A STUDY OF APTITUDES, COGNITIVE STYLES, AND PERSONALITY CHARACTERISTICS AS FACILITATORS AND DIFFERENTIATORS OF CREATIVITY IN FOUR DISTINCT DISCIPLINES

A Dissertation

Presented to

the Faculty of the Graduate School

The University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

---

by

Roslyn Abrevaya Korb

December, 1973

ACKNOWLEDGEMENTS

Invaluable assistance was sought and received from a number of individuals in the development of this study.

Dr. Ronald G. Frankiewicz, chairman of the research committee, was both a director and a friend. From conception to final copy, he willingly offered time, encouragement, and expertise. For his insight into all phases of the study, for his committment to the completion of the study, and for his continued and continual support, I am deeply grateful.

I am indebted also to the other members of the research committee, Dr. James Baxter, Dr. Samuel Miller, Dr. Robert Stewart, and especially Dr. Carl Shaw, whose meticulous and perceptive editing of the manuscript greatly enhanced the value of the study.

To the several faculty members of the University of Houston, who saw enough merit in this study to permit access to their classes, and to the twenty-two individuals who participated in this study as judges, I offer my thanks.

In addition, I would like to express my heartfelt thanks for the incalculable instances of friendship and assistance provided by several fellow students. They always managed to be there when they were needed, as did my parents, Mr. and Mrs. Harry Abrevaya.

Lovingly, I thank my husband, Laurie, and my sons, Andrew and Lee, for their complete devotion, their understanding and acceptance, and their unwavering faith. Besides helping to make this study possible, they made it all worthwhile.

A STUDY OF APTITUDES, COGNITIVE STYLES, AND PERSONALITY CHARACTERISTICS AS FACILITATORS AND DIFFERENTIATORS OF CREATIVITY IN FOUR DISTINCT DISCIPLINES

An Abstract of a Dissertation

Presented to

the Faculty of the Graduate School

The University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

---

by

Roslyn Abrevaya Korb

December, 1973

Korb, Roslyn A. "A Study of Aptitudes, Cognitive Styles, and Personality Characteristics as Facilitators and Differentiators of Creativity in Four Distinct Disciplines." Unpublished doctoral dissertation, the University of Houston, 1973.

ABSTRACT

Although the primary purpose of this study was to try and determine if creativity in different disciplines was a function of differential cognitive variables, i.e., aptitudes and cognitive styles, or if it was a generalized cognitive ability, several concomitant issues were also examined. First, Guilford's (1967) theoretical position that individuals, creative in different disciplines, should have specifically different aptitudes was contrasted with Mednick's (1963) stance that creative aptitude is the same irrespective of the discipline in which it is exhibited. Secondly, Merrifield's (1964) statement that there are both facilitators and differentiators of creativity was pursued by operationally defining facilitators as those variables which could distinguish creative individuals from non-creative individuals, and defining differentiators as those variables which would separate creative individuals into discipline-oriented groups. Thirdly, personality variables were assessed to determine their role as either facilitators or differentiators of creativity.

Accordingly, an initial sample, composed of 146 upper level college students majoring in one of the four fields of art, writing, mathematics or music, was identified and tested. The test battery consisted of 16 Structure of Intellect measures, one for each of the divergent production aptitudes hypothesized by Guilford as indicative of creative ability;

the Remote Associates Test of Mednick; the Thinking Interest Survey, a measure of cognitive style developed for this study; and the 16 Personality Factor Test of Cattell.

Following the administration of the tests, each of the subjects submitted one of his own products for rating by at least three judges who were experts in one of the four fields under investigation. The judges had been selected a priori according to their perceptions of criteria for a creative product. Through judges ratings of their products, 77 creative individuals were identified: 19 in art, 19 in writing, 21 in mathematics and 18 in music.

Since the small sample size precluded the use of all 40 variables in a single analysis, linear combinations of the 40 variables were developed through factor analysis, and scores on the 13 factorially-derived variates were used in the analysis. For both the four discipline-oriented creative groups and the creative and non-creative samples, multivariate analyses of variance followed by discriminant analysis were performed. It was found that variates in all three domains: aptitude, cognitive style and personality, functioned as facilitators and differentiators of creativity, and, of the 13 factorially-derived variates, eight could be considered differentiators of creativity, three were found to be facilitators, and two were found to be both facilitators and differentiators.

The findings of this study supported the following conclusions: (1) individuals, creative in the four fields of art, writing, mathematics and music had specifically different cognitive aptitudes, cognitive styles and personality traits; (2) Guilford's theoretical position was more characteristic of the creative sample than was Mednick's; (3) personality

characteristics were differentiators of creativity as well as facilitators; and, (4) the use of arbitrary aptitude variables in the identification of creativity, irrespective of the discipline in which it is exhibited, needs to be reassessed.

TABLE OF CONTENTS

LIST OF TABLES

Tables

LIST OF FIGURES

Figures

CHAPTER I

INTRODUCTION

Creativity is recognized as something beneficial both to the individual (Maslow, 1958) and to society, in general (Groch, 1969). However, precisely what creativity is or even what it is related to is still somewhat nebulous despite a great deal of research and thought into that question during the last twenty years. One reason for the lack of clarity in the conception of creativity is the great diversity of theoretical and methodological approaches in studying creativity. Another reason for the lack of clarity is the failure by most creativity researchers to recognize the assumptions they are making about the creative process (Eisenman, 1968). In particular, they fail to consider whether creativity in different disciplines is dependent upon differential cognitive variables or whether it is a generalized cognitive phenomenon. Apparently, they assume it is a generalized phenomenon, for most researchers study creativity in one discipline and then generalize the results to all others (Eisenman, 1968). The question of whether creativity is a function of differential cognitive variables, or whether it is a generalized cognitive phenomenon, has not been resolved, however, and thus requires empirical investigation.

Recent literature indicates that cognitive structure is the result of the interaction between cognitive aptitudes, cognitive styles and personality trends (Messick, 1972). Personality variables have been investigated in several studies of creativity and seem to be consistent across individuals who are creative in different

disciplines (Dellas & Gaier, 1970; Stein, 1968). Cognitive aptitudes and cognitive styles, however, have not been investigated as possible differentiators of creative individuals in different disciplines, although the abundance of conflicting results in creativity research indicates that they should be. Consequently, the purpose of the present study was to attempt an empirical resolution of the question of whether creativity in different disciplines is a function of differential aptitudes and/or differential cognitive styles, or whether it is a generalized cognitive phenomenon.

Theoretical Approaches

It is possible to address the problem in terms of various theoretical approaches to creativity. With regard to aptitude variables, Guilford theorizes that creative ability is a multifaceted phenomenon. Through work on his Structure of the Intellect (SOI) model, the existence of sixteen of the twenty-four postulated aptitudes indicative of creative ability have been confirmed (Guilford, 1967), although their relationship to creative production warrants further investigation (Dellas & Gaier, 1970; Stein, 1968). The implication of this theory is that individuals differ in the degree to which they possess each of the aptitudes; furthermore, no one individual will exhibit equal levels on all aptitudes (Guilford, 1967). Thus, Guilford's position indicates that creativity in a specific discipline is dependent upon differential aptitudes. Guilford emphasizes this implication of his theory when he states that writers should utilize resources in the semantic area; those in the visual arts should depend heavily on figural information and mathematicians, and scientists should depend heavily on symbolic content. (Guilford, 1967).

In contrast, Mednick's theory (1962) of creativity, is based on the premise that creativity is a unidimensional ability. In fact, Mednick defines the creative thinking process as "the forming of associative elements into new combinations which either meet specified requirements or are in some way useful" (Mednick, 1962, p. 219). Although the associations formed are dependent upon the problem at hand, from Mednick's viewpoint the cognitive process is the same and underlies all creative thought regardless of the specific field of application (Mednick, 1962, p. 220). Therefore, in answer to the question of differential aptitudes or generalized ability, Mednick's theory implies that an individual who exhibits creativity in one discipline is, given the opportunity, capable of exhibiting creativity in any other. Although Mednick did not address the question of creativity as a generalized ability in his initial theoretical paper, subsequent validation studies with the test of remote associations, tend to support this implication. (Mednick, 1963; Higgins & Dolby, 1967; Mednick, Mednick & Jung, 1964).

From another theoretical standpoint, Merrifield (1964) makes a distinction between facilitating and differentiating components of creativity. A facilitating component is one required of all subjects by the nature of the task. In other words, it is something they all must possess to accomplish the task. A differentiating component, on the other hand, is one which contributes to the separation of one individual from other individuals. If cognitive variables differentiate creative individuals into various discipline-oriented creative groups, as Guilford's theory predicts the aptitudes should, they would be considered differentiators of creativity. If, on the other hand, they merely serve to differentiate creative individuals from non-creative

individuals, as the literature indicates the personality variables do, they would be considered facilitators of creativity.

Cognitive styles, as defined by this study, are a predisposition or an affinity for engaging in specific thinking patterns, and as such, are not to be confused with the capacity to think in a specific way. Some dimensions of cognitive style which have been identified (Frankiewicz, 1966) are tolerance for ambiguity, interest in logical thinking, interest in reflective thinking, interest in divergent thinking and interest in convergent thinking. Although investigators validating SOI aptitude tests have found that cognitive style variables account for unique and significant amounts of criterion variance in these tests (Guilford, Christiansen, Frick & Merrifield, 1961; Frankiewicz, 1966), the relationship between cognitive style and factors of creative ability has not been thoroughly investigated. Thus, before various cognitive styles can be properly categorized as either facilitators or differentiators of creativity, their relationship to creativity must be empirically determined.

Literature Relevant to Aptitudes and Creativity

Most studies of the cognitive aspects of creativity have investigated the differences between high creative individuals and low creative individuals. Very few studies have explored the difference between individuals who are creative in different disciplines. Of those that have, Barbarik (1966) found that scientists showed a preference for subordinate categorization of concepts, whereas creative visual artists showed a preference for superordinate categorization of concepts. Schechter, Schmeidler & Staal (1965) found that art students recalled dreams more frequently and had more imaginative dreams than did either

science or enginering students, although there were no differences between these groups on tests of creativity. Mackler & Shontz (1965) found that artists and dancers could be discriminated on the basis of one aptitude--originality--but were not distinguishable on the basis of thirteen others. Finally, Drevdahl (1956), using tests of six SOI aptitudes, found that one aptitude, evaluation of semantic transformations (MMT), the capacity for redefinition, successfully distinguished creative science students from creative art students where creativity was judged by instructors familiar with the work of the students.

A few studies have been directly concerned with the question of creativity as a discipline-specific or a generalized ability. One such study (Piers & Kirchner, 1971) used two instruments to measure creativity, the Revised Art Scale of the Welsh Figure Preference Test and Mednick's Remote Associates Test. These two instruments were administered to 145 undergraduate students and the tests were found to be uncorrelated. This absence of relationship between two apparent measures of creativity "tended to support a specificity theory rather than one of generality" (Piers & Kirchner, 1971, p. 271).

Bee (1962), investigating the possibility that there may be "some sort of 'g' factor of divergent ability, i.e., individuals may tend to be 'creative' across different kinds of content" (Bee, 1962, p. 149), used 126 fifth-grade children who were identified as having a wide range of cognitive abilities. Included were individuals with every possible combination of high verbal, spacial and numerical abilities and low verbal, spacial and numerical abilities. It was assumed that the three content areas, numerical, verbal and spacial, were comparable to the three content areas labeled by Guilford as symbolic, semantic and figural. Six tests, one for each of the symbolic,

semantic and figural divergent production aptitude were administered. It was found that verbal and numerical (semantic and symbolic) divergent thinking were unrelated, but that spacial (figural) abilities were somewhat related to both verbal and numerical abilities. It was concluded that there was some evidence that individuals, at least at fifth-grade level, tend to be creative across different content areas or that creativity may be a generalized rather than a discipline-specific ability.

Some studies have found evidence that creativity is a function of differential abilities, although they were not directly concerned with this problem. Rossman & Horn (1972), investigating the cognitive, motivational and temperamental indicants of creativity and intelligence, found a dimension which represented "an important distinction" (Rossman & Horn, 1972, p. 284) between individuals majoring in engineering and individuals majoring in art. These two groups were distinguished by such cognitive variables as Ideational and Word Fluency, Serial-Nonsense-Syllable Memory, Artistic Preferences, and Necessary Arithmetic Operations. The engineers scored significantly higher on the Necessary Arithmetic Operations Test, while the artists scored significantly higher on all the other tests.

Similarly, Jones (1962), studying 150 sixth-grade children, found that some tests of semantic divergent production predicted the creative quality of a written product ($r = .48$) better than tests of figural divergent production ($r = .32$), whereas tests of figural divergent production predicted the "creative quality" of artwork better ($r = .54$) than tests of semantic factors ($r = .40$). It would appear there are different abilities operating in the production of creative written work and creative art work, a finding supportive of a differential aptitude theory of creativity.

In another study, Welsh (1946) gave four tests of creative ability to 30 professional artists and 48 college students from various areas. Two of the tests were semantic tests and two were figural tests. The two figural tests separated the artists from the students, whereas the two semantic tests did not. This experiment was followed by another one (Fisichelli & Welsh, 1947) with 24 art majors brought into the comparisons. The art majors scored significantly higher on tests of a figural nature than did the unselected students.

The contradictory findings of some other studies in creativity could perhaps be taken as evidence that creativity in different fields is a function of differential abilities. For example, Elliott (1964) found a significant positive relationship between creativity in advertising, as judged by advertising executives who were asked to select their most creative employees, and performance on tests of semantic divergent production. Beittel (1964), on the other hand, found no relationship between creativity in art, as judged by having faculty members rate student art works, and performance on these same tests of semantic divergent production. So, it may be postulated that semantic ability is necessary for creative work in advertising, but irrelevant to creativity in art.

