	0.124	0.156	0.797	Not significant

R = 0.452 F = 0.813 Not significant

*** .10 significance level

Table XV

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE ACTIVITY

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.001	0.131	0.004	Not significant
2. Stanford Scientific Apt.	-0.293	0.142	-2.068	t .05 ≥ 1.9926**
3. Bennett	0.021	0.149	0.141	Not significant
4. B1-N	-0.017	0.198	-0.087	Not significant
5. B2-S	0.127	0.149	0.850	Not significant
6. B4-D	-0.110	0.223	-0.493	Not significant
7. Strong I	-0.347	0.356	-0.975	Not significant
8. Strong II	1.070	0.565	1.895	t .10 ≥ 1.6657***
9. Strong V	0.337	0.298	1.132	Not significant
10. Strong VIII	0.196	0.161	1.218	Not significant
11. Strong IX	0.136	0.254	0.536	Not significant
12. Strong X	0.087	0.211	0.412	Not significant
13. Engineer	-0.178	0.386	-0.460	Not significant
14. Chemist	-0.446	0.430	-1.037	Not significant
15. Production manager	-0.034	0.181	-0.189	Not significant
16. Personnel manager	-0.194	0.228	-0.848	Not significant
17. Grade point average	0.023	0.133	0.171	Not significant
18. Occupational level	0.207	0.144	1.439	Not significant

R = 0.564 F = 1.481 Not significant

** .05 significance level *** .10 significance level

Table XVI

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE OF FLEXIBILITY

	Variable	Beta	Standard Error	"t"	Significance Level
1.	Otis	0.091	0.142	0.642	Not significant
2.	Stanford Scientific Apt.	-0.272	0.153	-1.775	t .10 ≧ 1.6657***
3.	Bennett	0.125	0.161	0.776	Not significant
4.	B1-N	-0.207	0.214	-0.967	Not significant
5.	B2-S	0.126	0.161	0.783	Not significant
6.	B4-D	-0.083	0.241	-0.343	Not significant
7.	Strong I	0.144	0.385	0.375	Not significant
8.	Strong II	0.327	0.611	0.536	Not significant
9.	Strong V	-0.072	0.322	-0.223	Not significant
10.	Strong VIII	-0.028	0.174	-0.159	Not significant
11.	Strong IX	-0.076	0.275	-0.276	Not significant
12.	Strong X	-0.063	0.228	-0.277	Not significant
13.	Engineer	-0.706	0.417	-1.692	t .10 ≧ 1.6657***
14.	Chemist	0.068	0.465	0.146	Not significant
15.	Production manager	0.182	0.196	0.929	Not significant
16.	Personnel manager	-0.060	0.247	-0.242	Not significant
17.	Grade point average	-0.119	0.144	-0.824	Not significant
18.	Occupational level	0.275	0.156	1.764	t .10 ≧ 1.6657***

R = 0.451 F = 0.808 Not significant
*** .10 significance level

the total variance in this criterion is accounted for by the predictor variables. This is shown in Table XVII. The F index is 1.669, which is significant at the .10 level of confidence. Three of the predictor variables were significant at the .10 and .05 level. It would seem normal that those who had the greatest interest in engineering and physical sciences would demonstrate the most initiative in their field. The most self-sufficient and verbally skilled engineers demonstrated the most initiative. Again, scientific aptitude and engineering interest seem to inhibit creativity in the form of initiative.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Knowledge" is 0.459. This would indicate that 21.1 percent of the total variance in the criterion is accounted for by the predictor variables. This is shown in Table XVIII. The F index is 0.845, which is not significant at an acceptable level. Only one predictor variable is significantly related to the criterion at a .05 level.

The multiple correlation between the 18 predictor variables and the criterion dimension of "Conformity" is 0.398. This indicates that 15.8 percent of the total variance in this criterion is accounted for by the predictor variables. This is shown in Table XIX. The F index is 0.5961, which is not significant at any level. There are only two of the variables that are significant at the .10 level. Those who were more verbal appear to conform more. This may be due to the fact that ideas verbally expressed are more likely to be conforming ones. Those who had interests similar to chemists and production managers were conformers. Perhaps this is caused by the fact that these occupations deal so greatly with accepted, established facts.

The multiple correlation between the 18 predictor variables and the criterion "Curiosity" is 0.509. This may indicate that 25.9 percent of the

Table XVII

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE INITIATIVE

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	-0.046	0.128	-0.358	Not significant
2. Stanford Scientific Apt.	-0.171	0.139	-1.232	Not significant
3. Bennett	-0.020	0.146	-0.135	Not significant
4. B1-N	-0.126	0.194	-0.651	Not significant
5. B2-S	0.278	0.146	1.906	t .10 ≥ 1.6657***
6. B4-D	-0.192	0.218	-0.882	Not significant
7. Strong I	-0.442	0.349	-1.266	Not significant
8. Strong II	1.117	0.554	2.017	t .05 ≥ 1.9926**
9. Strong V	0.084	0.292	0.289	Not significant
10. Strong VIII	0.048	0.158	0.302	Not significant
11. Strong IX	0.186	0.249	0.745	Not significant
12. Strong X	0.388	0.207	1.881	t .10 ≥ 1.6657***
13. Engineer	-0.409	0.378	-1.080	Not significant
14. Chemist	-0.301	0.421	-0.714	Not significant
15. Production manager	-0.092	0.177	-0.516	Not significant
16. Personnel manager	-0.087	0.224	-0.388	Not significant
17. Grade point average	-0.064	0.131	-0.488	Not significant
18. Occupational level	0.005	0.141	0.034	Not significant

R = 0.588 F = 1.669 Significant at the .10 level
** .05 significance level *** .10 significance level

Table XVIII

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE KNOWLEDGE

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.061	0.141	0.430	Not significant
2. Stanford Scientific Apt.	-0.176	0.152	-1.157	Not significant
3. Bennett	-0.064	0.161	-0.401	Not significant
4. B1-N	0.011	0.213	0.051	Not significant
5. B2-S	0.023	0.160	0.142	Not significant
6. B4-D	0.066	0.240	0.275	Not significant
7. Strong I	0.198	0.383	0.517	Not significant
8. Strong II	0.985	0.608	1.621	Not significant
9. Strong V	-0.437	0.320	-1.365	Not significant
10. Strong VIII	0.036	0.174	0.208	Not significant
11. Strong IX	-0.046	0.273	-0.167	Not significant
12. Strong X	-0.084	0.227	-0.372	Not significant
13. Engineer	-0.893	0.415	-2.150	$t_{.05} \geq 1.9926$**
14. Chemist	-0.407	0.462	-0.880	Not significant
15. Production manager	0.053	0.195	0.272	Not significant
16. Personnel manager	0.325	0.246	1.321	Not significant
17. Grade point average	0.076	0.143	0.530	Not significant
18. Occupational level	0.165	0.155	1.067	Not significant

R = 0.459 F = 0.845 Not significant

** .05 significance level

Table XIX

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE CONFORMITY

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.077	0.033	0.283	Not significant
2. Stanford Scientific Apt.	-0.025	0.023	0.025	Not significant
3. Bennett	0.023	0.037	0.019	Not significant
4. B1-N	-0.133	0.015	0.366	Not significant
5. B2-S	-0.036	0.012	0.047	Not significant
6. B4-D	-0.028	0.018	0.013	Not significant
7. Strong I	-0.350	0.078	0.782	Not significant
8. Strong II	0.507	0.096	0.652	Not significant
9. Strong V	0.222	0.063	0.451	Not significant
10. Strong VIII	-0.054	0.037	0.090	Not significant
11. Strong IX	-0.225	0.054	0.634	Not significant
12. Strong X	0.325	0.069	1.931	t .10 = 1.6657***
13. Engineer	0.368	0.067	.735	Not significant
14. Chemist	-0.664	0.066	1.932	t .10 = 1.6657***
15. Production manager	-0.213	0.044	1.109	Not significant
16. Personnel manager	0.035	0.041	0.019	Not significant
17. Grade point average	0.016	0.055	0.011	Not significant
18. Occupational level	0.080	0.056	0.250	Not significant

R = 0.398 F = 0.5961 Not significant

*** .10 significance level

total variance in this criterion is accounted for by the predictor variables. This is shown in Table XX. The F index is 1.109, which is not significant at any level. It is interesting to note that the only predictor variable that is significant at the .05 level is self-sufficiency. The fact that self-sufficiency is related to curiosity indicates that a person must have confidence in himself before he can be brave enough to doubt and be curious. It would seem normal that interests in engineering and physical sciences would be positively related to curiosity. Perhaps specific interests in straight engineering and chemistry tend to limit curiosity in other areas.

Variables Isolated by the Step-Wise Method Showing Maximum Correlation with the "Contribution" and "Creativity" Dimension

This method of analysis picks out those predictor variables that make the greatest contribution in descending order of importance. Significance levels are also established. These results are shown in Tables XXI and XXII. The "contribution" dimension is the total score derived from the Biographical Information Sheet, while the "creativity" dimension is the first trait in the Supervisor Rating Form. Three predictor variables, the neuroticism scale, the grade point ratio, and the "over-all creativity" ranking (in a group of 100) correlate significantly with the "contribution" criterion at the .10 level of confidence. The F index is 2.5402 and the R is 0.3093 with 9.6 percent of the variability in the criterion accounted for by the predictor variables. The "over-all creativity" ranking is individually significant in predicting the criterion at the .05 level of confidence. Table XXI indicates that those who have made the most creative contributions are more neurotic and greater achievers than the average chemical engineer.

Table XX

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES, AND SIGNIFICANCE LEVELS FOR INDEPENDENT VARIABLES WITH THE DEPENDENT VARIABLE CURIOSITY

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	-0.049	0.136	-0.359	Not significant
2. Stanford Scientific Apt.	-0.054	0.148	-0.364	Not significant
3. Bennett	0.117	0.155	0.751	Not significant
4. B1-N	-0.172	0.206	-0.836	Not significant
5. B2-S	0.315	0.155	2.026	t .05 = 1.9926**
6. B4-D	-0.261	0.232	-1.124	Not significant
7. Strong I	-0.036	0.371	-0.097	Not significant
8. Strong II	0.908	0.589	1.542	Not significant
9. Strong V	-0.094	0.310	-0.403	Not significant
10. Strong VIII	0.086	0.168	0.510	Not significant
11. Strong IX	-0.063	0.265	-0.237	Not significant
12. Strong X	0.252	0.220	1.145	Not significant
13. Engineer	-0.537	0.402	-1.333	Not significant
14. Chemist	-0.616	0.448	-1.375	Not significant
15. Production manager	-0.038	0.189	-0.201	Not significant
16. Personnel manager	0.144	0.238	0.604	Not significant
17. Grade point average	-0.028	0.139	-0.199	Not significant
18. Occupational level	0.081	0.150	0.541	Not significant

R = 0.509 F = 1.109 Not significant

** .05 significance level

Table XXI

VARIABLES ISOLATED BY THE STEP-WISE METHOD SHOWING MAXIMUM CORRELATION WITH THE "CONTRIBUTION" DIMENSION

Predictor Variable	Beta	Standard Error	"F"	Significance Level
4. B1-N	0.079	0.114	0.474	Not significant
17. Grade point average	0.156	0.115	1.856	Not significant
20. "Overall creativity" ranking	0.243	0.117	4.342	Sig. at the .05 level

R = 0.3093 $F_{.05}$ with df 72/3 $\cong$ 2.724 $F_{.05}$ with df 74/1 $\cong$ 3.968

F = 2.5402 $F_{.01}$ with df 72/3 $\cong$ 4.048 $F_{.01}$ with df 74/1 $\cong$ 6.98

F is significant at the .10 level

Table XXII

VARIABLES ISOLATED BY THE STEP-WISE METHOD SHOWING MAXIMUM CORRELATION WITH THE "CREATIVITY" DIMENSION

Predictor Variable	Beta	Standard Error	"F"	Significance Level
2. Stanford Scientific Apt.	-0.251	0.117	4.581	Sig. at .05 level
5. B2-S	0.201	0.115	3.072	Not significant
9. Strong V	-0.305	0.152	4.007	Sig. at .05 level
12. Strong X	0.134	0.117	1.321	Not significant
13. Engineer	-0.272	0.253	1.159	Not significant
14. Chemist	0.161	0.222	0.523	Not significant
19. Professional self-confidence score[a]	0.263	0.263	0.994	Not significant
21. Correction score[a]	0.205	0.137	2.230	Not significant
22. Total score[a]	0.188	0.244	0.590	Not significant

[a]Taylor-Ellison biographical inventory

$R = 0.5234$ $F_{.05}$ with df $66\frac{1}{4}9 \geq 2.012$ $F_{.05}$ with df $74\frac{1}{4}1 \geq 3.968$

$F = 2.7671$ $F_{.01}$ with df $66\frac{1}{4}9 \geq 2.676$ $F_{.01}$ with df $74\frac{1}{4}1 \geq 6.98$

Significant at the .01 level

Because a man's rank in a group of 100 correlates with his "contribution" score, this would suggest that such rankings depend heavily on the tangible demonstrations of creativity.

A group of nine predictor variables has been isolated to show a maximum correlation at the .01 level of confidence with the "creativity" criterion. The F index is 2.7671 and the R is 0.5234 with 27.4 percent of the variability in the criterion accounted for by the predictor variables. Two of these predictor variables are individually significant at the .05 level of confidence: the Stanford Scientific Aptitude Test and interests in social service and social welfare. The former suggests that an aptitude for science is a good predictor of creativity. The latter may indicate that the most creative individuals are those with broad interests who are not confined to science. The Taylor-Ellison Biographical Inventory contributes fairly heavily in the total combination of variables.

Correlations Between the Taylor-Ellison Biographical Inventory and the "Contribution" and "Creativity" Dimensions

The Taylor-Ellison Biographical Inventory has been related to the criteria of "Contribution" and "Creativity." The "Contribution" dimension is the total score derived from the Biographical Information Sheet completed by the chemical engineers. The "Creativity" dimension is the first trait in the Supervisor-Rating Form.

The Taylor-Ellison Inventory is not significantly related to the "Contribution" dimension at any level, as shown in Table XXIII. The F index is 1.6144 and the R is 0.2887. Therefore only 8.3 percent of the variability in the criterion variables has been accounted for by the predictor

Table XXIII

CORRELATIONS OF THE TAYLOR-ELLISON BIOGRAPHICAL INVENTORY WITH THE "CONTRIBUTION" DIMENSION

Predictor Variable	Beta	Standard Error	"F"	Significance Level
19. Professional self-confidence score	0.223	0.342	0.423	Not significant
20. Creativity rating score	0.545	0.477	1.306	Not significant
21. Correction score	0.230	0.222	1.072	Not significant
22. Total score	-0.382	0.627	0.371	Not significant

$R = 0.2887$ $F_{.05}$ with df 71$\not{4}$4 $\geq$ 2.482 $F_{.05}$ with df 74$\not{4}$1 $\geq$ 3.968

$F = 1.6144$ $F_{.01}$ with df 71$\not{4}$4 $\geq$ 3.564 $F_{.01}$ with df 74$\not{4}$1 $\geq$ 6.98

Not significant

variables. This means that tangible creative contributions are not predicted by this inventory.

The Taylor-Ellison Inventory correlates with the "Creativity" dimension at the .10 level of confidence, as shown in Table XXIV. The F index is 2.168 and 10.9 percent of the variability in the criterion has been accounted for by the predictor variables.

A Statistical Discussion of Predictor Variables Correlated with Self-Rankings and Supervisor-Rankings on Creativity

The Self-Ranking and the Supervisor-Ranking on creativity were made by ranking a man in a group of 100. Table XXV shows that the Self-Ranking does not correlate significantly with the group of predictor variables at any acceptable level of confidence. Only three predictor variables were individually significant. It seems normal that the more dominant and more secure individuals would have a tendency to rate themselves higher than those who are less confident. Those who had interests in physical sciences, engineering and chemistry rated themselves as more creative in their fields. Table XXVI shows that the Supervisor-Ranking on creativity does not correlate significantly with the group of predictor variables. Only one predictor variable correlates significantly with the criterion. This is interest in physical sciences and engineering. These tables indicate that the rankings are not significantly related to the predictor variables.

Table XXIV

CORRELATIONS OF THE ELLISON-TAYLOR BIOGRAPHICAL INVENTORY WITH THE "CREATIVITY" DIMENSION

Predictor Variable	Beta	Standard Error	"F"	Significance Level
19. Professional self-confidence score	0.559	0.337	2.748	Not significant
20. Creativity rating score	0.501	0.470	1.138	Not significant
21. Correction score	0.349	0.219	2.524	Not significant
22. Total score	-0.591	0.619	0.912	Not significant

R = 0.3299 $F_{.05}$ with df 71&4 = 2.482 $F_{.05}$ with df 74&1 = 3.968

F = 2.1683 $F_{.01}$ with df 71&4 = 3.564 $F_{.01}$ with df 74&1 = 6.98

Significant at the .10 level

Table XXV

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES AND SIGNIFICANCE LEVELS OF THE PREDICTOR VARIABLES WITH THE CRITERION VARIABLE OF THE "SELF-RANKING ON CREATIVITY" DIMENSION

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.032	0.132	0.240	Not significant
2. Stanford Scientific Apt.	0.107	0.143	0.750	Not significant
3. Bennett	0.025	0.151	0.166	Not significant
4. B1-N	0.268	0.200	1.339	Not significant
5. B2-S	-0.187	0.151	-1.242	Not significant
6. B4-D	0.503	0.225	2.237	Sig. at .05 level
7. Strong I	-0.104	0.360	-0.290	Not significant
8. Strong II	1.136	0.571	1.991	Sig. at .05 level
9. Group V	0.497	0.301	1.652	Not significant
10. Group VIII	-0.010	0.163	-0.062	Not significant
11. Group XI	0.167	0.257	0.650	Not significant
12. Group X	0.249	0.213	1.172	Not significant
13. Engineer	0.079	0.390	0.203	Not significant
14. Chemist	-0.814	0.434	-1.875	Sig. at .10 level
15. Production manager	0.074	0.183	0.403	Not significant
16. Personnel manager	-0.122	0.231	-0.527	Not significant
17. Grade point average	0.069	0.135	0.513	Not significant
18. Occupational level	0.007	0.145	0.046	Not significant

R = 0.551 F = 1.383 Not significant

Table XXVI

THE MULTIPLE R, BETAS, STANDARD ERRORS, "t" SCORES AND SIGNIFICANCE LEVELS OF THE PREDICTOR VARIABLES WITH THE CRITERION VARIABLE OF "OVER-ALL RANKING ON CREATIVITY" DIMENSION

Variable	Beta	Standard Error	"t"	Significance Level
1. Otis	0.105	0.145	0.727	Not significant
2. Stanford Scientific Apt.	-1.176	0.156	-1.125	Not significant
3. Bennett	0.072	0.165	0.438	Not significant
4. B1-N	-0.071	0.218	-0.324	Not significant
5. B2-S	0.080	0.164	0.484	Not significant
6. B4-D	-0.038	0.246	-0.153	Not significant
7. Strong I	-0.286	0.393	-0.728	Not significant
8. Strong II	1.088	0.624	1.744	Sig. at .10 level
9. Strong V	0.051	0.329	0.155	Not significant
10. Strong VIII	0.102	0.178	0.572	Not significant
11. Strong IX	-0.057	0.281	-0.202	Not significant
12. Strong X	0.205	0.233	0.882	Not significant
13. Engineer	-0.481	0.426	-1.128	Not significant
14. Chemist	-0.390	0.475	-0.821	Not significant
15. Production manager	-0.146	0.200	-0.728	Not significant
16. Personnel manager	-0.057	0.252	-0.225	Not significant
17. Grade point average	-0.054	0.147	-0.368	Not significant
18. Occupational level	0.111	0.159	0.698	Not significant

R = 0.411 F = 0.643 Not significant

Chapter V

SUMMARY AND CONCLUSIONS

Summary

This study was concerned with the problem of predicting creative performance in a group of chemical engineering graduates for whom psychological test scores were secured approximately 15 to 20 years ago. It can be described as a longitudinal study. It is also a predictive and concurrent validity study.

The chemical engineers in the study graduated from the North Carolina State University in the years 1947-51. The study involved 140 engineers. Usable returns were secured on 76 of them. The predictor variables used were 18 psychological test scores. These included intelligence, personality, scientific aptitude, and interest indexes. The criterion variables were two in number: (1) a creative performance evaluation secured by a twelve-dimension rating form completed by the engineer's immediate superior, and (2) a composite score designated as "contributions" secured from a form completed by the engineer himself of his publications, inventions and other significant contributions made since graduation. The Taylor-Ellison Biographical Inventory was also used as a predictor variable. Relationships were determined among these criteria by regression methods.