Similarly, Gough (1961), using tests of semantic flexibility and fluency, and tests of figural and Gestalt transformations, found no relationships between scores on these tests and supervisor and peer ratings of creativity in science. Drevdahl (1956), however, did find that students judged to be creative in sciences scored higher on tests of originality, word fluency, and adaptive flexibility than did non-creative science students. Again, it may be postulated that originality,

word fluency and adaptive flexibility are "critical" to scientific creativity, while semantic fluency and flexibility, and Gestalt and figural transformations are relatively unimportant in scientific creativity.

Studies of creativity within a single field also could be taken as evidence that differential cognitive abilities may be operating in specific fields. Shouksmith (1958), for example, found that ideational fluency was related to creative essay writing. Simpson (1971) found that the study of music was conducive to gains in word fluency, elaboration and spontaneous flexibility. Karlins, Schuerhoff & Kaplan (1969) found that spacial orientation correlated highly with rated creativity in architecture while spacial visualization and remote associations did not. Finally, Skager, Klein & Schultz (1967) found that tests of divergent production of figural systems and tests of ability to visualize predicted the judged "esthetic quality" (p. 106) of drawings whereas figural fluency and figural redefinition did not.

In general, the type of results reported in this section have been described as highly inconsistent and have been taken as evidence that SOI tests indicative of creative ability have little construct validity (i.e., it is doubtful whether they are related to creativity at all) (Dellas & Gaier, 1970; Stein, 1968). It is also true that investigators who obtained these findings, proceeding from the point of view that creativity is a generalized ability, have interpreted their results as indicative of faulty test construction. However, if these results are approached from a discipline-specific point of view, they would be expected, and could serve as evidence that differential abilities exist in different fields.

Literature Relevant to Cognitive Style

Although the use of cognitive style variables, as defined in this study, has not been attempted in creativity research, variables which appear to be somewhat analogous to these cognitive style variables have been used. Weissman (1970) studied the relationship of several creativity measures (the Barron-Welsh Art Scale, and tests of spontaneous and adaptive flexibility and ideational fluency) to the "intellectual disposition scale" of the Omnibus Personality Inventory. This scale describes persons ranging from those with broad intrinsic interests and strong literary and esthetic perspectives to those who are anti-intellectual but are interested in tangibles and learning the practical. He found a significant positive relationship between a disposition toward intellectuality and all measures of creativity. Gibson, Kibler & Barker (1968) found a significant positive relationship between scores on creativity tests and a critical thinking instrument (the Watson-Glaser Critical Thinking Appraisal). Hedrick, Lilly & Merrifield (1968), in a study of elementary school children, used an altered version of the Inventory of Children's Interests which has scales labeled: school concern, diligence, self-confidence and intolerance of ambiguity, along with tests of figural creativity. They found that children's interests were independent of figural creativity.

MacKinnon (1962) and Haag & David (1969) used the Strong Vocational Interest Blank in the study of creativity. MacKinnon found that occupational interests on the SVIB were the most effective predictors of ratings of creativity in architecture, for, certain preferences of work, amusement and school subjects were significantly related to ratings of creativity. Haag & David found no relation between the Banking Scale and the Office Work Scale of the SVIB and various measures of creativity.

Windholtz (1968) used the Kuder Preference Record and various devergent thinking tests and determined that higher levels of creativity were related to higher levels of literary and musical interests, interest in helping others and interest in aesthetic experience.

From the results of these studies, it would appear, interests, variously defined, could be relevant to creativity, at least in adults. Whether cognitive styles, as defined by this study, are relevant to creativity within a specific discipline or interest within a specific discipline, remains for empirical verification. Intuitively, however, a predisposition to engage in a kind or kinds of thinking over and above the capacity to undertake those kinds of cognitive activity should account for unique variance in judged creativity.

The Plan of the Study

The purpose of this study was to investigate the question of whether creativity in different disciplines is a function of differential cognitive variables (i.e., aptitudes and perferences for cognitive styles) and personality, or whether it is a generalized cognitive phenomenon; and, concomitantly, to determine those variables which may be considered differentiators of creativity as opposed to facilitators. In order to carry out this investigation, an initial sample of subjects in the four distinct disciplines of art, writing, mathematics and music were selected; tests to be administered to the initial sample were selected or developed and validated; the most creative subjects in the initial sample were identified based on some criteria of creativity other than cognitive variables; and the data from the four discipline-oriented creative groups, as well as that from the creative and non-creative samples, were analyzed using multivariate analysis of variance.

The two global hypotheses to be tested in this study were:

1. The four discipline-oriented creative groups are distinguishable on the basis of cognitive and personality variables.

2. Cognitive and personality variables will distinguish the creative from the non-creative sample.

If the first of these hypotheses is supported, several specific predictions of how the discipline-oriented groups are distinguishable, in terms of Guilford's theory, will then be examined.

3. Are artists distinguishable from writers, mathematicians and musicians on the basis of aptitudes in the figural content area?

4. Are writers distinguishable from artists, mathematicians and musicians on the basis of aptitudes in the semantic content area?

5. Are mathematicians distinguishable from artists, writers and musicians on the basis of aptitudes in the symbolic content area?

If both global hypotheses are supported, joint consideration of cognitive and personality variables over these hypotheses will afford categorization of the variables as differentiators and/or facilitators. For both hypotheses, aptitude, cognitive style and personality variables will be considered simultaneously, realistically accommodating intricate inter-relationships over domains.

CHAPTER II

PROCEDURES

Sample Selection

Selection of Potential Subjects

Since the purpose of the present study was to determine if individuals who are creative in different fields are distinguishable, one obvious requirement for the selection of subjects was that they be creative in different disciplines. This requirement necessitated addressing a very controversial topic, namely the criterion problem, the concern of which is the validity of identifying subjects as creative.

In general, it has been concluded that the creative act involves three things: the person, the product and the process (Groch, 1969; Jackson & Messick, 1965). Since the basic concern of this study was with the cognitive aspects of creativity, the identification of creative individuals by tests of cognitive process would have required many of the assumptions which, in fact, this study was investigating. So, the use of cognitive variables to identify creative individuals was excluded as a possibility and some evaluation of either the person and/or the product was needed.

There was some basis for using personality variables to identify creative individuals. As has been noted previously, numerous studies have found that there are certain personality traits characteristic of "creative" individuals irrespective of discipline. Among these traits

are independence, dominance, introversion, openness to stimuli, self-acceptance, intuitiveness, flexibility and lack of concern for social norms (Dellas & Gaier, 1970; Stein, 1968). However, the use of personality variables to identify creative individuals was not a definitive solution to the criterion problem for three reasons. First, there is some doubt (Ohnmacht, 1970) as to whether subjects identified as creative through personality variables would be the same as those identified through cognitive variables, i.e., aptitudes. Secondly, establishing the relative "creativeness" of each subject's personality profile was impossible to implement since the number of available subjects was extremely limited; and finally, personality variables, exclusively, have negligible predictive validity with creativity, irrespective of how they are defined. Thus, personality variables were not used as a means of identifying the creative individuals in the initial sample, but they were measured, and included with the cognitive variables as possible facilitators of creativity.

The third aspect of the creative act, the product, was the other possible method for identifying creative individuals. Products could be used in the identification of creative individuals only if rated on the basis of their creativity by qualified experts in each of the disciplines chosen for study. One obvious requirement of this procedure was a discernible product, while another requirement was the selection of judges.

Four fields used in this study which met the former requirement of a discernible product were the visual arts, "creative" writing, music and mathematics. Besides meeting this requirement, these four fields were appealing from research precedence--all had been used, although not simultaneously, in previous research on creativity

(Lowenfield & Beittel, 1959; Shouksmith, 1958; Gough, 1961; Beittel, 1964; Elliott, 1964; Skager, Klein & Schultz, 1967; and Simpson, 1971). Even more significantly, it follows from Guilford's theory (1967) that individuals who are creative in these four fields should have specifically different cognitive abilities.

Therefore, individuals who had a major interest in one of the fields of art, "creative" writing, music or mathematics were chosen for the initial sample pool. A "major" interest implied that the sample was restricted to individuals who were majoring in one of the four fields at or beyond his junior year in college; additionally, the sample had to contain individuals who had a sufficient interest in one of these fields to produce a product in it. Thus, the initial sample was composed of 146 college-age or older individuals who had produced a product in one of the four fields of art, "creative" writing, music or mathematics. The products produced by subjects in the initial sample included paintings, designs and sketches in the art area; poetry and short stories in "creative" writing; scores and compositions in music; and a series of three structured problems in mathematics which permitted a continuum of responses from most to least original (Appendix A). Only the mathematics group was given an assignment specifically for this study. In art, products were developed as part of class assignments. In both music and writing, each subject was asked to select his best product and submit it for judging.

The subjects in the initial sample were selected from universities in and around the Houston area, including the University of Houston, Houston Baptist College and Sam Houston State University. They ranged in age from 20 to 45 with the preponderance of them being between 20 and 25 years old. All subjects volunteered to participate in the study,

although some participated as part of a class project and others were offered fiscal remuneration to gain their cooperation.

Selection of Judges

A second requirement in using products to identify creative individuals was the selection of competent judges to evaluate the products. Judges selection in creativity research has traditionally been considered an insignificant problem and has been handled with very imprecise methodology (Korb & Frankiewicz, 1973). In this study, however, the method of selecting judges was very critical since subjects were admitted to the analysis sample solely on the basis of the judges' ratings of their products. Additionally, judges were being selected from four distinct disciplines, so some communality of judgment had to be ascertained in order to minimize group distinctions based solely on different perceptions of creativity among the four sets of judges.

One way to account for differences in perception among the four sets of judges would have been to have all the judges rate all the products irrespective of the judges' expertise, or lack of expertise, in disciplines other than his own. This was not possible, however, since experts, for the most part, declined to judge products outside their area of expertise. More importantly, it was necessary to maintain a relatively homogeneous level of judge expertise, in the rating of the products. Thus, an *a priori* determination of the judges' perceptions of a creative product in their field was necessary.

Development of Strategy for Judge Selection

Accordingly, 32 brief statements, developed from the theoretical criteria for the analysis of a creative product given by Jackson & Messick (1964), were prepared on separate 3" x 5" cards for potential

judges to rate in a modified Q-sort. A variation of Stephenson's (1953) Q-methodology was used in this study for several reasons. First, it was particularly well-suited to the judgmental task involved because it allowed each statement to be compared with every other statement, thereby accommodating shifts of statements from one category to another. Secondly, it was valuable for small sample sizes (Kerlinger, 1966; Guilford, 1954); and finally, it provided a method for determining judge-factors or judge "types" (Rinn, 1961) which could then be used as a basis for the selection of judges. Data from the sort was initially collected using the following procedures. A sample of 16 potential judges composed of mature artists, mathematicians, scientists, writers and music educators was told that each of the 32 statements could be defined as part of a creative product, and instructed to sort each statement into one of nine categories according to its "suitability" in defining a creative product in the judge's particular field. Potential judges were not told to sort the statements into a fixed distribution since it was felt a distribution requirement would be unnecessarily limiting.

The analysis of the 32-statement sort had two objectives. The first was to determine if a set of judges with homogeneous perceptions of the criteria for a creative product could be established. Hence, the 16 sorts were interrelated using both product-moment correlation coefficients to measure pattern similarity between pairs of sorts, and intraclass correlation coefficients to measure magnitude and pattern similarity between pairs of sorts. The resulting correlation matrices were reduced in rank by both an obverse alpha factor analysis (Kaiser & Caffrey, 1965) and an obverse maximum likelihood procedure (Jöreskog, 1967), each followed by a varimax rotation (Kaiser, 1958). Resulting were six judge-factors robust over analytical techniques.

To clarify the solution, four judges were withdrawn from the potential judge sample. This elimination of judges was a legitimate procedure since, in an obverse or Q-technique factor analysis, a reduced rank explanation is sought of the judge covariance matrix, rather than of the statement covariance matrix. The sorts of the remaining 12 judges were reanalyzed following identical procedures and resulted in a three common-factor solution robust over all four analytic procedures.

The similar pattern alignment of judges in these four solutions indicated a high degree of robustness of factor pattern, together with a high degree of stability of judge factors across contrasting analytical techniques. Additionally, the composition of sets of judges was unaffected by the choice between coefficients reflecting pattern similarity or coefficients reflecting both magnitude and pattern similarity. In this instance the judge factors were not field-specific, thus, the basic methodology was effective in discriminating judge types, irrespective of the particular field in which they had expertise.

The refinement of the sort was a second objective of this analysis and was initiated by preparing 21 additional statements complying with the Jackson & Messick criteria. These statements were included in the sort to insure adequate sampling of each of the five criteria and to provide a larger statement pool from which eventually only the most discriminating statements would be retained.

It was felt a limited number of statements would be necessary from the standpoints of imposition and time required to make the sort, compatability with an optional distribution restriction ala Stephenson, (1953), and reliability considerations. The entire set of 53 statements

was subsequently administered to nine of the twelve original subjects with the same instructions retained. The intrajudge consistency estimates of reliability were calculated for each of the nine judges, resulting in a median coefficient of .51 and a range of .34 to .87. Due to the interaction of the additional 21 statements with the original 32 statements, changes in the perception of the latter can be expected, and estimates of intra-judge test-retest reliability coefficients should be depressed. With intraclass coefficients as lower bound estimates of individual judge reliability (Cronbach, Rajaratnam & Gleser, 1963), the reliabilities ranged from .29 to .56 with a median value of .44.

In addition, the 53-statement sort was administered to a sample of twenty graduate students in elementary education who were assumed to have little expertise in any one of the fields under investigation. The purpose of this administration was not to interpret judge factors, per se, but was, rather, for purposes of comparison with the expert judge sample to facilitate removal of statements from the sort. Regression score estimates of factor scores (Thurstone, 1935) were developed for each of the 53 statements in the 'expert' and 'naive' samples. Those statements with standardized estimated factor scores less than $|0.9|$ standard deviations from the mean, indicative of constrained variance in defining creative products, were removed from the sort. Additionally, those statements supporting a full range of factor score estimates in the naive sample exclusively were eliminated because these statements were thought to be the least effective in distinguishing one judge "type" from another. This procedure resulted in a final sort of 29 statements; and, as with both of the prior sorts, the number of statements from each of Jackson & Messick's (1964) five criteria was proportional to the complexity of the criterion.