Of the twelve characteristics in the Supervisor Rating Form, only three were predicted significantly from the predictor variables. These were persistence (.10 level of significance), enthusiasm (.05 level of significance), and initiative (.10 level of significance). This would

indicate that the predictor variables are not fully able to discriminate between the high and low creative individuals and that the creative individual, assuming he possesses these twelve traits, could not be fully predicted using this test battery.

Neither the self-ranking nor the supervisor-ranking on creativity is significantly related to the predictor variables as a group. The literature had suggested that a self-rating on creativity is a fairly good predictor.

The Taylor-Ellison Biographical Inventory has been shown by recent research to be successful in the prediction of creativity. In this study the inventory scores were correlated with the "contribution" and "creativity" criteria. The inventory does not predict creativity when related to the "contribution" dimension but does relate significantly at the .10 level of confidence to the single "creativity" dimension from the Supervisor Rating Form. This criterion dimension is more general in nature, giving subjective opinion and weight. These statistics indicate that a subjective rating by a supervisor, taking quality of products, characteristics and work habits into account is an effective criterion. The creative individual who rarely produces measurable products could still obtain a high rating in creativity using this criterion.

Three variables--neuroticism, grade point average and "over-all creativity" ranking--were isolated by the step-wise method as showing the maximum correlation with the "contribution" dimension at the .05 level of significance. The "over-all creativity" ranking variable is significant at the .05 level of significance in predicting creativity when considered by itself with the other two variables held constant. This would indicate that supervisors could subjectively rank men on creativity well enough by an "over-all" rating to predict

those who would make the most tangible creative contributions. These relationships suggest that engineers with high scores on the neuroticism scale of the Bernreuter Inventory may be more productive in terms of their contributions. Using the criterion of "tangible contributions," these three predictors do better taken together than when included with the rest of the test battery. Seven variables are isolated as showing maximum correlation with the "creativity" dimension. These are: the Stanford Scientific Aptitude Test, the Bernreuter "Self-sufficiency" scale, Strong Groups V and X, the engineer scale, the chemist scale, and three scores from the Taylor-Ellison Biographical Inventory.

Two of these variables, scientific aptitude and social service interests, are significant at the .05 level. This suggests that while scientific aptitude contributes to creativity, wide-ranging interests rather than strong specific interests in engineering and chemistry would be typical of the creative person. Self-sufficiency shows a positive relationship indicating that this trait enables the individual to venture into creative efforts. The Taylor-Ellison Biographical Inventory is the maximal predictor variable with a "creativity" criterion based upon subjective characteristics and work habit ratings, but not with the criterion of tangible creative products. Since the correlation of these variables is significant at the .01 level, the information obtained here is reliable.

Discussion of Hypotheses

At the outset of this study seven hypotheses were presented. Each of these hypotheses will be examined in terms of the statistical data secured in the study.

Hypothesis 1. There is a significant relationship between scientific aptitude, as measured by the Stanford Scientific Aptitude Test, and creative performance.

There is a slight but negative relationship between scientific aptitude and creativity as measured by the rating forms. Tables XIII, XV and XVI indicate a significant relationship between scientific aptitude and three of the creativity dimensions, i.e., fluency, activity, and flexibility. Tables X, XI, XII, XIV, and XVIII support this slightly negative trend, but not significantly. If, however, Table XXII is examined, the Stanford Scientific Aptitude Test correlates significantly in a positive direction with the single "creativity" dimension used as a criterion. These results indicate that the relationship between scientific aptitude and creativity is not established in this study.

Hypothesis 2. There is a significant relationship between intelligence, as measured by the Otis Mental Ability Test, and creative performance.

Intelligence is neutrally or only slightly related to creativity in a positive direction, when measured by the Supervisor Rating Form. In Table XIV the creativity dimension of perception demonstrates a significantly positive relationship with intelligence. The creativity dimensions of independence, fluency, perception, activity, flexibility, initiative, knowledge, and conformity indicate only a possible positive trend. These results suggest that once an average IQ is obtained, creativity does not seem to be related to differing degrees of intelligence.

Hypothesis 3. There is a significant relationship between emotional stability, as measured by the Bernreuter Personality Inventory, scale B1-N, and creative performance.

There is no significant relationship between the criteria of creativity, as measured by the Supervisor Rating Form, and neuroticism. Table XXI shows, however, that neuroticism is isolated as one of the three predictor variables correlating with the "contribution" dimension of the criteria. This suggests that neuroticism can not be characteristic of creative men, but it is definable in those who have actually demonstrated tangible creativity.

Hypothesis 4. There is a significant relationship between self-sufficiency, as measured by the Bernreuter Personality Inventory, scale B2-S, and creative performance.

There seems to be a positive relationship between self-sufficiency and creativity, using the Supervisor Rating Form as the criterion. Characteristics of persistence, initiative and curiosity show a significantly positive relationship with the self-sufficiency score. Tables XII and XIV support this trend. In Table XXII self-sufficiency is one of the seven variables correlating most highly with the "creativity" dimension of the criteria. It seems reasonable to believe that the most creative individuals are more self-sufficient since they must be secure enough to deviate from accepted facts.

Hypothesis 5. There is a significant relationship between dominance, as measured by the Bernreuter Personality Inventory, scale B4-D, and creative performance.

Examination of two of the creativity dimensions, persistence and curiosity, suggests a slightly negative but insignificant relationship between creativity and dominance. Table XXV, which presents the predictor variables against the "self-ranking" on creativity dimension, shows that dominance is significantly related to a high self-rating. It would seem

that the more dominant, forceful individual would have a more self-assured attitude toward himself and his creative ability. The relationship between dominance and creativity is indefinite.

Hypothesis 6. There is a significant relationship between understanding physical and mechanical relationships, as measured by the Bennett Test of Mechanical Comprehension and creative performance.

The statistics derived from this paper show no established relationship between mechanical comprehension and creativity in any form.

Hypothesis 7. There is a significant relationship between certain vocational interest patterns on the Strong Vocational Interest Blank and creative performance.

Certain significant relationships in vocational interest patterns can be seen from the statistics. Interests in the biological sciences are related in a slightly negative direction to the criteria ratings. Interests in engineering and the physical sciences are positively related to the creativity dimensions of activity and initiative. Table XXVI illustrates a significantly positive relationship between this same interest and the criterion of "over-all supervisor ranking" on creativity. Table XXV demonstrates that a high self-ranking in creativity is positively related to interest in the field. Interests in social service and welfare are somewhat positively related to creativity. This may imply that the creative individual has unlimited interests. Verbal and linguistic inclinations are positively related to the criteria with statistical significance. Those who communicate more about their discoveries would naturally be rated more creative by their colleagues. It is hard to explain why specific interests in engineering are negatively related to creativity in a significant fashion unless specific interests curtail creativity by restricting one to known fact and tried theory.

Interests in chemistry are also related to creativity in a somewhat negative direction. Grade point average is only slightly related in a positive direction. "Occupational level" or "aspiration level" is positively related to creativity, again, perhaps because those with the most drive would tend to produce more. Although the interest trends are somewhat indefinite, general patterns can be noticed.

Discussion of the Rating Forms

When ratings are obtained under controlled conditions with trained raters, they are a valuable source of criterion data. The accuracy of ratings can be greatly increased by the use of well-constructed rating scales with clearly defined, unambiguous units that safeguard against "halo effect." Trait acquaintance of the raters is taken for granted under controlled conditions. With these things in mind, the Supervisor-Rating Form in this study was constructed with each trait on a separate colored page to emphasize the distinctiveness of the characteristics to be rated. Various levels of the trait were defined in order to eliminate some of the individual rater subjectivity. Unfortunately, this rating form involved subjectivity since a different rater was judging each member of the sample. Each man was rated by a different superior in a different environment, making it impossible to exercise an adequate amount of control over these ratings.

Another problem in the study that would tend to lower reliability is the fact that the numerical estimates of the "contributions" involved considerable subjectivity. Unfortunately, the contribution dimension was extremely research-scientific oriented and, consequently, it failed to assess other more general types of creativity. Many of the contribution forms were

returned without anything written on them because the engineer could not list his creative products under an appropriate heading or in such objective terms.

It was also difficult to compare the products of creativity from men in such far-ranging occupations. The creative products of a salesman would not be easily comparable to those of a physical chemist. This was a fallacy inherent in the study.

Final Conclusions

This is a predictive validity study where scores from the test battery were checked against direct measures of the subjects' subsequent creative performance. The uncontrollable variables encountered were numerous, which may in part explain the low correlations. The very definition of creativity itself is still undecided, making the establishment of a criterion both difficult and arbitrary.

The Taylor-Ellison Biographical Inventory did a better job in predicting creativity than did the test battery. The expansiveness and generality of this inventory might suggest that creativity is best predicted from the most facts about a person, whether they be biographical facts, subjective ratings or work history. Perhaps combined criteria using the rated characteristics plus the "contribution" dimension might have yielded a higher level of prediction. While the tests do show an interesting relationship to certain parts of the criteria, this particular battery of tests did not predict creativity at a sufficient level of significance. It is clear that more research into the possibilities of test prediction needs to be done. The indefinite nature of creativity makes it extremely difficult to set up a test

battery that will assess the numerous aspects of this complex characteristic. The subject of creativity is provocative. The trait can be manifested in so many ways that a comparison between individuals is difficult. Still undetermined is the question of whether creativity can be considered a single characteristic or whether it is simply a combination of general traits. This study has demonstrated many interesting trends and relationships in spite of its failure to predict creative performance with a high degree of accuracy. It has also served to illustrate the difficulties inherent in any study on the prediction of creativity.

A P P E N D I X E S

APPENDIX A

GRADUATE SCHOOL OF BUSINESS ADMINISTRATION
UNIVERSITY OF NORTH CAROLINA , CHAPEL HILL

January 15, 1966

Dear Sir:

In the period from 1947 through 1950 you participated in taking a battery of tests which were administered to your graduating class at the North Carolina State University. These tests were administered to you by Dr. Pike and myself in the hope of later using these results in research.

At the present time, the University of North Carolina has been given a grant by the Richardson Foundation, in Greensboro, to promote the identification and utilization of creative abilities. I am using part of this grant in an effort to discover predictors of creative talent in chemical engineers.

Miss Susan Hinman, a graduate student in the Master's program at the university, is working with me on this project and will be communicating with you concerning this study.

Realizing that your time is valuable and that effort is required to complete these forms, we can only hope that you will cooperate with us in the interests of expanding our knowledge about creativity. Because you have already taken tests, information about your achievements and personality characteristics can be extremely valuable when used in conjunction with those scores. Without your help this study will be impossible.

I would like to give you a brief explanation of the way this project has been set up. You will receive an envelope containing several items:

#1. A Supervisor Rating Form and an accompaning letter of explanation. The form and letter are to be given to your immediate supervisor. He will use this form to rate your creativity and several other characteristics which we believe are related to creativity. He will send this form directly back to us. It is hoped that you will encourage him to complete this form as soon as possible. His rating will be kept confidential.

#2. A Biographical Information sheet. You are asked to complete this form which asks for specific information concerning the amount and quality of the ideas, products and job improvements that you have developed during your work career.

#3. A Biographical Inventory Form. You are also asked to complete this following the given directions.

You will be sent the necessary material shortly. We hope you will help us in gathering the necessary material for the study. The time and effort which you contribute is greatly appreciated.

Sincerely,

D. J. Moffie
Associate Professor of
Business Administration

APPENDIX B

GRADUATE SCHOOL OF BUSINESS ADMINISTRATION
UNIVERSITY OF NORTH CAROLINA CHAPEL HILL
27515

January 24, 1966

Dear Sir:

Your colleague is participating in a research project dealing with the subject of creativity which is being supported by a grant from the Richardson Foundation in Greensboro, N. C. and carried out through the School of Business Administration at the University of North Carolina. This study is an attempt to discover which characteristics of a man's work habits and personality will best predict the amount of creativity he demonstrates on his job. We need your help to complete this study and sincerely hope you will work with us.

Enclosed in this envelope is also a Supervisor Rating Form which was developed in the effort to predict creativity. Will you please read the directions on the front of this form, complete it as soon as you are able, and return it directly to us in the self-addressed envelope. Please try to rate this man on each of the given traits. Be sure to write the Name of the man you are rating on the front of the rating form.

Your colleague knows the general nature of this rating form, and that by giving it to you has demonstrated his willingness for you to complete it for our research purposes. The results of this Supervisor Rating Form will be kept strictly confidential.

Realizing that your time is valuable and that effort is required to complete this form carefully, we can only hope that you will cooperate with us in the interest of expanding our knowledge about the general subject of creativity. Without your assistance in completing and returning this form, our study will be impossible.

We greatly appreciate the time and effort you are contributing to this project.

Sincerely,

D. J. Moffie

D. J. Moffie
Associate Professor of
Business Administration

APPENDIX C

University of North Carolina

School of Business Administration

Chapel Hill, N. C.

Supervisor Rating Form

These rating forms are for the purpose of evaluating the Chemical Engineers graduating from N. C. State University during the years 1947, 48, 49 and 1950. The ratings will be kept in the strictest confidence and will be used for research purposes only.

Directions:

On the attached forms several traits are described. Each trait is described by different degrees along an 11 point scale, except for the first trait which is described by a fifteen point scale. When rating the man, consider all of the descriptive statements first. Next, write the number of the statement which best describes the man in the box provided at the top of the page. The odd numbers between the statements indicate a position on the scale between the two statements to be used if it more accurately represents this man.

No one description may exactly describe this man, but make the best choice you can. Rate this man in relation to other men in similar positions in your department or to other engineers you have known.

The fact that a man may score low on several or all of these traits does not imply that he is a poor worker or invaluable to the organization. Each of these traits is only a minor contributor to his overall performance.

Please try to rate this man on each trait without considering other traits or his overall performance.

Your cooperation on filling out this form is greatly appreciated.

Creativity as demonstrated by the man's Work

Consider the implications of his work, its impact, the originality of the approaches used by the person, the comprehensiveness and novelty of the solutions, the degree to which his work has opened the way and stimulated further research. Do not consider other aspects of his performance----ONLY the CREATIVITY of his work.

1.

2. His work has demonstrated very little creativity or originality. It usually has provided no more than a rather simple solution to the immediate problem.

3.

4. His work has generally been a result of standardized approaches demonstrating little creativity. At its best, it has produced minor innovations which have been limited to the immediate problem.

5.

6. He has been moderately successful at solving problems and eliminating difficulties that arise in his work. Generally, his work has been of moderate importance but definitely narrow in applicability.

7.

8. His work has occassionally demonstrated some relatively original approaches and new ideas in the solution of some difficult problems but it has been mostly familiar or conventional and usually somewhat narrow in terms of its implications and applicability.

9.

10. He has more than the average number of new ideas, and his work has been often fresh and original. He has pointed out ways that techniques or results could be used beyond their original purpose.

11.

12. He has conclusively demonstrated a high degree of creativity. His work has presented comprehensive solutions to difficult problems, with some significant implications applicable to other areas of research.

13.

14. The impact of his work has been quite exceptional. His very creative solutions to very complex problems have broad generality and have even opened up important new areas of investigation with wide implications.

15.

(1)

GO ON TO NEXT PAGE

Persistence in Work

Consider his ability to stick to his work or projects even when long hours are required to reach a solution.

1.

2. He very rarely persists in tasks and doesn't hesitate to give up early. He usually loses his enthusiasm for his project as soon as it takes extra effort and time.

3.

4. He rarely endeavors to stay with problems until they are completed. He has a tendency to pass on problems that require additional effort rather than try to complete them himself.

5.

6. He is as persistent as most workers, staying with a problem longer if it is one of his special interests.

7.

8. He has a persistent concentration on all aspects of his work. The amount of required work necessary to complete it does not deter his interests.

9.

10. He always persevers on all tasks assigned to him. He spends much "after-hours" time on his work problems in a persistent effort to complete them successfully.

11.

(2)

GO ON TO NEXT PAGE

Enthusiasm for Work

Consider his demonstrations of enjoying his work; his desire to work on problems that challenge him; his attitude that most problems can be solved if you work hard on them.

1.

2. He fulfills the requirements of the job but exhibits very little enthusiasm or interest in spending time on difficult and challenging work.

3.

4. He is somewhat interested in certain aspects of his work more than others. He prefers routine work rather than having to exert more effort on a more challenging problem.

5.

6. He seems to enjoy his work and has done as well on his assignments as the average worker.

7.

8. He is enthusiastic about his work and enjoys problems that provide him with the opportunity to tackle a new problem. He thinks "positively" about the possibilities of solving any work problem that he takes on.

9.

10. He is extremely enthusiastic about his work, and has the attitude that all problems can be solved in some way. He seeks the opportunity to work on more difficult assignments even when it takes up his leisure time.

11.

(3)

GO ON TO NEXT PAGE

Independence in his work

Consider his ability to make decisions on his own, work in a self-reliant fashion and his willingness to separate himself from others in order to do some original thinking.

1.

2. He dislikes having to work independently. He often consults others rather than work on a project by himself.

3.

4. He has demonstrated little desire to work independently and little ability to be self-reliant about his work.

5.

6. He is average in independence in his work. He can work independently when the situation demands, but prefers to work either with a group or in a structured work situation.

7.

8. He likes to have the chance to do independent work often. He enjoys the opportunity to work on a task without detailed specifications.

9.

10. He is happiest when he is permitted to work independently, with no restrictions. He is totally self-reliant and is able to tolerate being temporarily withdrawn from others.

11.

(4)

GO ON TO NEXT PAGE

Fluency of Ideas and Suggestions

Consider the number of ideas and suggestions that he can produce and the number he spontaneously brings forth.

1.

2. He very rarely can produce ideas even when he is making an effort. His responses are usually commonplace and unoriginal.

3.

4. He occasionally produces some ideas when the quality of the ideas isn't of primary importance.

5.

6. He can produce the average number of ideas of a man in his job. Those he produces are usually of practical worth.

7.

8. He has suggestions and alternative ideas. He often volunteers recommendations for new procedures and methods on his own initiative.

9.

10. He is always overflowing with ideas and suggestions that are realistic and well thought through.

11.

(5)

GO ON TO NEXT PAGE

Ability to Perceive and Observe the Unusual

Consider the frequency of his unusual approaches and techniques, his ability to see new relationships between the basic elements of a problem, his ability to put whatever he is working on into a new perspective.

1.

2. He is just barely adequate in succeeding in his work and very rarely has seen beyond the obvious aspects of a problem.

3.

4. He can occasionally produce results in his work but rarely will he make anything but a typical approach to the improvement of a method or produce a unique solution.

5.

6. He has average ability for coming up with new perspectives and for putting the problem in a new light by seeing new relationships between the basic elements of a problem.

7.

8. He can frequently put the fundamentals of a problem or task into a new light or perspective that no one has done before, which gives him a unique solution.

9.

10. He always perceiving new, unusual relationships and acquires new perspectives on the situation. His work techniques, ideas, improvements in his products demonstrate that he is very unusual in his solution of the problem.

11.

(6)

GO ON TO NEXT PAGE

Activity Level

Consider this man's tendency to be energetic, having the habit of always being busy with some kind of work project.

1.

2. He is very slow-moving, very unenergetic, and barely manages to get the work done.

3.

4. He is usually rather slow but gets his work done. He does the least amount of work possible.

5.

6. He demonstrates an average activity level, expending the normal amount of energy in getting his work done.

7.

8. He is energetic and busily engages in the task until it is finished.

9.

10. He is extremely energetic and almost hyper-active about his work. He puts the maximum amount of effort into everything he does. He is always busy doing something constructive.

11.

(7)

GO ON TO NEXT PAGE

Flexibility in Work Habits and Procedures

Consider his ability to modify and change his work habits, revise his ideas and reverse his already-decided approach to a problem when it appears that the solution he is getting is inadequate or unappropriate.

1.

2. He very seldom revises or changes a pre-decided technique or route to the solution of a problem even if it is obvious that the answer obtained by this method will be inappropriate.

3.

4. Occasionally he will revise his approach when the situation demands it. He has a tendency to do only what is familiar to him and hesitates to deviate from procedures that he has found to be successful before.

5.

6. He usually follows his pre-decided course to a problem but he does make the average number of minor adjustments and changes.

7.

8. He often structures a problem from a new angle, knowing that it is more effective, and frequently changes his techniques and procedures to produce a better solution.