Selection of Judges for the Study

The refined 29-statement sort was used to select the judges for this study from a new judge pool. A more complete description of these procedures is available in Appendix B. The potential judge pool included university, conservatory and institute instructors in the four fields as well as individuals who had an outstanding reputation for expertise in one of the four fields. Six judges in art, science and mathematics, and five judges in music and "creative" writing were asked to sort the 29 attributes of a creative product. Subsequently, an obverse or Q-technique factor analysis followed by varimax rotation of the judge pool over these ipsative orderings of attributes were employed to identify judges who were consistent in their ordering of the attributes.

Analysis of the ratings from the 22 potential judges followed the multiple analytic procedures set out previously in the development of the sort and resulted in the eight-factor solution summarized in Table 1. As may be seen, the first factor is a general factor, with judges from three of the four areas loading significantly on it. The next three factors are primarily discipline-specific factors, and the last four are essentially singlets stratified over discipline areas. Because the selection of three judges from each discipline, exclusive of idiosycratic judges, optimizes interjudge reliability by discipline area, multiple graphic rotations of the first four orthogonal factors were performed. Whereas rotation in factor analysis is usually performed to separate factors, the objective of the graphic rotations in this case was to condense or reduce four factors accounting for 48 percent of the variance among the sorts into one factor in order to select judges over disciplines from the communality of the evolved

TABLE 1

Signigicant[1] Loadings of Judges from
Alpha Factor Analytic Solution
Rotated to a Varimax Criterion

Judges		Factors I	II	III	IV	V	VI	VII	VIII
Art	1					-.624			
Art	2			-.701			-.392		
Art	3							.717	
Art	4			.674					
Art	5			.474					.818
Art	6								
Science	7						.410		
Science	8				.666				.400
Science	9								-.469
Science	10				.694				
Science	11	.390			.732				
Science	12		.434		.532	-.413			
Writing	13			-.642					
Writing	14	.772							
Writing	15					.878			
Writing	16	.766							
Writing	17								
Music	18		.701						
Music	19					.414		.418	
Music	20	.667							
Music	21							.866	
Music	22		.910						

[1] $b_{ij} \geq |.392|$ is significant at the .05 level

factor. As may be seen in Table 2, this procedure yielded 13 judges, four from science and three each from art, English and music.

Although it was felt that this procedure had produced a set of judges with homogeneous perceptions of the attributes of a creative product, verification was needed. Therefore, the sorts of the judge pool were subjected to an unrestricted maximum-likelihood factor analysis (Jöreskog, 1967). When a one-factor solution was requested as the minimum number of factors to extract, the factor extracted (displayed in Table 2) was virtually identical in pattern to the factor obtained in the graphic solution. The likelihood-ratio statistic calculated for this one-factor solution indicated that one factor was sufficient to account for the variation in the correlation matrix and was thus a "proper" (Jöreskog, 1967) solution.

Judges' Perception of Creative Products

To determine how these 13 judges were consistent in their perception of the attributes of a creative product, standardized factor scores for each of the 29 attributes on the reduced factor were estimated using Thurstone's (1935) regression algorithm:

$$[FS] = [SS] \times [R]^{-1} \times [A]$$

where $[SS]$ is the 29 x 22 standardized score matrix for each of the attributes; $[R]^{-1}$ is the inverse of the correlation matrix between the 22 judges; and $[A]$ is the matrix of factor pattern coefficients for the 22 judges on the reduced factor in Table 2. Table 3 lists the standardized estimated factor score of the reduced factor for each of the 29 attributes in the sort.

TABLE 2

Unitary Factor Solutions for Judges

Judges		Graphically Reduced Alpha Factor-Analytic Solution	Maximum-Likelihood Solution
Art	1	.031	.100
Art	2	-.650	-.596
Art	3	.209	.433
Art	4	.518	.314
Art	5	.577	.485
Art	6	.391	.440
Science	7	-.300	-.106
Science	8	.491	.575
Science	9	.321	.187
Science	10	.630	.694
Science	11	.439	.399
Science	12	.549	.557
Writing	13	-.600	-.486
Writing	14	.601	.617
Writing	15	.159	.242
Writing	16	.438	.426
Writing	17	.351	.481
Music	18	.537	.556
Music	19	-.026	.158
Music	20	.478	.578
Music	21	.100	.170
Music	22	.439	.466

TABLE 3

Estimated Standardized Factor Scores
For The 29 Statements

Statement	Estimated Factor Scores
Confronting a creative product sometimes requires the observer to revise his world.	2.3364
A creative product often challenges conventional ways of thinking.	2.2087
A creative product tends to generate rather than terminate thought.	1.37980
A creative product sometimes involves an extreme departure from the traditional way of doing things.	.99640
A creative product often evokes surprise in the observer, on first exposure to it.	.99452
A creative product, which at first appears complex, often is found to have an underlying or hidden simplicity.	.73858
On first exposure to a creative product, the observer often requires a period of adaptation to assimilate it into his experience.	.68098
A creative product sometimes violates conventional logic, but somehow manages to hang together and have a logic of its own.	.67202
In a complex creative product, the internal elements of the product must blend together and be appropriate to each other.	.63844
The individual elements of a creative product must contain an internal order.	.63102
The creative product must contain a "logical fit" within its context or, of the product's elements with each other.	.62994
A creative product invites the observer to move out, emotionally, in new directions.	.20583
Upon observing a creative product, there is often a recognition of inevitableness about it, given the context in which it is embedded.	.01243

TABLE 3 (cont.)

Statement	Estimated Factor Scores
The creative product must "make sense" in light of the demands of the situation.	-.00005
The observation of a creative product presents an occasion for reflection and wonder.	-.12016
A creative product is an object worth savoring over a long period of time.	-.12046
A creative product usually involves a radical shift in approach to a subject or in handling material.	-.18409
The originality of a creative product is relative to the norms of the population from which the product came.	-.40360
The creative product is always novel or original.	-.41069
A truly creative product has endurance.	-.41096
A creative product which at first appears simple, turns out, on closer inspection to possess only apparent simplicity.	-.49490
A creative product often leaves the observer with a feeling of contentedness.	-.61593
A creative product transforms the constraints of reality.	-.65026
A creative product has intensity and concentration of meaning about it which requires continued attention.	-.84216
A creative product offers something new each time time it is experienced.	-.90184
A creative product does not disclose its significance on first exposure to it.	-1.26624
A creative product of the highest form makes the observer feel as if his expectations had been fulfilled.	-1.36309
A creative product bears a clear relation to the environment or to the internal motivations of its producer.	-1.39170
The total import of a creative product is obvious on first exposure to it.	-2.94916

Apparently, these 13 out of the 22 judges isolated on the reduced factor perceived a creative product as surprising, different and even disturbing since it challenges tradition and generates thought. Also, a creative product was internally consistent and required adequate time for experiencing it.

The Creative Sample

The creative sample was identified by the judgment of products of subjects in the initial sample. At least three judges in each discipline were selected by the Q-sort analysis. In both music and "creative" writing, subjects were admitted to the creative sample from the pool of potential subjects only if their products were ranked at or above a middle rank, i.e., at least 5 on a scale of 1 (least creative) to 9 (most creative), by two of the three judges. The intraclass correlations among the judges were .84 and .63 in music and "creative" writing, respectively.

For the mathematics groups, there were additional criteria. As has been noted (p. 83; Appendix A), products for the mathematics groups consisted of three structured problems. All three judges in this group independently rated the performance of each subject on each problem, separately, rather than attempting to give each individual a composite "creativity" score over the three problems. Thus, each individual received nine rankings, one for each problem from each judge. Only those subjects with a score of middle rank or above on six of the nine problem-judge rankings were admitted to the creative sample from the pool of potential subjects.

For art, products consisted primarily of paintings and designs, and as such, were impossible to store or remove from the classrooms in

which they were produced. Also, the products were available for judging only on the day when the finished products were turned in for assessment by the instructors in the courses. Thus, the judges had to rate these products at a specific time and in a specific place.

Although each judge was made aware of the time and constraints for judging, various personal circumstances prevented certain ones from appearing at one of the two specified times. Thus, half of the initial art subjects were rated by one of the judges selected by the Q-sort, and the other half was rated by two of the three selected judges. In both cases, however, the instructors' ratings of the products were made available to the investigator and these were used in conjunction with the rating of the selected judges in selecting the creative art subjects. This was a feasible procedure since the correlation between the selected judges and the instructors was .72 in one case and .84 in the other.

These selection procedures resulted in a sample of 77 subjects retained from the pool of 146 potential subjects:

19 in art
19 in writing
21 in mathematics
18 in music

Instrumentation

Structure of Intellect Tests

Tests of cognitive ability were selected in support of the two aptitude theories under investigation--Guilford's and Mednick's. Guilford's theory implies creativity is a function of 18 independent divergent production aptitudes. These aptitudes include a generalized sensitivity to problems, word fluency, associational fluency, expressional fluency, spontaneous and adaptive flexibility, originality and the

ability to make transformations. Of the 18 hypothesized aptitudes, tests for only 16 were available from either the Aptitude Research Project or Sheridan Psychological Supply. Each test measures an aptitude in one of three content areas--semantic, figural or symbolic--and is concerned with operations upon either units, classes, systems, transformations, relations or implications. The SOI mnemonic for each aptitude is available in Appendix C. Test titles and descriptions, the SOI aptitude they are measuring, and test reliabilities, as determined in this study, are presented in Appendix D.

The validity of these tests as measures of SOI aptitudes was established through factor analytic techniques (Guilford & Hoepfner, 1967). The validity of these tests as predictors of creativity has not been established, and is, in fact, questionable (See p. 8). Since the purpose of the present study was to examine specific creativity-oriented aptitudes rather than to establish predictors of creativity, as such, the use of these tests in this study was warranted.

All the SOI aptitude tests required some degree of subjectivity and judgment in scoring. Since several individuals participated in scoring these tests under the supervision of the investigator, each scorer scored all the subjects for a given instrument. This procedure was used to minimize inter-scorer variability. Scorers were not aware of either an individual's identity or his group membership, a necessary procedure for reducing scorer bias. If estimates of reliability for a particular test were inordinately low, the test was rescored by a different scorer to insure adequate adherence to scoring criteria.

The Remote Associates Test

Mednick's theory was examined with the Remote Associates Test (RAT) (Mednick & Mednick, 1968). This test appears to be a valid measure of the ability to see relationships between seemingly mutually remote ideas, (Higgins, 1966) which Mednick postulates as the creative process, and was therefore included in the test battery for this study. Again, however, its ability to predict creative production has not been completely established; but it was not used as such in this study (Mednick, 1963). The split-half reliability of this instrument is .86 (Mednick & Mednick, 1968). The Remote Associates Test had an objective scoring procedure.

The Personality Test

The personality test was the Sixteen Personality Factor Questionnaire, Form A (16PF) (Cattell, Eber & Tatsuoka, 1970). This particular personality instrument was selected because it appeared to assess those traits which make up the constellation of traits indicative of the creative personality and, also, it has been used in previous research on creativity (Cross, Cattell & Butcher, 1967; Drevdahl & Cattell, 1958; Drevdahl, 1956). A brief description of the 16 scales and their pre-established dependability and stability coefficients are given in Appendix E. The 16PF had an objective scoring procedure.

The Thinking Interest Survey

The Thinking Interest Survey, Form C, (TIS) was used to assess cognitive styles, which were defined in this study as a predisposition or an affinity for engaging in specific thinking patterns. This characterization of cognitive style is consistent with that offered by Guilford, et al (1961) and more recently by Messick (1972). The instrument, an extension of the Thinking Interest Survey of Frankiewicz &

Merrifield (1966), was administered to all subjects in the initial sample. In its present form the TIS contains 70 dichotomous items, each of which is apparently related to some aspect of interest in a certain style of thinking. Since many items were added to the original instrument, a construct validation of the 70-item instrument was necessary. The complete validational process and its results are available in Appendix F.

Briefly, seven dimensions of cognitive style were found. Each dimension, or scale, was interpreted and labeled on the basis of those items which were significantly associated with it. Table 4 contains the name of each scale along with a lower bound estimate (i.e., h^2) of reliability.

The Thinking Interest Survey was scored by obtaining estimates of the factor scores for each of the subjects on each of the seven scales according to the algorithm:

$$[F] = [Z] \times [R]^{-1} \times [A] \times [L]^{-1} \times [B]$$

where $[F]$ is the 145 x 7 matrix of standardized regression estimates of factor scores; $[Z]$ is the 146 x 70 matrix of scores for each of the 70 items, standardized over 145 respondents; $[R]^{-1}$ is the inverse of the 70 x 70 interitem correlation matrix; $[A]$ is the 70 x 25 first-order factor pattern matrix; $[L]^{-1}$ is the inverse of the 25 x 25 first-order interfactor correlation matrix; and $[B]$ is the 25 x 7 second-order factor pattern coefficient matrix.

Testing Procedures

These tests were administered to the initial sample by the investigator or by individuals trained by the investigator, to eliminate variance due to inconsistent testing instructions. Tests were given at the

TABLE 4

Scales Associated With The Thinking Interest Survey

Scale	Name	h^2
I	Tolerance of Ambiguity	.62
II	Interest in Logical Thinking	.61
III	Interest in Initial Alternative Thinking Leading to Rigidity	.65
IV	Interest in Problem Solving	.70
V	Interest in Reflective Thinking	.80
VI	Interest in Diversity	.52
VII	Interest in Perseverative Thinking	.60

beginning of the first summer session, June 1973, in various locations on the University of Houston campus.