9.

10. He never hesitates to abandon conventional problem-solving methods that have become inappropriate or unprofitable. He is always revising and re-organizing his ideas, methods and procedures in the search for better solutions.

11.

(8)

GO ON TO NEXT PAGE

Initiative

Consider his demonstrations of self-initiated actions, ideas, methods, suggestions and his willingness to make them known.

1.

2. He very rarely demonstrates self-initiated action. He needs detailed instructions and follows the course that is suggested to him.

3.

4. He rarely suggests new ideas or courses of action without being prodded.

5.

6. He possesses the average amount of initiative for a man in his position. Occasionally, he suggests new ideas and new procedures spontaneously.

7.

8. He frequently comes up with new ideas and suggestions on his own initiative.

9.

10. He has a great deal of initiative and much of his energy is directed toward self-initiated actions, ideas and plans.

11.

(9)

GO ON TO NEXT PAGE

Knowledge of Work

Consider his knowledge of methods and procedures of his own work area as well as related areas.

1.

2. He possesses very little, if any knowledge about his own work and other related areas.

3.

4. He possesses some fundamental knowledge about his present job and related areas.

5.

6. He has a satisfactory knowledge of his present work and an average familiarity with related areas.

7.

8. He knows a lot about his job and related areas and is able to comprehend the basic nature of most of the problems he faces.

9.

10. He knows almost everything about his own work and is an authority in the field. He possesses knowledge far beyond his own area of specialization.

11.

(10)

GO ON TO NEXT PAGE

Tendency toward Conformity

Consider his ability to maintain his own beliefs and ideas even when others disagree with him.

1.

2. He conforms in almost all aspects of his work and would be very uncomfortable if he thought he were working differently than the others.

3.

4. He is usually a conformer but once in a while will not follow the group pattern.

5.

6. He demonstrates the average amount of conformity for a man in his work. If he is convinced that he is correct, he will break away from the group trend.

7.

8. He is rarely a conformer and has a tendency to depend more on his own opinion and ideas than those accepted by the group. Occasionally he is quite blatently non-conforming in some of these ideas and suggestions and will not give in to the group.

9.

10. He never conforms for "conformity's sake". He doesn't hesitate to follow a different procedure, idea, or theory from that of his co-workers.

11.

(11)

GO ON TO NEXT PAGE

Curiosity

Consider his predisposition to inquire into anything that interests him, either in his area of specialization or otherwise.

1.

2. He very rarely questions methods or procedures. He is seldom interested in inquiring into a new area or problem. He usually accepts what he is told without question.

3.

4. He occasionally is curious about special problems in his own area but doesn't do much to follow up with actual investigations.

5.

6. He has the average amount of curiosity about his own work area and spends some time investigating these.

7.

8. He is curious. Frequently his curiosity leads him toward better ideas because he has penetrated deeper than just a surface investigation.

9.

10. He is very curious. He possesses an active curiosity that is constantly leading him into new explorations even beyond the confines of his own area of specialization.

11.

(12)

GO ON TO NEXT PAGE

Over-all Rating in Creativity on-the-job

Consider all the men who are presently working under you, or who have previously worked under you. Then, consider this man's creativity as demonstrated in his work. Creativity, for the purpose of this evaluation is defined as "the development, proposal and implementation of new and better solutions." Now, rank this man in relation to the other men that you have supervised on the same type of job. Place an "X" on line at the point which best describes how much creativity he possesses when compared to one-hundred (100) men.

100-90	90-70	70-30	30-10	10-0
highest	high	middle	low	lowest
10%	20%	40%	20%	10%

(14)

GO ON TO NEXT PAGE

Supervisor Information Form

Directions: Please answer the following questions about yourself.

1. How long have you supervised this man?

2. How long have you been in your present position?

3. Encircle the number that best describes your job:

    1. My job is more exciting than it was 5 years ago.
    2. My job is as interesting as it was 5 years ago.
    3. My job is not interesting enough at the present time to evoke my enthusiasm.
    4. I do not particularly like my work.

THE END

APPENDIX D

Biographical Information Sheet

Directions: Please fill in the information requested on this sheet as completely as possible. If you cannot give an exact answer to the question, give the best possible estimate. The back of these sheets may be used if additional space for answers is needed.

I. Your present Job

a. Job title:

b. Employer's Name and Address:

c. Briefly describe the work you do:

d. Describe your supervisory responsibilities, if any:

e. Approximately how many men do you supervise? _____

f. The approximate percentage of your time devoted to each acitivity:

Research _____%

Teaching _____%

Administration _____%

Other _____%

g. Offices held in your company or institution: List.

GO ON TO NEXT PAGE

II. Productivity in Scientific-Professional Work

	Serial Number	Title	Description
a. Patents issued:			
# 1			
# 2			
# 3			
# 4			

Approximate number of Patents issued per year _____

b. Patent Disclosures:

1

2

3

4

Approximate number of Patent disclosures per year _____

	Title	Description	Reference	Approximate length
c. Publications:				

Approximate number of publications per year _____

d. Research reports:

GO ON TO NEXT PAGE

Approximate number of research reports per year _____

Title	Description

e. Unpublished oral presentations:

Approximate number per year _____

f. Unprinted research reports:

Approximate number per year _____

g. Unprinted, but completed, articles:

Approximate number per year _____

h. Studies completed, but not yet written:

Approximate number per year _____

Title	Estimated significance

i. New products/compounds/processes developed:

Approximate number per year _____

Title	Estimated Significance

j. New instruments developed:

Approximate number per year _____

k. New analytical methods developed:

Approximate number per year _____

l. New ideas/theories/principles:

Approximate number per year _____

m. Official suggestions submitted and accepted.

Approximate number per year _____

n. Improved processes:

Approximate number per year _____

o. Describe briefly the best scientific and technical accomplishment that you have made.

(4)

GO ON TO NEXT PAGE

III. General information

Society's Name	Description

a. Membership held in scientific/ professional societies:

1

2

3

b. Grade of membership held in these societies:

c. Professional awards received: (Describe briefly)

e. Awards received from your employing institution. (Describe briefly)

GO ON TO NEXT PAGE

Self-Rating on Creativity

If you were to rank yourself as to creativity in a group of one hundred men working in your field, in what group would you rank yourself? For the purpose of this evaluation consider "creativity" as the "development, proposal and implementation of new and better solutions." Mark an X on the line at the point which best describes how much creativity you possess when compared to one hundred other men.

100-90	90-70	70-30	30-10	10-0
10%	20%	40%	20%	10%
Highest	High	Middle	Low	Lowest

(6)

THANK YOU FOR YOUR COOPERATION

THE END

APPENDIX E

THE BIOGRAPHICAL INVENTORY

Form CRI

The purpose of this inventory is to discover information concerning some of the important factors in the background and lives of scientific personnel and to relate these measures to their future contributions and accomplishments.

Since this instrument has been designed so that your responses can be scored for distortion, you should be as accurate and as honest in your answers as you can.

INSTRUCTIONS

1. After reading each question carefully, select the one best or most appropriate answer and circle the corresponding letter to the left of it. If you change your answer be certain that your former choice is erased.

   EXAMPLE: 27. The newsmagazine which I personally prefer is:
   A. Time
   (B) U. S. News
   C. Newsweek

2. Answer all questions. Even if the question doesn't completely apply to your situation, give the "closest" or most "plausible" answer. For example: several questions have to do with your college success. If you have not been to college, consider then your "high school success."

3. In questions which refer to your father or mother, you should answer these with reference to the person who most fully acted as a father or mother to you. This person may be either your true father or mother, a foster parent, a relative, a guardian or someone else.

4. We greatly appreciate your cooperation and assistance in this research and you should know that your specific answers to each question will be kept strictly confidential.

0. _____

Last Name (print) Middle Name First Name

1. What is your age?
   A. Under 26.
   B. 27 to 34.
   C. 35 to 42.
   D. 43 to 50.
   E. Over 50.

2. At what age did you first develop an high interest in math?
   A. Under 10 years of age.
   B. 10 to 15.
   C. 16 to 20.
   D. 21 or over.
   E. Never.

3. At what age did you first take a real interest in what makes things work, such as vacuum cleaners, electric lights, alarm clocks, etc.?
   A. I never did.
   B. I don't remember.
   C. Under 6 years of age.
   D. 6 to 12.
   E. Over 12 years of age.

4. Compared to others, how much reading did you do between the ages of 12 and 18 (excluding school work)?
   A. Read everything that looked interesting.
   B. Read during a large part of my free time.
   C. Read occasionally.
   D. Read seldom from lack of opportunity.
   E. Read seldom, from choice.

5. How often during your adolescence did you have a desire to be alone, to pursue your own interests and thoughts?
   A. Very frequently.
   B. Frequently.
   C. Occasionally.
   D. Rarely.
   E. Very rarely, if ever.

6. When did you decide upon your occupation?
   A. In junior high school or earlier.
   B. In high school.
   C. First 2 years in college.
   D. Second 2 years in college.
   E. After receiving my bachelor's degree.

(7-9)

Please indicate the approximate age that you first began to participate *actively* in the activities listed below. (Only consider participation which was on your own *outside* of school.)

7. Collecting (stamps, coins, rocks, insects, etc.).
   A. 7 years or younger.
   B. 8 to 12.
   C. 13 to 17.
   D. 18 or over.
   E. Never actively participated.

8. Writing (stories, poems, etc.).
   A. 7 years or younger.
   B. 8 to 12.
   C. 13 to 17.
   D. 18 or over.
   E. Never actively participated.

9. Camping.
   A. 7 years or younger.
   B. 8 to 12.
   C. 13 to 17.
   D. 18 or over.
   E. Never actively participated.

10. At what age did you start dating the opposite sex as a fairly regular part of your social life?
    A. Under 14.
    B. 14 to 16.
    (Continued above)
    C. 17 to 20.
    D. 21 or over.
    E. Never.

11. How achievement oriented were your friends during your youth?
    A. Very achievement oriented.
    B. Quite achievement oriented.
    C. Somewhat achievement oriented.
    D. Not very achievement oriented.
    E. Not at all achievement oriented.

12. How interested were you in making repairs around the house up to the age of 18?
    A. Strong interest.
    B. Mild interest.
    C. Indifferent.
    D. Mild dislike.
    E. Strong dislike.