Optimally, testing should have been done in large groups to minimize variance due to non-uniform testing conditions. When groups of subjects were available, this procedure was followed. However, in some cases it was necessary to test individuals in a one-to-one situation. The same relative order of testing (Appendix G) was maintained for all subjects, however, and each aptitude test was allotted a fixed amount of time. The timing devices were all calibrated by the same electric clock to insure uniformity.

Measurement of Variates

The data consisted of 40 variables spanning three distinct domains. These included seventeen aptitude tests, seven cognitive style scales and 16 personality scales. The use of all 40 variables in a single one-way fixed-effects multivariate analysis of variance and subsequent discriminate analyses would not have been legitimate due to limited degrees of freedom; the smallest of the four initial groups contained only 24 subjects. On the other hand, each set of variables could not be analyzed independently in a one-way multivariate analysis of variance and discriminant analysis since this would have neglected any relationships which might exist between the three distinct domains, a principal focus of this study. A check of the determinants of the variance-covariance matrices indicated all four arose from the same population variance-covariance matrix, hence, the variance-covariance matrices were pooled over the four discipline areas. The resulting variance-covariance matrix was rescaled into an intercorrelation matrix of all 40 variables and factor analyzed to reduce the order of the data. This matrix of correlations between variables was

analyzed using the alternative factor analytic techniques of alpha factor analysis (Kaiser & Caffrey, 1965) and incomplete principal components analysis (Thomson, 1936), each followed by rotation to an orthogonal position using the varimax criterion (Kaiser, 1958). This analysis resulted in thirteen common factors which were robust under the different analytic techniques. Each of the thirteen resulting factors was considered a unitary variate although each was composed of a weighted combination of the original 40 variables. Regressed factor score estimates (Thurstone, 1935) were obtained for each subject in the sample on each of the thirteen variates evolved in the incomplete principal component analysis; these thirteen variates were subsequently used as dependent variables in the analyses mong the four discipline-oriented creative groups and between the creative and non-creative samples.

Interpretation of Variates

Since factorially constructed variates were used in the analysis, the meaningfulness of the analysis was contingent upon the interpretation and subsequent labeling of each of the thirteen variates. Thus, a description of each variate together with selected ones of the original 40 variables that were associated with and contributed significantly[1] to the interpretation of the variate follows. It should be noted that the sequence of analysis to this point has assured maximum construct validity for each of the following 13 variates.

---

[1] A factor weight of $|.255|$ is significant at the .01 level for 146 subjects.

Variate A - Fluency-Flexibility

.869	DMU	Ideational Fluency
.766	DMC	Spontaneous Flexibility
.716	DFT	Adaptive Flexibility
.712	DFI	Figural Elaboration
.342	16PF	Imagination
.314	EMI	Sensitivity to Problems
.275	DFU	Figural Fluency
.270	DFC	Spontaneous Flexibility

Variate A is almost a pure aptitude variate, although there is some imaginative personality characteristic involved. It encompasses fluency and flexibility in both the semantic and figural content areas, and as such, could be considered a measure of an individual's ability to produce many diverse products of a semantic and/or a figural nature.

Variate B - Scientist Personality Syndrome

-.830	16PF	Tense, frustrated, overwrought
-.798	16PF	Apprehensive, worrying, troubled
.695	16PF	Emotionally stable, calm, mature, high ego strength
-.598	16PF	Suspicious, hard-to-fool
.458	16PF	Controlled, socially precise, high self-concept, controlled
.414	16PF	Emotionally stable, faces reality, calm, mature
.295	TIS	Interest in divergent thinking

This variate represents the personality profile of "creative" scientists as characterized by Cattell, Eber & Tatsuoka (1970). In other words, a person having a high positive score on this variate would be relaxed, self-assured, confident, emotionally stable, mature, easy to get along with, self-sufficient, venturesome, spontaneous and interested in divergent thinking.

Variate C - Symbolic Aptitude

.771	DSI	Symbol Elaboration
.707	DSR	Divergent production of symbolic relations
.569	DFT	Adaptive flexibility as exhibited in the Match Problems test
.418	DSU	Word fluency - divergent production of symbolic units
.352	DFU	Figural fluency
.332	DSS	Expressional fluency - divergent production of symbolic systems
.329	16PF	Intelligence, abstract thinking
.283	EMI	Sensitivity to problems
-.246	16PF	Venturesome
-.238	TIS	Interest in divergent thinking
-.238	16PF	Imaginative

This variate was labeled a symbolic variate since every symbolic aptitude assessed loaded significantly on it. There is also some figural aptitude associated with this variate although the instruments used to measure these particular figural aptitudes are somewhat symbolic in actual content. A person scoring high on this variate would have strong symbolic aptitudes, would exhibit intelligent, abstract thinking, would be restrained, not interested in divergent thinking and would be oriented toward the practical and realistic aspects of situations.

Variate D - Originality in a Semantic Context

.645	DMT	Originality
.600	DFC	Spontaneous flexibility
.588	16PF	Shrewd, worldly, penetrating
.549	RAT	Remote Associates Test
.392	DMI	Semantic Elaboration
.373	DMR	Associational fluency
.306	16PF	Imaginative
.302	DFT	Adaptive flexibility
.265	16PF	Intelligence
.256	TIS	Interest in divergent thinking

As the title suggests, this variate represents the ability to be original primarily in a semantic context. Originality, itself, implies an ability for flexible thinking, i.e., the ability to make easy shifts, as well as a certain degree of shrewdness, imagination and intelligence. The relatively high loading of the Remote Associates Test (RAT) on this variate indicates that, at least for this sample, good performance on the RAT is highly related to originality in a semantic context.

Variate E - Enthusiastic Participation

.796	16PF	Impulsive, enthusiastic
.715	16PF	Venturesome
-.515	16PF	Self-sufficient, resourceful
.482	16PF	Outgoing, participating
.383	16PF	Assertive, competitive, dominant
.307	EMI	Sensitivity to problems

Variate E is essentially composed of personality scales. Individuals who score high on this variate are impulsive, spontaneous, attention-getting and outgoing. They evidence, in general, an eagerness for group participation, perhaps to gain the admiration of the group since self-assessment of their contributions to the group are non-resourceful but conventional and socially acceptable.

Variate F - Semantic Fluency

.784	DMS	Expressional fluency
.637	DMR	Associational fluency
.602	16PF	Tender, sensitive
.488	DMI	Semantic elaboration
.332	RAT	Remote Associates Test
.313	EMI	Sensitivity to problems

Variate F is composed primarily of aptitudes, although there is a strong personality element in it, tenderness and sensitivity. The aptitudes loading on this variate are all semantic in nature, with semantic fluencies - both expressional and associational leading the variate; hence the name. The RAT loads on this variate, although not as strongly as it did on Variate D. Variate F and Variate D are both essentially semantic aptitude variates, although they are independent of each other. They differ quite markedly, in that Variate D contains originality, spontaneous flexibility, the imaginative scale of the 16PF, adaptive flexibility, and others, which this variate does not. On the other hand, this variate contains expressional fluency, the tender scale of the 16PF, and a sensitivity to problems which Variate D did not.

Variate G - Artists' Personality Syndrome

.726	16PF	Assertive, competitive, dominant
.708	16PF	Experimenting, liberal, analytical
.499	16PF	Self-sufficient, resourceful
.457	16PF	Suspicious, hard-to-fool
.436	16PF	Intelligent, abstract thinking
.331	16PF	Imaginative
-.241	16PF	Shrewd

Variate G is totally a personality variate. It represents those personality traits which characterize the "creative" artist (Cattell, Eber & Tatsuoka, 1970). A person who scores high on this variate would be dominant, radical, self-sufficient, natural and strongly affected by inner motivations.

Variate H - Marshalled Strictness

.774	16PF	Conscientiousness, moralistic, persevering
.583	16PF	Controlled, high self-concept
-.411	TIS	Interest in logical thinking
.374	DSU	Word fluency
.274	DSS	Expressional fluency

Individuals scoring high on Variate H may be characterized as conscientious, controlled, not interested in logical thinking and evidencing poor symbolic fluency; whereas those individuals scoring low disregard rules, are emotionally undisciplined, self-indulgent and have an interest in logical thinking which facilitates their symbolic fluency.

Variate J - Interest in Perseveration

.692	TIS	Interest in perseverative thinking
-.506	TIS	Interest in logical thinking
.436	TIS	Interest in divergent thinking
.411	RAT	Remote Associates Test
.272	DSU	Word fluency

A cognitive style or profile dominates this variate. A high score on this variate represents an interest in perseverative, illogical and divergent thinking, and these cognitive styles are associated with the ability to form remote associations and word fluency.

Variate K - Intellectualist Syndrome

.758	TIS	Tolerance for ambiguity
-.525	16PF	Outgoing, participating
-.303	16PF	Tender-minded, overprotected, sensitive
.257	EMI	Sensitivity to problems
-.227	16PF	Shrewd, calculating

This variate was titled the intellectualist syndrome since it seems to represent those interests, personality traits and aptitudes that represent an "intellectualist" stereotype. An individual with a high score on this variate would be characterized as tolerant of ambiguity, reserved, aloof, self-reliant, realistic and forthright.

Variate L - Interest in Problem Solving

.792	TIS	Interest in problem solving
.449	DSS	Expressional fluency
.356	16PF	Sensitive

This variate represents a strong willingness to entertain new ideas for approaches and methodology in solving problems. In addition, a person scoring high on this variate would have the necessary aptitudes and sensitivity to solve problems if they were embedded in a symbolic context.

Variate M - Interest in Reflective Thinking

.886	TIS	Interest in reflective thinking
.421	EMI	Sensitivity to problems

Variate M represents an interest in reflective thinking from the standpoint of seeing and comprehending problems presented.

Variate N - Interest in Fluent-Rigid Production

.761	TIS	Interest in alternative, rigid thinking
.496	DFU	Figural fluency
.244	DSS	Expressional fluency

This variate was labeled Fluent-Rigid Production since it is characterized by an interest in flexible, alternative, generative thinking at the outset of problem situations which shifts to rigid, inflexible production once an apparent proper alternative has been found. Figural and expressional fluency are suggestive of doodling, first inventively, then compulsively, as one's interest in thinking shifts from a fluent to a rigid style.

A brief summary of these factorially established variates is presented in Table 5. Of particular interest, is the domain saturation index. This index is the proportion of common factor variance attributed to a domain for each variate, and has been developed by delineating each of the three domains in terms of the original 40 variables.

TABLE 5

Variates Used In Analysis

Variate	Name	Predominant Domain	Domain Saturation Index		
			Aptitude	Personality	Style
A	Fluency-Flexibility	Aptitude	.912	.075	.013
B	Scientist Personality Syndrome	Personality	.049	.912	.039
C	Symbolic Aptitude	Aptitude	.851	.124	.025
D	Originality in a Semantic Context	Aptitude	.690	.281	.029
E	Enthusiastic Participation	Personality	.117	.825	.058
F	Semantic Fluency	Aptitude	.775	.214	.012
G	Artists Personality Syndrome	Personality	.075	.912	.013
H	Marshalled Strictness	Personality	.215	.659	.126
J	Interest in Perseveration	Cognitive Style	.249	.124	.627
K	Intellectualist Syndrome	Cognitive Style	.245	.358	.396

TABLE 5 (Cont.)

Variates Used In Analysis

Variate	Name	Predominant Domain	Domain Saturation Index		
			Aptitude	Personality	Style
L	Interest in Problem Solving	Cognitive Style	.343	.182	.476
M	Interest in Reflective Thinking	Cognitive Style	.225	.093	.682
N	Interest in Fluent Rigid Production	Cognitive Style	.352	.108	.539

CHAPTER III

ANALYSIS AND RESULTS

The Four Discipline-Oriented Creative Groups

Scores on the 13 factorially-derived variates for the four discipline-oriented creative groups were investigated by a one-way fixed-effects multivariate analysis of variance. This analysis tests the global hypothesis that the vectors of means, i.e., centroids, of the four groups are equal. It resulted in an F-ratio of 2.64 which with 39 and 181 degrees of freedom was significant beyond the .0001 level. Thus, the global hypothesis of equal mean vectors was rejected and the alternative hypothesis that the four discipline-oriented creative groups are distinguishable on the basis of cognitive and personality variables was found tenable.

Each vector was composed of 13 means, one for each of the variates. The means and standard deviations for each of the 13 variates are shown in Table 6 together with the univariate F-value and associated probability level for each of the 13 variates. A profile of the means for each of the eight variates retained in the discriminant function is displayed in Figure 1. It is evident from this graphic display that performance on each of the variates was extremely disparate across the four creative groups.

The creative art and mathematics differed systematically from the creative music and writing groups over Variates A, D and H. The former groups were lower in Fluency-Flexibility and Originality in a Semantic Context and higher in Marshalled Strictness, whereas the latter groups

TABLE 6

Means And Standard Deviations For The Thirteen Variates
In Standard Score Form Together With The Univariate
F-Values And Associated Probability Levels For
The Four Discipline-Oriented Creative Groups

Variate	Discipline-Oriented Creative Groups: Art n=19 Mean	Art StdDev	Writing n=19 Mean	Writing StdDev	Mathematics n=21 Mean	Mathematics StdDev	Music n=18 Mean	Music StdDev	F	p
A - Fluency-Flexibilty	-.21	1.59	.25	.84	-.26	.62	.26	.59	1.56	.21
B - Scientist Personality Syndrome	-.22	1.13	-.14	1.04	-.11	.93	.51	.76	2.16	.10
C - Symbolic Aptitude	-.65	1.09	.16	.92	.43	.91	.02	.79	4.74	.005
D - Originality in a Semantic Context	-.38	.87	.37	.91	-.26	.96	.30	1.11	3.01	.04
E - Enthusiastic Participation	-.27	1.03	.18	1.09	.03	.97	-.14	1.06	.63	.60
F - Semantic Fluency	-.17	1.17	.24	1.00	-.06	.88	.00	.97	.58	.62
G - Artist Personality Syndrome	-.04	.80	.39	1.24	-.43	1.02	.13	.72	2.51	.06
H - Marshalled Strictness Attributed to Superego	.45	1.15	-.69	.76	.34	.80	-.21	.84	7.06	.001

TABLE 6 (Cont.)