13. Please indicate by the following scale how long you actively participated in studying radio, electronics, etc. (Up to the age of 18.)
    A. Never or practically never.
    B. 1 year or less.
    C. 2 to 4 years.
    D. 5 to 7 years.
    E. 8 or more years.

14. Please indicate by the following scale how long you actively participated in reading non-fiction (up to the age of 18).
    A. Never or practically never.
    B. 1 year or less.
    C. 2 to 4 years.
    D. 5 to 7 years.
    E. 8 or more years.

(15-18)

To what extent did you experiment with each of the following during your youth?

15. Crystal, radio and/or short-wave sets.
    A. To a great extent.
    B. To a large extent.
    C. To some extent.
    D. To a small extent.
    E. Not at all.

16. Chemistry sets.
    A. To a great extent.
    B. To a large extent.
    C. To some extent.
    D. To a small extent.
    E. Not at all.

17. Electromagnets and motors.
    A. To a great extent.
    B. To a large extent.
    C. To some extent.
    D. To a small extent.
    E. Not at all.

18. Telescopes.
    A. To a great extent.
    B. To a large extent.
    C. To some extent.
    D. To a small extent.
    E. Not at all.

19. How would you describe your ambition when you were an adolescent?
    A. I was very ambitious; I intended to make something of myself.
    B. I was quite ambitious; I took it for granted I would make something of myself.
    C. About average in ambition.
    D. Not very ambitious; I wasn't concerned about it.
    E. Not at all ambitious.

(20-23)

Various types of achievements are listed in the statements below. Indicate whether you accomplished each achievement prior to the age of 22.

20. Won a prize or award in a scientific talent search.
    A. Yes.
    B. No.

21. Had a scientific paper published in a science journal.
    A. Yes.
    B. No.

22. Had a poem, story, or article published in a public newspaper, or magazine, or in a state or national high school anthology.
    A. Yes.
    B. No.

23. Wrote an interpretive report about another field of study (outside of school or work).
    A. Yes.
    B. No.

24. To what extent did you have feelings of doubt about your intellectual abilities during your childhood and adolescence?
    A. To a great extent.
    B. To some extent.
    C. To a small extent.
    D. Not at all.
    E. Was not particularly aware of my intellectual abilities.

25. During your childhood, how often did you participate in playing practical jokes?
    A. Frequently.
    B. Occasionally.
    C. Seldom.
    D. Never.

26. During your childhood how often did you suggest the projects of your neighborhood friends? (Build a tree hut, make a lemonade stand, put on plays, etc.)
    A. Frequently.
    B. Occasionally.
    C. Seldom.
    D. Never.
    E. Too few projects to say.

27. How would you describe your childhood?
    A. Extremely happy.
    B. Happy.
    C. Rather happy.
    D. Rather unhappy.
    E. Unhappy.

28. Which of the following tended to be the most distressing to you in your youth?
    A. Unpopularity with boys.
    B. Shyness with girls.
    C. Unpopularity with teachers.
    D. Lack of achievement in school.
    E. None of the above were at all distressing to me.

29. How important was education considered in your childhood home?
    A. Unimportant.
    B. Nice to have but not necessary.
    C. Helpful but not essential.
    D. Important but not imperative.
    E. Very important, practically imperative.

30. How much schooling did your father have?
    A. High school graduate or less.
    B. Attended college.
    C. Graduate training.
    D. One or more graduate degrees.

(31-32)

Indicate the degree to which each of the following "taboos" was imposed upon you as a child and adolescent by your family.

31. Not staying out late.
    A. Strongly imposed openly.
    B. Strongly imposed by implication.
    C. Weakly imposed openly.
    D. Weakly imposed by implication.
    E. Not imposed.

32. Not missing church on Sunday.
    A. Strongly imposed openly.
    B. Strongly imposed by implication.
    C. Weakly imposed openly.
    D. Weakly imposed by implication.
    E. Not imposed.

33. How important did your family generally regard economic and personal success?
    A. Highly important.
    B. Very important.
    C. Somewhat important.
    D. Not very important.
    E. Not important at all.

34. How old were you when you obtained your first car?
    A. 15 or younger.
    B. 16 to 17.
    C. 18 to 19.
    D. 20 to 21.
    E. 22 or over.

35. How much freedom did your mother give you during your childhood and adolescence?
    A. Not very much.
    B. A fair amount.
    C. Practically all I wanted.
    D. All I wanted.
    E. More than I wanted.

36. During your adolescence, how much time did you generally spend with your father in mutual activities per week?
    A. Less than 1 hour per week.
    B. 1 to 3 hours.
    C. 4 to 7 hours.
    D. 8 to 16 hours.
    E. Over 16 hours per week.

37. How frequently did you have disagreements with your parents during your adolescence?
    A. Frequently.
    B. Occasionally.
    C. Rarely, we had a harmonious relationship.
    D. Rarely, because of lack of contact and/or parental restrictions.
    E. Practically never, we had a very harmonious relationship.

38. During your youth, to what extent did your parents openly encourage you to take an interest in discovering things for yourself, as in science-like activities, etc.?
    A. To a large extent.
    B. To some extent.
    C. To a small extent.
    D. Not at all.
    E. They permitted it without encouragement.

39. Up to the age of 18, how would you describe your home life and your relationship with your parents?
    A. Practically perfect.
    B. Satisfactory.
    C. Rather satisfactory.
    D. Rather unsatisfactory.
    E. Unsatisfactory.

40. How old were you when you graduated from high school?
    A. 15 or younger.
    B. 16.
    C. 17.
    D. 18.
    E. 19 or older.

(41–42)

Consider the statements in the following two questions. Indicate how much each one was descriptive of your *mother* during your childhood.

41. My mother was very interested in outside activities away from home and spent a good deal of time on them.
    A. To a great extent.
    B. To some extent.
    C. To a small extent.
    D. Not at all.

42. My mother considered herself well informed about many subjects.
    A. To a great extent.
    B. To some extent.
    C. To a small extent.
    D. Not at all.

43. What kind of pre-elementary school training did you have?
    A. Attended nursery school only.
    B. Attended kindergarten only.
    C. Attended both nursery school and kindergarten.
    D. Attended neither nursery school nor kindergarten.

44. About what percentage of the students in your class did you surpass academically when you graduated from high school?
    A. 99%.
    B. 90%.
    C. 80%.
    D. 60%.
    E. 50% or less.

45. In general, how good a teaching job do you feel your high school science teachers did?
    A. An extremely good job.
    B. A fairly good job.
    C. Neither good nor poor.
    D. A rather poor job.
    E. An extremely poor job.

46. How much formal education have you completed?
    A. B.A. or B.S. degree, or less.
    B. Some graduate work, but no degree.
    C. M.A. or M.S. degree.
    D. Graduate work beyond master's degree.
    E. Doctor's degree.

47. During your pre-college training how would your teachers generally have evaluated you on a "desirable student" scale? Consider such things as whether you were cooperative, punctual, reserved, etc., or uncooperative, noisy, tardy, a troublemaker, a smart aleck, etc.
    A. Desirable student.
    B. Rather desirable.
    C. Not particularly desirable.
    D. Rather undesirable.
    E. Undesirable.

48. From which one of the following do you think you had gained the most knowledge up to the time you were about 18?
    A. School.
    B. Home environment.
    C. Extracurricular reading.
    D. My own observations.

49. About what percentage of students in your class did *you surpass* academically when you graduated from college? (If you have not yet graduated, give your estimate.)
    A. 99%.
    B. 90%.
    C. 60%.
    D. 40%.

50. During your undergraduate years in college how often did you visit your library to read materials not directly related to your classwork?
    A. Frequently.
    B. Occasionally.
    C. Rarely.
    D. Never.

51. How did your college freshman performance compare to your college senior grade-point average? (If you have not yet completed your senior year, give an estimate based upon the quarters completed.)
    A. They were both high.
    B. They were both about the same and above average for each level.
    C. They were about the same and about average for each level.
    D. Freshman performance was comparatively higher than senior.
    E. Senior average was comparatively higher than freshman.

52. In comparison with others in your classes, to what extent did you question your professors on subject matter?
    A. Considerably more often than average.
    B. Somewhat more.
    C. About average.
    D. Somewhat less.
    E. Considerably less.

53. Which of the following best describes how you felt about your undergraduate work in college?
    A. My work was well above average, but I was not satisfied with my progress.
    B. My work was above average, but I was not satisfied with my progress.
    C. My work was above average, and I was satisfied with my progress.
    D. My work was above average, but I was not completely satisfied with my progress.
    E. None of the above.

54. As an undergraduate, how often did you study with another student or students rather than alone?
    A. Very frequently.
    B. Frequently.
    C. Occasionally.
    D. Rarely.
    E. Very rarely, if ever.

(55–61)
Indicate how well you succeeded in each of the high school and/or college subjects listed in the following questions.

55. Art, painting, sculpturing, etc.
    A. Exceptionally well.
    B. Well.
    C. Fairly well.
    D. Poorly.
    E. Never studied this subject.

56. Biological sciences.
    A. Exceptionally well.
    B. Well.
    C. Fairly well.
    D. Poorly.
    E. Never studied this subject.

57. Physics.
    A. Exceptionally well.
    B. Well.
    C. Fairly well.
    D. Poorly.
    E. Never studied this subject.

58. Chemistry.
    A. Exceptionally well.
    B. Well.
    C. Fairly well.
    D. Poorly.
    E. Never studied this subject.

59. English.
    A. Exceptionally well.
    B. Well.
    C. Fairly well.
    D. Poorly.
    E. Never studied this subject.

60. Mathematics.
    A. Exceptionally well.
    B. Well.
    C. Fairly well.
    D. Poorly.
    E. Never studied this subject.

61. Engineering.
    A. Exceptionally well.
    B. Well.
    C. Fairly well.
    D. Poorly.
    E. Never studied this subject.

62. How would you describe your undergraduate college social activities involving the opposite sex, such as dances, dates, etc.? (If married during this period, do not answer.)
    A. Participated very often in social activities, and enjoyed them very much.
    B. I participated often in social activities, and almost always enjoyed them.
    C. I participated occasionally in social activities, and generally enjoyed them.
    D. I rarely participated in social activities, due to lack of time and diverging interests.
    E. I hardly ever participated in social activities, due to shyness and/or diverging interests.

63. What was your undergraduate grade-point average in all your science courses?
    A. A minus or better.
    B. B plus.
    C. B.
    D. B minus.
    E. C plus or lower.