Variate	Discipline-Oriented Creative Groups: Art n=19 Mean	Art n=19 StdDev	Writing n=19 Mean	Writing n=19 StdDev	Mathematics n=21 Mean	Mathematics n=21 StdDev	Music n=18 Mean	Music n=18 StdDev	F	p
J - Interest in Perseveration	.23	.96	-.05	1.01	-.13	.72	.15	.89	.69	.56
K - Intellectualist Syndrome	.42	1.21	.11	.78	-.05	.97	.00	.57	1.17	.33
L - Interest in Problem Solving	.12	1.11	.22	.98	-.34	.68	.17	.84	1.34	.27
M - Interest in Reflective Thinking	-.62	.92	.12	.90	.14	.97	.36	1.00	3.77	.01
N - Interest in Fluent-Rigid Production	.28	.95	-.07	1.06	.27	1.11	.03	.93	.56	.64

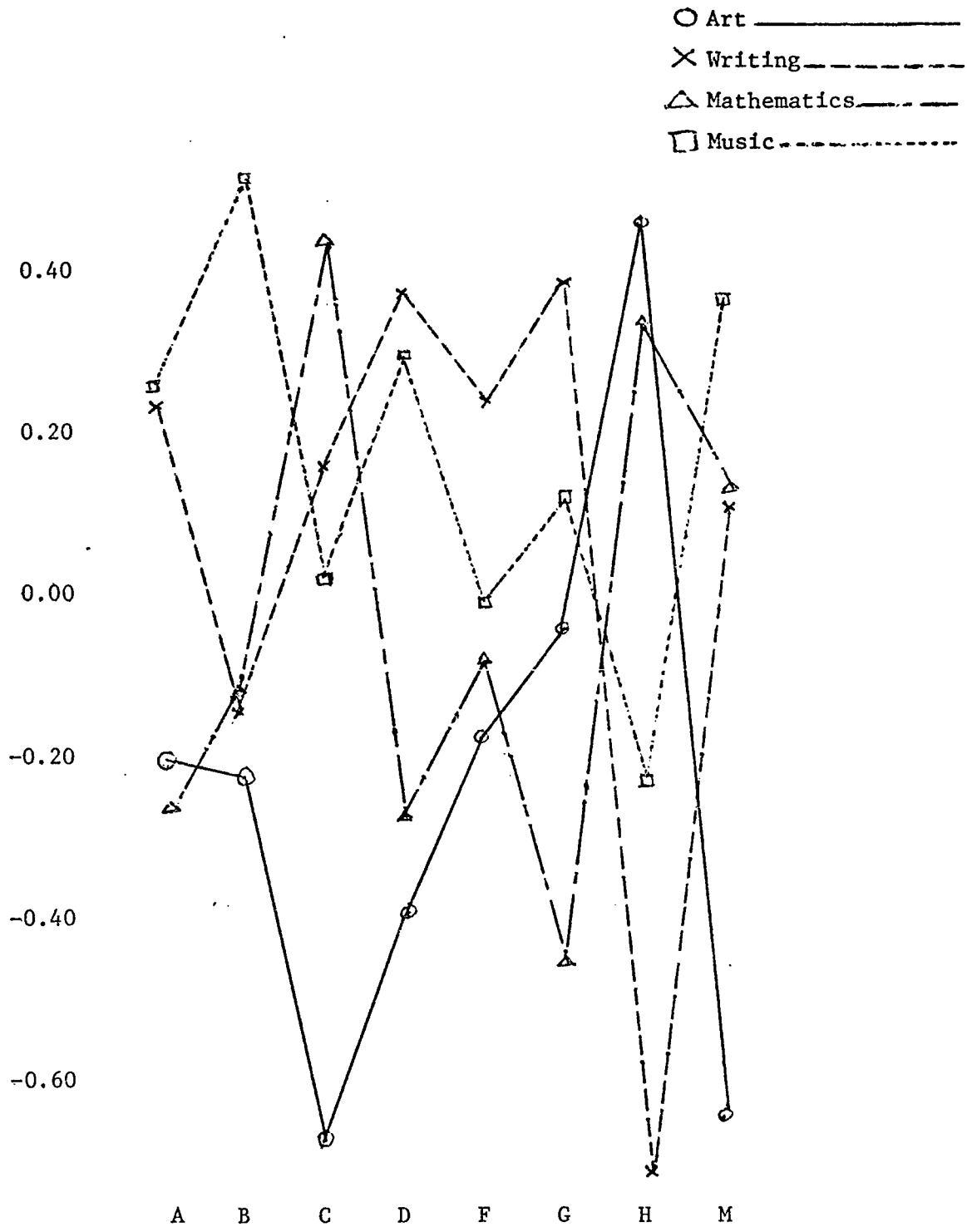


Fig. 1. Profile of Means for the Four Discipline-Oriented Creative Groups on the Eight Variates Retained in the Discriminant Function.

exhibited relatively higher levels of Fluency-Flexibility and Originality in a Semantic Context and relatively lower levels of Marshalled Strictness. The creative music group was unique in terms of Variate B, the Scientist Personality Syndrome, in that they scored high relative to the scores of the creative art, writing and mathematics groups. The creative art group was uniquely lower in Symbolic Aptitude and Interest in Reflective Thinking, Variates C and M, than were the remaining three creative groups. On Variate G, the creative writing and creative mathematics group appear to be juxtaposed, with the former exhibiting the Artist Personality Syndrome and the latter exhibiting the opposite of this personality syndrome. It also appears that the creative writing and creative art groups are juxtaposed on Variate F, with the writers exhibiting relatively high Semantic Fluency and the artists exhibiting relatively low Semantic Fluency.

Rejection of the global hypothesis simply indicated that there was a non-chance association between the classification variable, in this case discipline area, and the 13 variates. It did not indicate, however, which of the groups were different nor did it indicate which of the groups could be considered as coming from common populations. Additionally, it did not determine which of the variates led to the rejection of the hypothesis. Thus, additional analysis were performed to ascertain this information.

One method of additional analysis suggested by Stevens (1972) and Bock & Haggard (1968) is discriminant analysis. The purpose of discriminant analysis, when it is incorporated in multivariate analysis of variance, is to characterize major differences among the groups (Bock & Haggard, 1968) by determining linear combinations of the variates that provide maximum separation of the groups (Bock & Haggard, 1968).

Thus, scores on these 13 variates for the 77 subjects in the four discipline-oriented creative groups were investigated by a stepwise multiple discriminant analysis. The purpose of this analysis was to determine which of the 13 variates best distinguished the groups. Stepwise discriminant analysis includes variates in a discriminant function sequentially, based upon the variates' power to distinguish the groups in relation to the variates previously included in the discriminant function. Thus, the first variate entered into the function is that variate which best discriminates the groups in a univariate sense, i.e., that variate which has the highest univariate F-value. The next variate entered into the function is the best discriminator of the groups, once the effect of the first variate has been partialled out of the excluded variates. The third variate entered into the function is the best discriminator of the groups after the effects of the first and second variates have been partialled out of the excluded variates. This progression of variates stops once the criterion for inclusion in the discriminant function can no longer be met, although, in general, this criterion is so relaxed that every dependent variable is included in the discriminant function.

In this study, dual criteria were applied to the variates for inclusion in the discriminant function. Not only did the approximate F-value, an indication of the significance of the discriminant analysis, have to remain greater than the critical value for significance, but the partial or step-down F-values for each variate included in the discriminant function had to be significant at or beyond the 10% level. Although 10% is a relatively low probability level, as may be seen in Table 7, the use of this level rather than the more stringent 5% level allowed two additional variates of interest, i.e., the two personality syndromes,

TABLE 7

Step-down F-Values For The 13 Variates

Variate	Step-down F	p
H - Marshalled Strictness	7.06	.0004
C - Symbolic Aptitude	4.75	.0045
M - Interest in Reflective Thinking	3.94	.0117
D - Originality in a Semantic Context	3.63	.0171
A - Fluency-Flexibility	2.88	.0422
F - Semantic Fluency	2.64	.0567
B - Scientist Personality Syndrome	2.22	.0940
G - Artist Personality Syndrome	2.16	.1014
L - Interest in Problem Solving	1.49	.2256
K - Intellectualist Syndrome	.85	.4741
J - Interest in Perseveration	.54	.6551
E - Enthusiastic Participation	.59	.6266
N - Fluent Rigid Production	.45	.7158

to be included in the discriminant function. Table 7 also indicates the order in which each of the 13 variates were included in the discriminant function by the stepwise analysis. Using these dual criteria, eight variates were selected to constitute the discriminant function.

In this study, with four discipline-oriented creative groups and the eight variates, there could be no more than three orthogonal linear combinations of the variates since the maximum number of independent linear combinations is equal to the degrees of freedom among groups, or one less than the number of groups. However, only two discriminant functions were significant at or beyond the 5% level, as determined by Bartlett's (1954) statistic, although they accounted for 92% of the variation among the four groups over the eight retained variables.

Because these two discriminant functions are independent of one another, they can be used to characterize a basis in two dimensional discriminant space. The distances between the four group centroids in this two dimensional discriminant space are shown in Figure 2. The horizontal axis in Figure 2 represents the first discriminant function and the vertical axis represents the second. Table 8 contains the projection of each of the centroids on each of the discriminant functions.

TABLE 8

Centroids For Each Of The Four Discipline-Oriented Creative Groups On The Two Discriminant Functions

Group	Discriminant Function I	Discriminant Function II
Creative Artists	-1.39	- .62
Creative Writers	1.26	- .39
Creative Mathematicians	- .53	.79
Creative Musicians	.76	.14

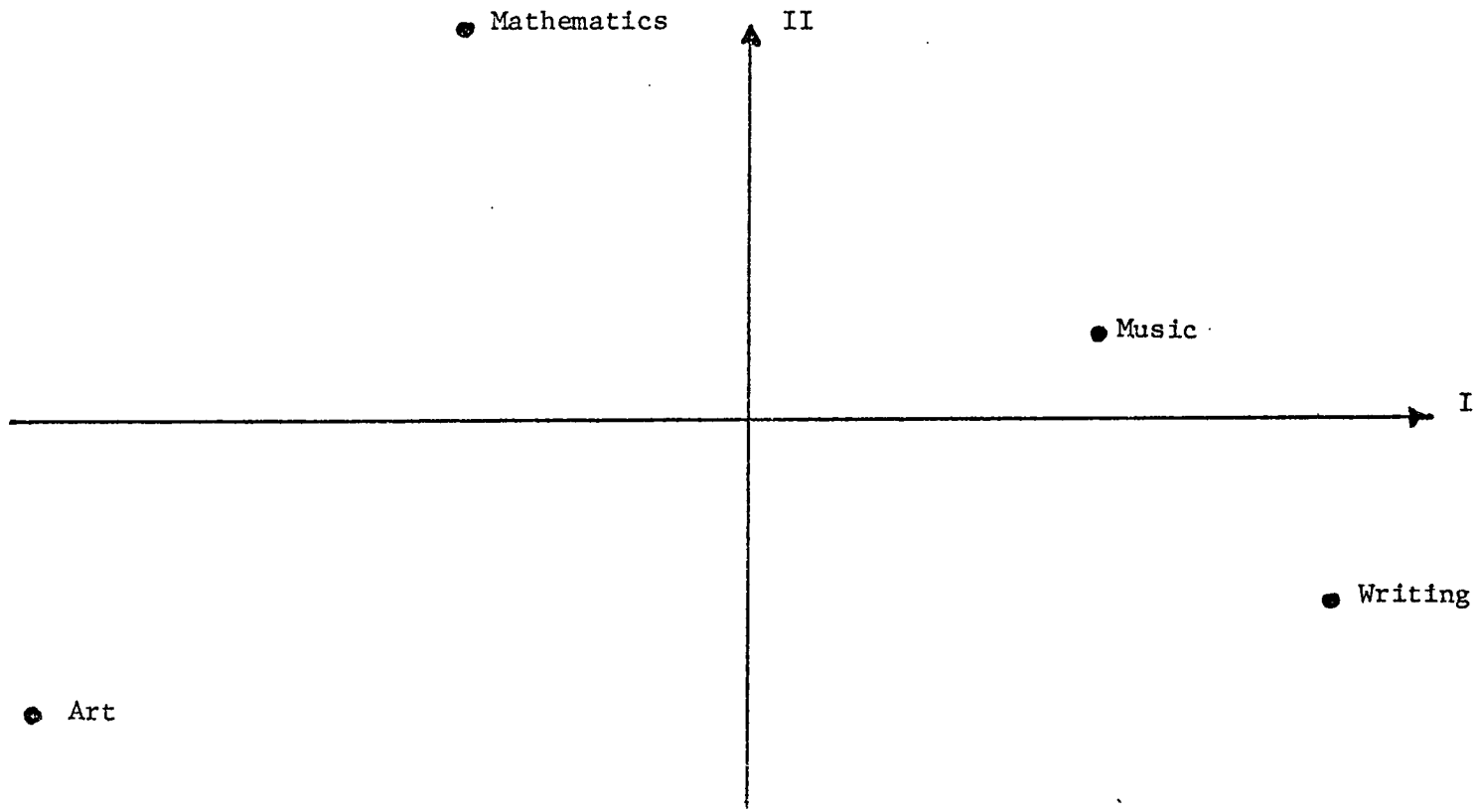


Fig. 2. A Plot of the Centroids of the Four Discipline-Oriented Creative Groups on the Two Significant Discriminant Functions.

It may be seen from Figure 2 that the first discriminant function differentiates the creative artists from the creative writers, the creative mathematicians from the creative writers, and the creative musicians from the creative artists. It does not, however, distinguish as vivdly the creative artists from the creative mathematicians nor the creative writers from the creative musicians. The second discriminant function differentiates the creative mathematicians from the creative artists and writers.

The nature of the two discriminant functions separating the four groups is indicated in Tables 9 and 10, which contain the coefficients of the discriminant functions in standardized form. Since statistical tests for the magnitude of coefficients of discriminant functions are unavailable (Anderson, Walberg & Welch, 1969), interpretation of the functions must be based on direction and relative magnitude of the coefficients. A comparison of the relative magnitude of the coefficients, however, requires that they be in standard-score form (Bock & Haggard, 1968).

Ordering the variates according to their standardized coefficients on the first discriminant function in terms of magnitude and direction (Table 9) reveals that Originality in a Semantic Context, an aptitude variate on which the Remote Associates Test of Mednick had its highest positive loading, has the highest positive coefficient. Marshalled Strictness, a personality attribute, has the only negative coefficient, but it is nearly equal in magnitude to that of Semantic Originality. It is also evident from Table 9 that the positive pole of this function represents primarily fluent-flexible aptitudes in a semantic context, while the negative pole is solely personality oriented--"Marshalled

TABLE 9

Standardized Coefficients For Ordered Variates On Discriminant Function I

Variate	Predominant Domain	Std.Coeff
D - Originality in a Semantic Context	Aptitude	.668
A - Fluency-Flexibility	Aptitude	.533
F - Semantic Fluency	Aptitude	.502
C - Symbolic Aptitude	Aptitude	.444
M - Interest in Reflective Thinking	Cognitive Style	.370
G - Artist Personality Syndrome	Personality	.300
B - Scientist Personality Syndrome	Personality	.133
H - Marshalled Strictness	Personality	-.671

TABLE 10

Standardized Coefficients For The Ordered Variates On Discriminant Function II

Variate	Predominant Domain	Std. Coeff.
C - Symbolic Aptitude	Aptitude	.703
M - Interest in Reflective Thinking	Cognitive Style	.541
H - Marshalled Strictness	Personality	.384
B - Scientist Personality Syndrome	Personality	.250
F - Semantic Fluency	Aptitude	-.088
D - Originality in a Semantic Context	Aptitude	-.108
A - Fluency-Flexibility	Aptitude	-.149
G - Artist Personality Syndrome	Personality	-.429

Strictness". Although aptitude variates dominate the positive pole of this function, and a personality variate defines the negative pole, a cognitive style variate, Interest in Reflective Thinking, follows the aptitude variates in relative magnitude, while the two personality syndromes which were admitted to the discriminant function at the less stringent 90% confidence level have the smallest loadings in terms of their absolute value.

With respect to group performance associated with this function, the creative writers, with their high positive score, would be characterized as being original in a semantic context, fluent and flexible in both the semantic and figural content areas, imaginative, emotionally undisciplined, self indulgent, interested in reflective thinking and as willing to disregard rules. The creative artists, on the other hand, would be characterized as having poor semantic aptitudes, lacking fluency and flexibility in both the semantic and figural content areas, while being conscientious, controlled and disinterested in reflective thinking. The musicians are very similar to the writers on this function, and could be characterized in the same way, while the mathematicians could be described as similar to the artists, although less dramatically.

When the variates' standardized coefficients on the second discriminant function are ordered in terms of magnitude and direction (Table 10), it may be seen that the positive pole of this function represents high symbolic aptitude, an Interest in Reflective Thinking, conscientiousness and control, and the Scientist Personality Syndrome. Associated with the negative pole of this function is the Artist Personality Syndrome.

The pattern of variate inclusion, in terms of the magnitude of the standardized coefficients, is an aptitude variate, a cognitive style variate, and then two personality variates. It is important to note that only one aptitude variate contributed to this discriminant function with substantial magnitude. The fact that a cognitive style variate took precedence over some aptitude and all personality variates in distinguishing the four creative groups is an indication of the viability of cognitive style as defined by this study. The first personality variate included in this function, the Artist Personality Syndrome, was admitted to the set of discriminating variates at the less stringent 90% level of confidence which supports the retention of the variate. Finally, the lack of any variates on this function to which Mednick's Remote Associates Test can be linked suggests a multiplicity of differentiating functions, impugning the theory of creativity as a generalized cognitive ability maintained by Mednick, while simultaneously tending to support the differential aptitude theory of Guilford.

Since the creative mathematicians had a high score on this function, they would be characterized as having high symbolic aptitudes and an interest in reflective thinking. They could also be described as being conscientious, controlled and having those personality traits which characterize creative scientists. The artists, with their negative score on this function, could be described as having those personality traits which characterize creative artists, together with seemingly poor symbolic ability and disinterest in reflective thinking.

The Creative and Non-Creative Samples

A one-way, fixed-effects multivariate analysis of variance was also done between the creative and non-creative samples using the 13 factorially-derived variates as dependent variables. It resulted in an F-ratio of 1.50. With 13 and 125 degrees of freedom, the hypothesis of equal mean vectors, i.e., centroids, between the creative and non-creative samples was rejected at the .10 level of significance. Thus, the second global hypothesis of this study, that cognitive and personality variables will distinguish the creative sample from the non-creative sample, had tentative support. Table 11 displays the means, standard deviations, univariate F ratios and step-down F's between both samples on each of the 13 variates. A profile of the means on each of these 13 variates is displayed in Figure 3.

A stepwise discriminant analysis of these 13 variates over the two samples was performed following rejection of the global hypothesis. Since the dual criteria that the approximate F-value had to remain greater than the critical value for significance and the step-down F's for each variate included in the discriminant function had to be significant at or beyond the .10 level were applied to the variates in the discriminant analysis between the four discipline-oriented creative groups, the same criteria were applied to the variates in the discriminant analysis between the creative and non-creative samples. Of the 13 variates, only three, the Artist Personality Syndrome, Symbolic Aptitude and Interest in Fluent-Rigid Production met these criteria and were thus included in the discriminant function separating the creative and non-creative samples.

TABLE 11

Means And Standard Deviations For The 13 Variables
In Standard Score Form Together With F-Values
And Associated Probability Levels For The
Creative And Non-Creative Samples

Variates	Creatives n=77 Mean	StdDev	Non-Creatives n=69 Mean	StdDev	Univariate F	p	Step-down F	p
G - Artist Personality Syndrome	.17	.88	-.21	1.11	4.86	.02	4.86	.03
C - Symbolic Aptitude	.14	.98	-.18	1.00	3.56	.06	3.67	.06
N - Interest in Fluent-Rigid Production	.13	1.00	-.16	.97	2.93	.09	3.08	.08
M - Interest in Reflective Thinking	.11	1.01	-.14	.98	2.27	.13	2.42	.12
K - Intellectualist Syndrome	-.09	.92	.11	1.09	1.37	.24	1.48	.23
B - Scientist Personality Syndrome	.09	.94	-.11	1.07	1.25	.26	1.35	.25
D - Originality in a Semantic Context	.07	1.01	-.08	.99	.76	.38	.82	.37
E - Enthusiastic Participation	-.07	1.03	.08	.97	.74	.39	.79	.37

TABLE 11 (Cont.)

	Creatives n=77 Mean	StdDev	Non-Creatives n=69 Mean	StdDev	Univariate F	p	Step-down F	p
H - Marshalled Strictness	.05	.98	-.06	1.03	.35	.55	.38	.54
J - Insterest in Perseveration	-.09	.92	.11	1.09	.31	.57	.34	.56
L - Interest in Problem Solving	.03	1.01	-.04	1.00	.24	.62	.26	.61
F - Semantic Fluency	.11	1.01	-.14	.98	.18	.67	.19	.66
A - Fluency-Flexibility	.01	1.11	-.02	.85	.03	.86	.03	.86

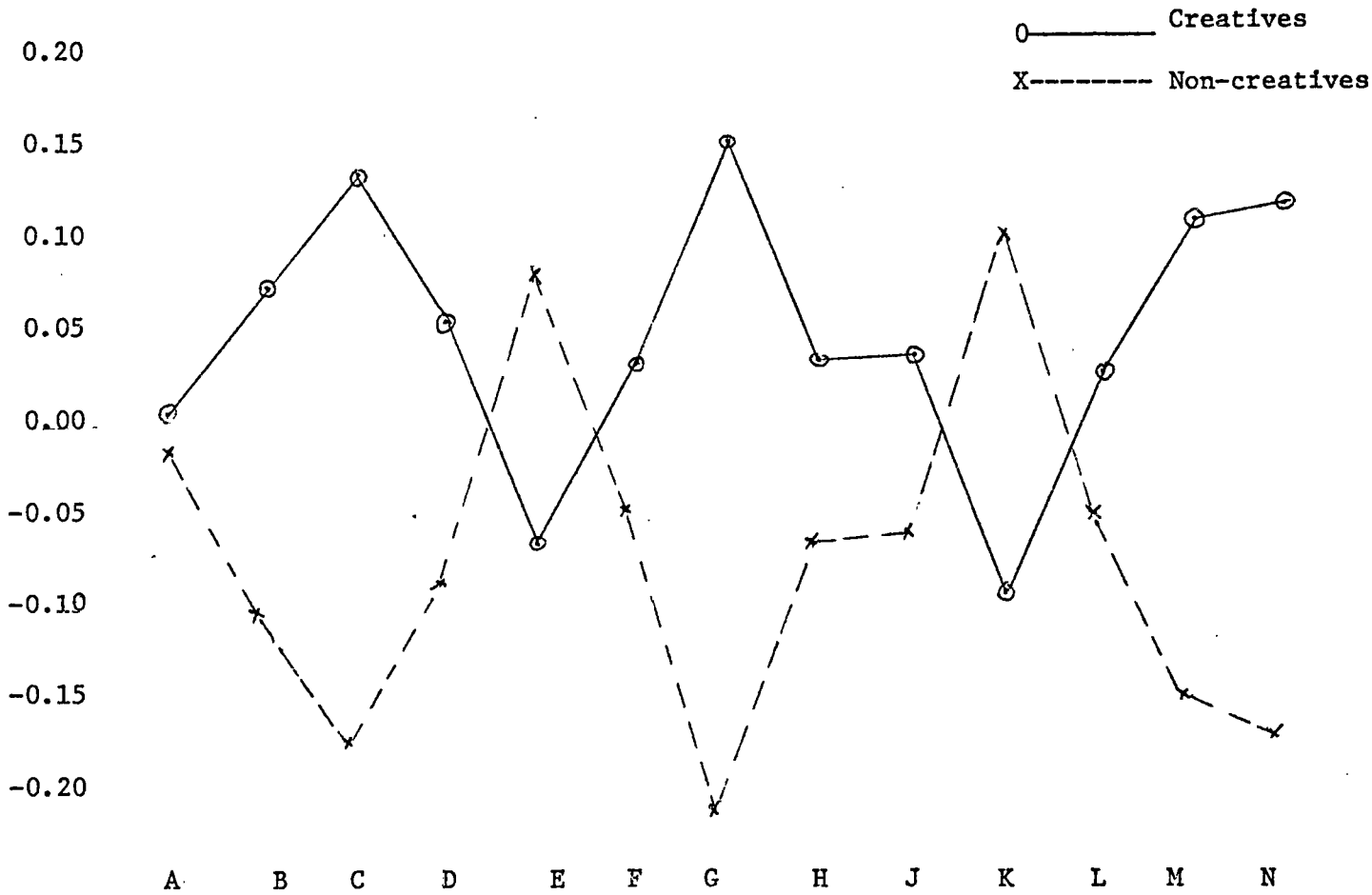


Fig. 3. Profile of Means for the Creative and Non-creative Samples on the Thirteen Factorially-Derived Variates.

Again, as in the prior discriminant analysis, the discriminant function can be depicted as the basis for a discriminant space into which group centroids can be projected, and distances coinciding to relative discriminatory power of each function can be examined. In this instance a one dimensional discriminant space obtains on which the distance between the group centroids is .787. The centroid of the creative sample on this function was .351, and the centroid of the non-creative sample was -.436. Thus, the creative sample was represented by positive scores on this function and the non-creative sample was represented by negative scores.

The standardized coefficients for the three variates on the discriminant function are ordered in terms of magnitude in Table 12. It is apparent that the creative sample, as opposed to the non-creative sample may be characterized as having those personality traits which are indicative of creative artists. They also appear to have high symbolic aptitudes and an interest in flexible, alternative, generative thinking.

Facilitators and Differentiators

Facilitators of creativity were defined as those variates which would separate creative individuals from non-creative individuals, while differentiators were defined as those variates which would distinguish creative individuals into various discipline-oriented creative groups. After subjecting the variates to two multivariate analyses of variance and subsequent discriminant analyses, it was possible to isolate those variates which functioned as facilitators of creativity and those which functioned as differentiators. The discriminant analysis between the creative and non-creative samples determined the facilitators, while

TABLE 12

Standardized Coefficients For Ordered Variates
On The Function Discriminating The Creative
And Non-Creative Sample

Variate	Predominant Domain	Std. Coeff
G - Artist Personality Syndrome	Personality	.668
C - Symbolic Aptitude	Aptitude	.578
N - Interest in Fluent-Rigid Production	Cognitive Style	.526

the discriminant analysis between the four discipline-oriented creative groups determined the differentiators.

As may be seen from Tables 13 and 14, only one variate, Interest in Fluent-Rigid Production, would be considered exclusively as a facilitator of creativity. On the other hand, aptitudes in the semantic content area, i.e., Originality in a Semantic Context and Semantic Fluency, together with Fluency-Flexibility, Interest in Reflective Thinking, the personality syndrome labeled "Marshalled Strictness" and the Scientist Personality Syndrome would be considered solely as differentiators of creativity. Of the 13 variates, the Artist Personality Syndrome and the Symbolic Aptitude variate could be considered as both facilitators and differentiators of creativity.