64. What was your overall undergraduate college grade-point average?
    A. A minus or better.
    B. B plus.
    C. B.
    D. B minus.
    E. C plus or lower.

65. How would you classify your ability to concentrate as an undergraduate?
    A. I had no trouble.
    B. I had a little trouble.
    C. I had quite a bit of trouble.
    D. I had a great deal of trouble.

66. In high school, which of the following best describes your study habits?
    A. Kept up with all my subjects.
    B. Fell behind in all my subjects then crammed for examinations.
    C. Kept up with some subjects and fell behind in others.
    D. Never studied. Got all my information from class.
    E. Don't remember.

67. When you were of high school age, how important was it to you to go on to college?
    A. Extremely important.
    B. Important.
    C. Somewhat important.
    D. Not very important.

68. How many companies have you worked for in the last five years (excluding military service)?
    A. One.
    B. Two.
    C. Three.
    D. Four.
    E. Five or more.

69. To how many professional organizations do you now belong?
    A. None.
    B. One.
    C. Two.
    D. Three.
    E. Four or more.

70. How many total years of experience have you had in your professional field?
    A. 0–2 years.
    B. 3–6 years.
    C. 6–9 years.
    D. 10–14 years.
    E. 15 years or over.

71. To what extent are you the kind of individual who becomes so absorbed in his own work and interests that he does not mind a lack of friends?
    A. To a great extent.
    B. To some extent.
    C. To a small extent.
    D. To a very small extent.
    E. Not at all.

72. To what extent has your school work had an effect on your other activities; that is, has it interfered or influenced other facets of your life (social, hobbies, etc.)?
    A. To a great extent.
    B. To a large extent.
    C. To some extent.
    D. To a small extent.
    E. Not at all.

73. What do you consider to be your capacity or ability to succeed in research?
    A. Superior.
    B. Above average.
    C. About average.
    D. Slightly below average.
    E. Does not apply.

74. How often do you have a desire to be alone, to pursue your own thoughts and interests?
    A. Very frequently.
    B. Frequently.
    C. Occasionally.
    D. Rarely.
    E. Very rarely.

75. How would you feel about giving a speech before a large group of your professional associates?
    A. I could not be forced to make such a talk.
    B. I would do it but would dislike it very much.
    C. I wouldn't object too much.
    D. I like to make such talks very much.

76. How often do you tend to suggest somewhat "wild ideas" during a discussion with your associates?
    A. Frequently.
    B. Occasionally.
    C. Rarely.
    D. Never.

77. To what extent do you enjoy conversation with rather ordinary conventional people?
    A. It is usually interesting.
    B. It is occasionally interesting.
    C. It is rarely interesting.
    D. It tends to annoy me because of its superficiality.
    E. It depends on the conversation.

78. How persistent or aggressive are you in gaining recognition of your ideas?
    A. Very persistent.
    B. Quite persistent.
    C. Somewhat persistent.
    D. I'm not very persistent.

79. In daily working situations, which one of the following would be most satisfying to you?
    A. Profit.
    B. Fame.
    C. Power.
    D. Security.
    E. Self-expression.

80. Which of the following adages do you think has been most significant in your life?
    A. "Do unto others . . ."
    B. "Seek self-fulfillment."
    C. "To thine own self be true."
    D. "Enjoy life to its fullest."
    E. None of the above.

81. How do you feel about your social and intellectual self-confidence?
    A. I am very confident of both.
    B. I am quite confident in both.
    C. Quite confident about my intellectual ability, but not as confident about my social ability.
    D. Quite confident about my social ability, but not as confident about my intellectual ability.
    E. I lack some self-confidence in both.

82. Which of the following best describes you?
   A. I greatly influence my associates in their opinions, activities, or ideas.
   B. I influence my associates somewhat in their opinions.
   C. Sometimes I influence my associates, sometimes I don't.
   D. I don't influence my associates much, but I have strong ideas of my own.

(83–85)
Please indicate the extent to which you have participated in each of the activities listed below.

83. Collecting (stamps, coins, rocks, etc.).
   A. Very frequently.
   B. Frequently.
   C. Occasionally.
   D. Seldom.
   E. Never.

84. Watching sports events.
   A. Very frequently.
   B. Frequently.
   C. Occasionally.
   D. Seldom.
   E. Never.

85. Participating in social club activities.
   A. Very frequently.
   B. Frequently.
   C. Occasionally.
   D. Seldom.
   E. Never.

86. How many scientific journals do you review regularly?
   A. None.
   B. 1 or 2.
   C. 3 or 4.
   D. 5 or 6.
   E. 7 or more.

87. To what extent can you tolerate ambiguous directions?
   A. I do not like to proceed unless the instructions are made clear to me. It is not that I cannot proceed on my own, but I'd rather not make unnecessary false starts.
   B. It is frustrating to be given inadequate instructions and I feel it is more difficult to get off to a good start.
   C. It is irritating to be given ambiguous instructions, but I usually am able to proceed without it affecting my work too much one way or the other.
   D. I prefer to be given rather ambiguous instructions. This leaves me free to proceed in the direction I feel will be most productive.

88. To what extent do you feel that hard work is the basic factor of success?
   A. To a great extent.
   B. To some extent.
   C. To a small extent.
   D. To a very small extent.
   E. Not at all.

89. Rate your drive, as compared to your associates, on the dynamic force of yourself, as expressed in your activities. Consider the energy with which you conduct your research studies or other requirements, the speed of your accomplishment, the amount of work you get done.
   A. Somewhat below average.
   B. Average.
   C. Somewhat above average.
   D. Good.
   E. Outstanding.

(90–91)
Suppose you were offered an opportunity to receive a substantial advance in salary and prestige in your occupation. In the following two questions indicate how important each condition would be in hindering or stopping you from accepting the opportunity.

90. Someone else would choose the type of research you directed.
   A. Would stop me from making the change.
   B. Might stop me from making the change.
   C. Would be a serious consideration, but would not stop me.
   D. It wouldn't matter at all.

91. You would be fired if you didn't perform well.
   A. Would stop me from making the change.
   B. Might stop me from making the change.
   C. Would be a serious consideration, but would not stop me.
   D. It wouldn't matter at all.

92. Under which kind of person do you think you would work best?
   A. An understanding, warm and friendly person.
   B. One who gives support for new ideas.
   C. One who is aloof, lets me work alone.
   D. Supervisors' personalities have little influence on me.

93. Rate your ability, as compared with your associates, to discern value or the absence of value in things, facts, ideas, intellectual relationships, problems, experiments, etc., for scientific or scholarly purposes of any kind. Consider your ability to discriminate between the pertinent and the irrelevant, practical or impractical, and so on, within the focus of scientific activities.
   A. Outstanding.
   B. Good.
   C. Somewhat above average.
   D. Somewhat below average.

94. Rate your ability, as compared with your associates, to determine your own thought and action, especially in scientific work, upon the basis of your own perception and judgments. Consider your power in thinking and acting, to set a course of behavior and to move toward a goal without the prompting, pressure, guidance, or authorization of any mind but your own.
   A. Somewhat below average.
   B. Average.
   C. Somewhat above average.
   D. Excellent.
   E. Outstanding.

95. Rate your ability, as compared with your associates, to grasp ideas and use them in thinking rationally, with explicit clarity and fullness.
   A. Somewhat below average.
   B. Average.
   C. Somewhat above average.
   D. Excellent.
   E. Outstanding.

96. Rate your capacity, as compared with your associates, to make use of all facilities and means, obvious or not, which are potentially available for the performance of your scientific work.
   A. Outstanding.
   B. Excellent.
   C. Somewhat above average.
   D. About average.
   E. Somewhat below average.

97. Rate your ability, compared with your associates, to sense and grasp significance in things, etc., without explicit comprehension of it, or prior to comprehension — that is *intuitively*.
   A. Outstanding.
   B. Excellent.
   C. Somewhat above average.
   D. About average.
   E. Somewhat below average.

98. Rate your desire, compared with your associates, to add to the body of scientific insight, through discovery or invention. Consider the intensity of your desire to achieve new insights for their own sake,

apart from any specific utility, and the degree to which you draw major satisfaction in life from searching for such insights.

A. Somewhat below average.
B. About average.
C. Somewhat above average.
D. Excellent.
E. Outstanding.

99. Rate your desire, as compared with your associates, to master the known body of scientific principles and theories. Consider the degree to which you seem eager to grasp such principles, rather than merely to know what you can use on a specific job or problem.

A. Outstanding.
B. Excellent.
C. Somewhat above average.
D. About average.
E. Somewhat below average.

100. Rate your ability, as compared with your associates, to change your ideas and behavior and to tolerate changes around you. This involves the ability to be able to see things in various frames of reference, and to move from one perspective of thought to another.

A. Outstanding.
B. Excellent.
C. Somewhat above average.
D. About average.
E. Somewhat below average.

101. How would you describe yourself in creativeness as compared to your associates?

A. Much more creative than most of my associates.
B. More creative than average.
C. Slightly more creative than average.
D. About average.
E. Less creative than average.

102. Please indicate by the scale below to what extent your natural aptitude influenced you in becoming a scientist.

A. To a great extent.
B. To some extent.
C. To a small extent.
D. Did not influence me at all.

103. Please indicate by the scale below to what extent your desire for exploring the unknown influenced you in becoming a scientist.

A. To a great extent.
B. To some extent.
C. To a small extent.
D. Did not influence me at all.

Which phrase best describes the way you feel when you discuss most of your science-like activities and science accomplishments with your associates?

A. I feel highly gratified.
B. I feel gratified.
C. I feel satisfied and interested.
D. I feel somewhat uncomfortable.
E. I don't usually discuss my scientific accomplishments with my associates.

105. Assume you are in a situation in which the following two alternate courses of action arise. Which *one* of the two would you be most likely to do?

A. Finish my research through the stage of publishing it.
B. Cooperate with my supervisor by doing what he wanted me to do next.

106. Assume you are in a situation in which the following two alternate courses of action arise. Which *one* of the two would you be most likely to do?

A. Be a good team man so that others like to work with me.
B. Gain the reputation, through controversy, if necessary, as one whose scientific word can be trusted.

107. Consider the words listed below. Which of them is the most important to you?

A. Money.
B. People.
C. Ideas.
D. Things.

108. What is the minimum contribution to the theoretical development of your specialty in science with which you would be satisfied during your professional career?