TABLE 13

Facilitators Of Creativity

Variate	Predominant Domain
C - Symbolic Aptitude	Aptitude
G - Artist Personality Syndrome	Personality
N - Interest in Fluent-Rigid Production	Cognitive Style

TABLE 14

Differentiators Of Creativity

Variate	Predominant Domain
A - Fluency-Flexibility	Aptitude
B - Scientist Personality Syndrome	Personality
C - Symbolic Aptitude	Aptitude
D - Originality in a Semantic Context	Aptitude
F - Semantic Fluency	Aptitude
G - Artist Personality Syndrome	Personality
H - Marshalled Strictness	Personality
M - Interest in Reflective Thinking	Cognitive Style

CHAPTER IV

DISCUSSION

The Four Discipline-Oriented Creative Groups

Each of the three domains under investigation, aptitudes, personality characteristics and cognitive styles contributed to distinguishing the four discipline-oriented creative groups. More particularly, from variates from the aptitude domain, three variates from the personality domain, and but one variate from the cognitive style domain significantly differentiated the discipline-oriented creative groups. Among the four aptitude variates, semantic and figural fluency-flexibility, symbolic aptitude, semantic originality and semantic fluency, Mednick's generalized cognitive aptitude, is isolated on only one of the two semantic aptitude variates, whereas the remaining three aptitude variates are characteristic of Guilford's symbolic, semantic and, to some extent, figural content areas.

Since aptitudes in the semantic content area distinguished the writers and musicians from the artists and mathematicians, the second specific prediction of this study, that aptitudes in the semantic content area would distinguish the creative writers from the other creative groups, was supported. In a similar fashion, aptitudes in the symbolic content area distinguished the mathematicians from the artists, which lends support to the third specific prediction of this study, that aptitudes in the symbolic content area would distinguish the creative mathematicians from the other creative groups. The first specific prediction of this study, that tests with figural content would distinguish the creative artists from the other creative groups, was not supported.

This latter result could have been a function of either the figural tests or of the sample selected for the study. In either case, the figural tests were totally submerged with other content-area tests, notably the semantic content tests on Variate A, in the factor analysis of the 40 observed variables, and did not function as differentiators of the four discipline-oriented creative groups.

Only two groups were undistinguishable on both discriminant functions, the writers and the musicians. This result could be accounted for in at least two ways. First, very few studies have been done which examined creativity in music, and, no theoretical position has been stated as to the expected aptitudes, cognitive styles or personality characteristics of creative musicians. Thus, the result that creative musicians and creative writers have very similar aptitudes, cognitive styles and personality characteristics may, in fact, be an accurate reflection of these two groups, and is a justifiable possibility, since both the musicians and writers could be classified under the more generic term, composers. On the other hand, of all the groups in the initial sample, the music group was the smallest. Thus, although the musicians met the criteria for inclusion in the creative sample, there were fewer musical compositions to rate. This limited number may have severely biased the judgment of the products since they conceivably represented only a limited range of creativity in music.

In terms of the two theoretical positions presented previously--Guilford's and Mednick's--the two significant discriminant functions, with different variates and their associated sets of aptitudes weighting heavily on each, lends support to Guilford's position. If only the first discriminant function had been significant, Mednick's theory of a

generalized cognitive aptitude would have gained validity, since the tests which loaded with the Remote Associates Test on the variates could be considered as essentially measuring the same generalized aptitude. However, the substantial existence of the second discriminant function, independent of the first, and on which the RAT had only a spurious weighting, is a strong indication that aptitudes, other than the capacity to form remote associations, may be indicative of creative abilities in different disciplines.

With regard to previous work done in the area of aptitudes and creativity, the results of this study supported the results of Jones (1961), Elliott (1964), Beittel (1964), Gough (1961), Drevdahl (1956), and Shouksmith (1958). Although several of these studies have been cited (Dellas & Gaier, 1970) as conflicting with one another, the results of the present study indicate that the conflicts may merely be an affirmation of the discipline-specific nature of creativity.

The findings of the present study do, however, seem to conflict with those of two studies cited, Rossman & Horn (1972) and Bee (1961). Although Rossman & Horn did find evidence that creative artists and creative engineers were distinguishable, this distinction was based on variables, which in this study, either favored the mathematicians (DSU) or were not relevant (DMU) to the separation of the artists and mathematicians. This discrepancy is not very surprising, however, in that engineers are not mathematicians; the criteria for creativity differed between the two studies; and the sets of variables used and the methods of analysis employed were widely divergent.

Bee's (1961) conclusion that there seems to be a generalized factor of creativity was based on evidence that tests of figural divergent production were related to tests of both semantic and symbolic divergent

production. The results of this study indicate that, although the figural tests are related to semantic-content tests, they are not related to symbolic-content tests. The fact that Bee employed fifth grade children as subjects, while this study used adults, could account for the different findings, for, cognitive differentiation has been found to be directly related to age (Lesser, 1962).

Since cognitive style variables, as defined in this study, have not been used previously in creativity research, and, since the instrument measuring cognitive styles was experimental, the results of this study, that individuals who are creative in different disciplines are distinguishable on the basis of cognitive style is a totally new finding, which, of course, requires further empirical verficiation. The results of this study do suggest that cognitive styles are relevant variables in the study of creativity and that they can serve as differentiators of creativity in specific disciplines, as they accounted for unique and significant variation among the four discipline-oriented creative groups.

The results with personality variables are extremely surprising since the literature in creativity emphasizes the position that there are certain personality traits which distinguish creative individuals, irrespective of their major-interest field. This study has found that there are also personality characteristics which separate individuals into discipline-oriented creative groups, a possibility which, heretofore, has not been considered.

The Creative and Non-Creative Samples

With respect to the pattern of domains represented by the variates contributing substantially to the distinction between the creative and non-creative samples, the variates, Artist Personality Syndrome and

Symbolic Aptitude, were followed by a cognitive style variate, Interest in Fluent-Rigid Production. This pattern reaffirms the use of cognitive style as a domain affording unique distinction of creatives from non-creatives. It also lends support to the literature in creativity which stresses the point that there are certain personality traits that characterize creative individuals, irrespective of their major-interest field. In fact, the Artist Personality Syndrome contains many of the personality traits which have been linked to a so-called "creative personality", including dominance, experimentation, self-sufficiency, resourcefulness and imagination (Barron, 1970).

Facilitators and Differentiators

It would be worthwhile, at this juncture, to restate the findings of this study with respect to facilitators and differentiators of creativity. As may be recalled from Tables 13 and 14 (p. 63), the Artist Personality Syndrome, Symbolic Aptitude and Interest in Fluent-Rigid Production were considered facilitators, while Marshalled Strictness, Symbolic Aptitude, Interest in Reflective Thinking, Originality in a Semantic Context, Fluency-Flexibility, Semantic Fluency, Scientist Personality Syndrome and Artist Personality Syndrome were considered differentiators. Thus, Symbolic Aptitude and the Artist Personality Syndrome were both facilitators and differentiators of creativity, while the remaining variates were either facilitators or differentiators.

The finding that the Symbolic Aptitude variate was both a facilitator and differentiator of creativity, coupled with the findings that: (1) this variate was on both discriminant functions developed to distinguish the four discipline-oriented creative groups; (2) this variate was the only aptitude variate included on the second discriminant function developed

to distinguish the four discipline-oriented creative groups; and (3) the composition of the second discriminant function was exclusive of Mednick-related variates and inclusive of only the four remaining cognitive style and personality variates makes it potentially the most fertile of the 13 variates for research into the detection of creativity and its distinction across disciplines.

It is obvious from Tables 13 and 14 (p. 63) that no one domain functioned solely as a differentiator or facilitator of creativity. The result that the one aptitude variate which served as a facilitator also served as a differentiator may aid in explaining the conflicting results that are abundant in the literature concerning aptitudes indicative of creative ability. If, in fact, aptitudes are primarily differentiators of creativity in various disciplines, then using arbitrary aptitude variables to distinguish creative individuals from non-creative individuals, irrespective of the field in which they exhibited creativity is an inadequate approach to the identification of creativity.

The finding that the one personality variate which served as a facilitator of creativity also served as a differentiator reinforces the findings of previous studies that certain personality characteristics are indicative of creativity, but it also adds a new dimension to the relationship of personality characteristics to creativity in that personality is not just a facilitator of creativity, but is, in fact, primarily a differentiator of creativity.

Of the three domains represented in this study, only cognitive style variates were exclusively either facilitators or differentiators of creativity. Thus, it may be argued that if only one domain were used in the identification of creative individuals, that one domain should be cognitive style.

Although these results are quite significant, and, in some instances, contrary to the literature, any conclusions which are formulated must be tempered by the limitations inherent in the study. In particular, the sample employed was limited to upper level college students who were somewhat productive in their respective disciplines. This limitation probably restricted the range of creativity at both ends of the continuum. For, it is conceivable that, at the lower end, less creative, or at least less productive, students would have changed fields prior to their junior year in college. While representation at the upper end could not be assured since judges were aware that they were rating students' products; and, although some products were rated as most creative by at least two judges, this may have been a relative judgment. Besides restricting the range of creativity, the sampling procedures precluded the selection of individuals, creative in their field, who were not associated with an institution. Although this procedure resulted in a sample relatively homogeneous with respect to "skill" level, it did not utilize the entire population of possible creatives.

It is difficult to assess the effect of these sampling limitations on the results of this study, although one might conjecture that a wider range of creativity might have resulted in the identification of more facilitators of creativity and that the inclusion of so-called "maverick" creatives might have resulted in greater differentiation across all three domains. These are conjectures, however, and should be empirically investigated.

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Summary

Although the primary purpose of this study was to try and determine if creativity in different disciplines was a function of differential cognitive variables, i.e., aptitudes and cognitive styles, or if it was a generalized cognitive ability, several concomitant issues were also examined. First, Guilford's (1967) theoretical position that individuals, creative in different disciplines, should have specifically different aptitudes was contrasted with Mednick's (1963) stance that creative aptitude is the same irrespective of the discipline in which it is exhibited. Secondly, Merrifield's (1964) statement that there are both facilitators and differentiators of creativity was pursued by operationally defining facilitators as those variables which could distinguish creative individuals from non-creative individuals, and defining differentiators as those variables which would separate creative individuals into discipline-oriented groups. Thirdly, personality variables were assessed to determine their role as either facilitators or differentiators of creativity.

Accordingly, an initial sample, composed of 146 upper level college students who were majoring in one of the four fields of art, writing, mathematics or music, was identified and tested. The test battery consisted of 16 Structure of Intellect measures, one for each of the divergent production aptitudes hypothesized by Guilford as indicative of creative ability; the Remote Associates Test of Mednick; the Thinking Interest Survey, a measure of cognitive style developed for this study; and the 16 Personality Factor Test of Cattell.

Following the administration of the tests, each of the subjects submitted one of his own products for rating by at least three judges who were experts in one of the four fields under investigation. These judges had been selected a priori based upon their perceptions of criteria for a creative product. Through ratings of their products, 77 creative individuals were identified: 19 in art, 19 in writing, 21 in mathematics and 18 in music.

Since the small sample size precluded the use of all 40 variables in a single analysis, linear combinations of the 40 variables were developed through factor analysis and scores on the 13 factorially-derived variates were used in the analysis. For both the four discipline-oriented creative groups and the creative and non-creative samples, multivariate analyses of variance followed by discriminant analysis were performed. It was found that variates in all three domains, aptitude, cognitive style and personality, functioned as differentiators of creativity, and, of the 13 factorially-derived variates, eight could be considered differentiators of creativity, while three were found to be facilitators.

The findings of the study supported the following conclusions.

Conclusions

The following specific conclusions may be drawn from this research:

1.) The four discipline-oriented creative groups may be distinquished and characterized by the 13 factorially-derived variates which, in this study, represent aptitudes, cognitive styles and personality characteristics. The creative artists may be characterized as having poor semantic and symbolic aptitudes, a disinterest in reflective

thinking, lacking fluency and flexibility in both the semantic and figural content areas, while being conscientious, controlled and having those personality traits which characterize creative artists. The creative writers may be characterized as being original in a semantic context, fluent and flexible in both the semantic and figural content areas, imaginative, emotionally undisciplined, self-indulgent, interested in reflective thinking, and as willing to disregard rules. The creative mathematicians may be characterized as having high symbolic aptitudes and an interest in reflective thinking, being conscientious, controlled and having those personality traits which are characteristic of creative scientists. The creative musicians may be characterized as essentially similar to the creative writers.

2.) Guilford's theory, that creativity in distinct disciplines, is a function of differential cognitive aptitudes was supported, while Mednick's position that creativity is a generalized cognitive ability was not confirmed.

3.) Cognitive style variables, as defined in this study, seem to be relevant to the study of creativity, both as differentiators of individuals who are creative in distinct disciplines and as facilitators of creativity.

4.) Personality traits are both facilitators and differentiators of creativity. This result was, in one respect, contrary to the literature in creativity which views personality characteristics solely as facilitators of creativity, but confirms some of the results which have found general personality characteristics of creativity.

5.) The creative and non-creative sample in this study may be distinguished and characterized by the 13 factorially-derived variates. The creative sample may be characterized as having those personality

traits which are indicative of creative artists, having high symbolic aptitudes and an interest in flexible, alternative, generative thinking, whereas the non-creative sample may be characterized as conforming, conservative, dependent, having poor symbolic aptitude and as disinterest in flexible, alternative thinking.

6.) Nine of the 13 factorially-derived variates may be characterized as either facilitators or differentiators, with the Interest in Fluent-Rigid Production being strictly a facilitator; and Originality in a Semantic Context, Semantic Fluency, Fluency-Flexibility, Interest in Reflective Thinking, Marshalled Strictness and the Scientist Personality Syndrome being solely differentiators.

7.) Two variates, the Symbolic Aptitude variate and the Artist Personality Syndrome, were found to be both facilitators and differentiators of creativity. This result with the aptitude variate, along with the other findings of this study, makes this the most fertile of the 13 variates for further research.