A. No theoretical contributions. All experimental or administrative.
B. Small theoretical contributions.
C. Moderate theoretical contributions.
D. Large theoretical contributions.
E. Very substantial theoretical contributions.

109. What level of original work do you want to produce at least once in your field in order to satisfy your minimum professional goals?

A. Little or no original work.
B. Noticeable level of original work.
C. Moderately high level of original work.
D. High level of original work.
E. Very high level of original work.

110. If you were working in a situation where some restrictive regulations, policies, etc., had a negative influence on your work, would you try to get them changed?

A. No — probably not.
B. Yes — but probably not very hard.
C. Definitely yes.
D. I would probably just ignore them as much as possible.

111. How well informed are you in other fields of science aside from your own area?

A. Very well.
B. Well.
C. Fairly well.
D. Not very well informed.

112. How often have you engaged in technical correspondence?

A. Very frequently.
B. Frequently.
C. Occasionally.
D. Rarely.
E. Very rarely, or never.

113. To what extent do you prefer to work with others?

A. To a very great extent.
B. To a great extent.
C. To some extent.
D. To a small extent.
E. To a very small extent.

114. How often have you found books more interesting than people?

A. Very frequently.
B. Frequently.
C. Occasionally.
D. Rarely.
E. Very rarely, if ever.

115. To what extent is your self-respect dependent upon reactions you receive from other people?

A. To a large extent.
B. To some extent.
C. To a small extent.
D. To a very small extent.
E. Not at all.

116. How would you describe your capacity for tolerating ambiguity, frustration, etc.?

A. Very great capacity.
B. Definitely more capacity than average.
C. Somewhat more capacity than average.
D. About average.
E. Probably less capacity than average.

117. How would you rate yourself on self-discipline.

A. Very high in self-discipline.
B. Above average in self-discipline.
C. About average in self-discipline.
D. Probably below average in self-discipline.

118. To what extent does it seem that you have tended in your life to seek out somewhat ambiguous, complex, or frustrating situations, etc., with respect to your choice of friends, personal life, work, etc.?
   A. To a great extent.
   B. To some extent.
   C. To a small extent.
   D. To a very small extent.

119. How ambitious are you for scientific success as compared with your associates?
   A. Extremely ambitious.
   B. Above average in ambition.
   C. Average in ambition.
   D. Below average in ambition.
   E. Well below average in ambition.

120. If your supervisor implemented a new research plan which you felt would be fruitless, what would you do?
   A. Try out his research plan.
   B. Ask for more information about his plan.
   C. Suspend judgment until more certain.
   D. Discuss it with him pointing out its weaknesses.
   E. It would depend upon other aspects of the situation.

121. During the past two years, how much *actual* opportunity have you had to do creative work? Consider freedom, overdirection, facilities, encouragement, etc.
   A. Great opportunity.
   B. Some opportunity.
   C. Little opportunity.
   D. Very little opportunity.

122. How accurate are you in performing tasks of an intellectual nature compared to your associates?
   A. Somewhat below average.
   B. About average.
   C. Somewhat above average.
   D. Good.
   E. Extremely accurate.

(123–125)
Please indicate below the importance you would place on each of the accomplishments contained in the next set of items.

123. Being promoted more rapidly than the typical person.
   A. Extremely important—highest priority to me.
   B. Very important — high priority.
   C. Relatively important — some priority.
   D. Not too important — low priority.
   E. Not at all important — no priority.

124. Producing work that is considered to be highly original.
   A. Extremely important—highest priority to me.
   B. Very important — high priority.
   C. Relatively important — some priority.
   D. Not too important — low priority.
   E. Not at all important — no priority.

125. Having high official status in the organization.
   A. Extremely important—highest priority to me.
   B. Very important — high priority.
   C. Relatively important — some priority.
   D. Not too important — low priority.
   E. Not at all important — no priority.

126. Which of the following would be most descriptive of your natural inclinations about work and people?
   A. More inclined to apply myself to and derive major satisfaction from my work.
   B. More inclined to derive my major satisfaction from both my work and from my friends, etc.

127. How would you regard yourself in respect to your overall achievements as of today?
   A. Very successful.
   B. Moderately successful.
   C. Neither successful nor unsuccessful.
   D. Somewhat unsuccessful.
   E. Unsuccessful.

128. To what extent would you prefer working alone (as compared to working with a supervisor)?
   A. To a very great extent.
   B. To a great extent.
   C. To some extent.
   D. To a small extent.
   E. To a very small extent.

129. To what extent do you tend to forget trivial things such as names of highways, small towns, details, obscure facts, etc.?
   A. To a great extent.
   B. To some extent.
   C. To a small extent.
   D. To a very small extent.

130. If you were to visit a manufacturing company, which of the following would interest you the most?
   A. Methods of testing the strength of new materials.
   B. Methods for predicting the properties of new materials.
   C. Methods for increasing public demand for new materials and other products.
   D. Methods for handling public relations.
   E. Methods for transporting raw materials.

131. How often do you have a craving for excitement?
   A. Very frequently.
   B. Frequently.
   C. Occasionally.
   D. Rarely.
   E. Very rarely.

132. To what extent do you think red tape, policies, procedures, etc., would hinder your work output?
   A. To a large extent.
   B. To some extent.
   C. To a small extent.
   D. To a very small extent.

133. How often do you evaluate and try to modify your own system of thoughts and ideas?
   A. Frequently.
   B. Occasionally.
   C. Rarely.
   D. Very rarely.

134. If you heard that a fellow had made some sort of negative comment about you, how would you react?
   A. Wouldn't give it another thought.
   B. Might think of it briefly then dismiss it as unimportant.
   C. Might be mildly concerned for a time.
   D. Would be somewhat concerned and probably would try to think back and discover how the situation developed.
   E. I would be quite concerned and would be a bit uneasy until I had "worked it through" either with the person or in my own mind.

135. If you were to feel miserable and blue what would you *least* prefer to do?
   A. Have a few drinks.
   B. Be by myself.
   C. Be with my friends.
   D. Try to sleep it off.

136. How well did you assimilate all of what *you thought* was important in your physics courses. Use the scale below to indicate your choice.
   A. Exceptionally high assimilation.
   B. High assimilation.
   C. Somewhat above average.
   D. About average.
   E. Somewhat below average.

137. How willing are you to accept new or apparently absurd approaches to the solution of problems?
   A. Frequently.
   B. Occasionally.
   C. Rarely.
   D. Very rarely, or never.

138. Which one of the following have you found most useful in solving research problems?
   A. Monographs and older literature.
   B. Handbooks and technical news magazines.
   C. Discussion with associates.

139. Which one of the following have you generally found to be most helpful in solving research problems?
   A. Handbooks and journal articles.
   B. Discussion with associates.
   C. Reflective thought.
   D. Discussion with persons from other fields.

140. Which one of the following factors do you feel to be most responsible for the world's ills?
   A. The lack of concern for one's fellowman, and an absence of ideals.
   B. The great emphasis on money as an indicator of success.
   C. The necessity of conforming to the norms of our present society · lack of individualism.
   D. The lack of privacy necessary for self-development.

141. Which of the following individuals would you *least* like to be?
   A. A person who has justifiably acquired a reputation of being a man of high character, who is considerate, dependable and efficient.
   B. A person who has a great deal of emotional stability, who knows what he wants out of life and has very few moods, feelings of depression, etc.
   C. A person who has a good sense of humor and an efficient outlook on life, who is realistic, and recognizes the humor and incongruities in his life and work.

142. Which of the following best describes your feelings about how much your life is oriented toward the present as opposed to a past or future orientation?
   A. I am very much aware of what is going on around me in the present, less so with the future and even less with the past.
   B. I believe that we can learn a great deal from the past and so my time orientation is spread about equally across the past, the present, and the future.
   C. I am mostly concerned with the immediate future which I usually have well planned.
   D. My concern is generally with the future toward which I expend my energies.

143. Describe yourself in comparison to your friends and associates on the depth and intensity of your emotions and feelings or reactions to situations, other people, and things.
   A. Somewhat less intense than average.
   B. About average.
   C. Slightly more intense than average.
   D. More intense than average.
   E. Considerably more intense than average.

144. To what extent do you feel your life has been complex in terms of your work, friends, social situations, etc.?
   A. To a great extent.
   B. To some extent.
   C. To a small extent.
   D. To a very small extent.

145. To what extent do you feel that striving for understanding has been a real force in your life?
   A. To a great extent.
   B. To some extent.
   C. To a small extent.
   D. To a very small extent.

146. In comparison to others you know, how often are you aware of a sense of complacency in regard to your work, your intellectual life, your personal life, and your social life?
   A. Frequently.
   B. Occasionally.
   C. Rarely.
   D. Very rarely.

147. Which of the following best describes you in comparison to others you know as to the amount of awareness and identity that you have of yourself as a separate and unique individual?
   A. My primary concern is with my work, my family, etc., so I am rarely aware of feelings of personal identity, etc.
   B. I occasionally have feelings of awareness, distinctness, and personal identity.
   C. I frequently have feelings of heightened awareness, distinctness, and personal identity which I feel are much deeper than those of others I know.

148. How often have you felt a sense of destiny in the course of your personal and professional development?
   A. Occasionally.
   B. Rarely.
   C. Very rarely.
   D. Practically never.
   E. I'm no mystic.

149. To what extent in your personal philosophy have you been aware of an underlying complexity in your work, social relationships, morals, etc.?
   A. To a great extent.
   B. To some extent.
   C. To a small extent.
   D. To a very small extent.

150. How did you feel about filling in a questionnaire such as this one?
   A. I enjoyed it; I would enjoy a discussion with those who constructed it.
   B. It was interesting.
   C. I found it somewhat interesting.
   D. I found it neither interesting nor too distasteful.
   E. It was a nuisance; I resented it.

151. Age: _____

152. Male Female (circle one)

153. Married Single Divorced Widow(er) (circle one)

154. How long have you been working for this company? (in months) _____

155. How long have you held your present position? (in months) _____

156. How many salary increases have you received since coming to this company? _____

157. How long have you worked under your present supervisor? (in months) _____

158. What percent of your time is spent actually working with him? % _____

159. What kind of relationship do you and he have with each other? (circle one)
   A. Business or professional relationship only.
   B. Friendly and informal, in addition to (A) above.
   C. Very friendly, personal interest, including social activities.

160. Do you and he have many interests in common? YES NO (circle one)

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