8.) The use of arbitrary aptitude variables in the identification of creativity, irrespective of the discipline in which it is exhibited, needs to be reassessed.

9.) Two of the specific predictions of this study, that semantic-content aptitude tests would distinguish creative writers from other discipline-oriented creative groups, and that symbolic content aptitude tests would distinguish creative mathematicians from other discipline-oriented creative groups were supported. A third prediction, that figural-content aptitude tests would distinguish creative artists from other discipline-oriented creative groups was not supported.

Recommendations

Specific Recommendations

The following recommendations are based on the results of this study:

1.) As was previously noted, the Symbolic Aptitude variate was, perhaps, the most fertile of the 13 factorially-derived variates in this study, for further research into both the identification of creativity and the differentiation of creativity in distinct disciplines. This result should be pursued by, perhaps, investigating those variables which weighted significantly on the Symbolic Aptitude variate as a complete set of dependent variables in the identification and differentiation of creativity.

2.) Although cognitive styles, as defined in this study, functioned well as both facilitators and differentiators of creativity, this result was effected on the basis of an experimental instrument. The use of this instrument is urged in both further research on creativity and, also, in other areas of psychological research.

3.) Since the creative musicians were found to be very similar to creative writers in terms of aptitudes, cognitive style and personality characteristics, this result should be verified with, perhaps, a larger initial sample of musicians from which creatives could be selected.

4.) Although the figural-content tests did not differentiate the creative artists from the other creative groups, as this study predicted they should, this result may have been a function of either the sample of figural-content tests chosen, or the sample of creative artists used in this study. In either case, further research is needed to determine if one or the other, or both, would make any difference in the differentiation or identification of creative artists.

General Recommendations

5.) As with any exploratory study such as this, there is always the need for replication and verification of the results in different populations. In this case, an interesting different population could conceivably be individuals who are more firmly established in their chosen field than the college students used in this study, or, on the other hand, individuals who are on the brink of choosing a specific discipline in which to focus their interest.

6.) If the type of results found in this study are indeed replicable, then an attempt should be made at using these three domains to predict those disciplines in which a given individual might exhibit creativity. This would entail both longitudinal and cross-validational studies.

7.) Finally, since creative behavior may be exhibited in disciplines other than the "fine arts" and mathematics, other fields should be investigated with respect to possible differentiation of creativity.

REFERENCES

Anderson, G.J., Walberg, H.J., and Welch, W. Curriculum effects on the Social Climate of Learning: A new representation of discriminant functions. American Educational Research Journal, 1966, 4, 315-328.

Barbarik, P. Preference for subordinating or superordinating and creativity in engineers, scientists, designers, and artists. Perceptual and Motor Skills, 1966, 32, 271-278.

Barron, F.X. Creative Person and Creative Process. New York: Holt, 1969.

Bartlett, M.S. A note on the multiplying factors for various chi-squared approximations. Journal of the Royal Statistical Society, Series B, 1954, 16, 296-298.

Bee, H.L. Divergent and convergent abilities compared. In E. Macoby and L. Rau (Eds.), Differential Cognitive Abilities, Stanford, Cal.: Stanford University, 1962.

Bock, R.D. and Haggard, E. The use of multivariate analysis of variance in behavioral research. In D.K. Whitla (Ed.), Handbook of Measurement and Assessment in Behavioral Sciences, Reading, Mass.: Addison-Wesley, 1968.

Brogden, H.E. and Sprechter, T.B. Criteria of creativity. In C.W. Taylor (Ed.), Creativity, Progress and Potential, New York: McGraw-Hill, 1964, 156-176.

Cattell, R.B., Eber, F., and Tatsuoka, M. Manual for the 16 PF, Urbana, Ill.: University of Illinois Press, 1970.

Cronbach, L.J., Rajaratnam, N., and Gleser, G.C. Theory of generalizability: A liberalization of reliability theory. British Journal of Statistical Psychology, 1963, 26, 137-163.

Cross, C.G., Cattell, R.B., and Butcher, J.J. The personality patterns of creative artists. British Journal of Educational Psychology, 1967, 37, 292-299.

Dellas, M. and Gaier, E.L. Identification of creativity: The individual. Psychological Bulletin, 1970, 73, 55-73.

Drevdahl, J.E. Factors of importance for creativity. Journal of Clinical Psychology, 1956, 12, 21-26.

Drevdahl, J.E. and Cattell, R.B. Personality and creativity in artists and writers. Journal of Clinical Psychology, 1958, 14, 107-111.

Eisenman, R.V. The psychology of modern art. In G.P. Powers and W. Baskin (Eds.), New Outlooks in Psychology, New York: Philosophical Library, 1966.

Elliott, J.M. Meauring creative abilities in public relations and advertising work. In C.W. Taylor (Ed.), Widening Horizons in Creativity, New York: Wiley and Sons, 1964.

Fisichelli, V.R. and Welch, L. The ability of college art majors to recombine ideas in creative thinking. Journal of Applied Psychology, 1947, 31, 278-282.

Frankiewicz, R.G. Problem preferences and thinking interest as related to success in college freshmen mathematics. Unpublished master's thesis, Kent State University, 1966.

Frankiewicz, R.G. and Merrifield, P.R. Thinking Interest Survey, Bureau of Educational Research, Kent State University, 1966.

Gibson, J.W., Kibler, R.J., and Barker, L.L. Some relationships between selected creativity and critical thinking measures. Psychological Reports, 1968, 23, 707-714.

Gough, H.G. Techniques for identifying the creative research scientist. In, Conference on the Creative Person, Berkley: University of California Institute of Personality Assessment and Research, 1961.

Groch, J. The Right to Create. Boston: Little, Brown, and Co., 1969.

Guilford, J.P. The Nature of Human Intelligence. New York: McGraw-Hill Book Co., 1967.

Guilford, J.P. Psychometric Methods, 2nd Ed. New York: McGraw-Hill, 1964.

Guilford, J.P., Christiansen, P.R., Frick, J.W., and Merrifield, P.R. Factors of interest in thinking. The Journal of General Psychology, 1961, 65, 39-56.

Guilford, J.P. and Hoepfner, R. Sixteen divergent production abilities at the ninth-grade level. Multivariate Behavioral Research, 1966, 1, 43-66.

Haag, R.A. and David, K.H. The latent dimensionality of several measures of creativity. The Journal of General Psychology, 1969, 80, 279-285.

Harris, C.W. and Kaiser, H.F. Oblique factor analytic solutions by orthogonal transformations. Psychometrika, 1964, 29, 347-362.

Helson, R. Personality characteristics and developmental history of

creative college women. Genetic Psychological Monographs, 1967, 76, 205-256.

Hetrick, S.H., Lilly, R.S., and Merrifield, P.R. Figural creativity, intelligence, and personality in children. Multivariate Behavioral Research, 1968, 3, 173-188.

Higgins, J. and Dolby, L.L. Creativity and mediated association: A construct validation study of the RAT. Educational and Psychological Measurement, 1967, 27, 1011-1014.

Holland, J.L. Some limitations of teacher ratings as predictors of creativity. Journal of Educational Psychology, 1959, 50, 219-223.

Jackson, P.W. and Messick, S. The person, the product, and the response: Conceptual problems in the assessment of creativity. Journal of Personality, 1965, 33, 309-320.

Jones, C.A. Relationships between creative writing and creative drawing of sixth-grade children. Studies in Art Education, 1962, 3, 34-43.

Joreskog, K.G. Some contributions to maximum-liklihood factor analysis. Psychometrika, 1967, 32, 309-329.

Kaiser, H.F. The varimax criterion for analytic rotation in factor analysis. Psychometrika, 1958, 23, 187-200.

Kaiser, H.F. and Caffrey, J. Alpha factor analysis. Psychometrika, 1965, 30, 1-14.

Karlins, M., Schuerhoff, C., and Kaplan, M. Some factors related to architectural creativity in graduating architecture students. Journal of General Psychology, 1969, 81, 203-215.

Kendall, M.G. A course in multivariate analyses. Griffin's Statistical Monographs and Courses, 2. New York: Hafner, 1957.

Kerlinger, F.M. Attitudes toward education and perceptions of teacher characteristics: A Q study. American Educational Research Journal, 1966, 3, 159-168.

Korb, R.A. and Frankiewicz, R.G. A strategy for judge selection in product-centered creativity evaluation. Unpublished manuscript accepted for presentation, American Educational Research Association, 1973.

Lesser, G.S. Recent revisions and educational applications of the concepts of intelligence and giftedness. Address at the Institute for School Psychologists, University of Wisconsin, 1962.

La Forge, R. Components of reliability. Psychometrika, 1965, 30, 187-195.

Lowenfield, V. and Beittel, K. Interdisciplinary criteria of creativity in the arts and sciences: a progress report. Research Yearbook, National Art Education Association, 1959, 35-44.

MacKinnon, D.W. The prediction of creativity from personality inventories. Paper read at the Western Psychological Association, 1962.

Mackler, B. and Shontz, F.C. Life style and creativity: An empirical investigation. Perceptual and Motor Skills, 1965, 20, 873-896.

Mednick, M.T. Research creativity in psychology graduate students. Journal of Consulting Psychology, 1963, 27, 265-266.

Mednick, M.T., Mednick, S.A., and Jung, C.C. Continual association as a function of level of creativity and type of verbal stimulus. Journal of Abnormal and Social Psychology, 1964, 69, 511-515.

Mednick, S.A. The associative basis of the creative process. Psychological Review, 1962, 69, 220-232.

Mednick, S.A. and Mednick, M.T. Manual for the Remote Associates Test, Boston: Houghtin-Mifflin Co., 1968.

Merrifield, P.R. Facilitating and differentiating components of creativity. Journal of Educational Measurement, 1964, 1, 103-107.

Messick, S. Beyond structure: In search of functional models of psychological process. Psychometrika, 1972, 37, 357-375.

Ohnmacht, P.W. Personality and cognitive referents of creativity: A second look. Psychological Reports, 1970, 26, 336-338.

Piers, E.B. and Kirchner, B.P. Productivity and uniqueness in continued word association as a function of subject creativity and stimulus properties. Journal of Personality, 1971, 39, 264-276.

Rinn, J.L. Q methodology: An application to group phenomena. Educational and Psychological Measurement, 1961, 21, 315-329.

Rossman, B.B. and Horn, J.L. Cognitive, motivational, and temperamental indicants of creativity and intelligence. Journal of Educational Measurement, 1972, 9, 265-286.

Rummel, R.J. Applied Factor Analysis, Evanston: Northwestern University Press, 1970.

Schechter, N., Schmeidler, G.R., and Staal, M. Dream reports and creative tendencies in students of the arts, sciences, and engineering. Journal of Consulting Psychology, 1965, 29, 415-421.

Schouksmith, G. Fluency and essay writing. British Journal of

Educational Psychology, 1958, 28, 266-260.

Simpson, J.W. The effect of selected musical studies on growth in general creative potential. Unpublished doctoral dissertation, University of Southern California, 1969.

Skager, R.W., Klein, S.P., and Schultz, C. The prediction of academic and artistic achievement at a school of design. Journal of Educational Measurement, 1967, 11, 105-117.

Skager, R.W., Schultz, C., and Klein, S.P. Points of view about preference as tools in the analysis of creative products. Perceptual and Motor Skills, 1966, 22, 83-94.

Stein, M.I. Creativity. In E.F. Borgatta and W.W. Lambert (Eds.), Handbook of Personality: Theory and Research, Chicago: Rand-McNally Co., 1968.

Stephenson, W. The Study of Behavior. Chicago: University of Chicago Press, 1953.

Stevens, J.P. Four methods of analyzing between variation for the k-group manova problem. Multivariate Behavioral Research, 1972, 7, 499-522.

Thomson, G. Some points of mathematical technique in factorial analysis of ability. Journal of Educational Psychology, 1936, 27, 37-54.

Thurstone, L.L. Multiple Factor Analysis. Chicago: University of Chicago Press, 1935, pp 511-518.

Weissman, H.N. Disposition toward intellectuality: Its composition and its assessment. The Journal of General Psychology, 1970, 82, 99-107.

Welch, L. Recombination of ideas in creative thinking. Journal of Applied Psychology, 1946, 30, 638-643.

Windholz, G. The relation of creativity and intelligence constellations to traits of temperament, interest, and value in college students. Journal of General Psychology, 1968, 79, 291-299.

APPENDIX A

PROBLEMS ASSIGNED TO MATHEMATICS GROUP AS THEIR CREATIVE PRODUCT

APPENDIX A

Problems Assigned To Mathematics
Group As Their Creative Product

1. List as many different results as you can.

   Express the one with four fours (no more and no fewer) using the various arithmetical operations (=, +, −, x, ÷).

   Sample results: 1 = 44/44

   1) _____

   2) _____

   3) _____

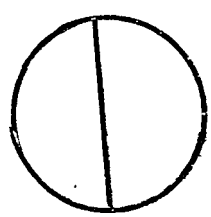
   ...
   ...
   ...

   11) _____

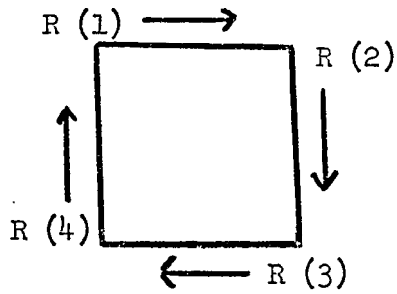
2. List as many different results as you can.

   Draw as many different ways to divide a circle in half.

   Sample results:



3. Think of four (4) rats, one at each of the four (4) corners of a square of side X.



Rat (1) wants to catch rat (2);

rat (2) wants to catch rat (3);

rat (3) wants to catch rat (4);

rat (4) wants to catch rat (1).

All four rats run at the same rate of speed (V).

They all start running in the directions indicated by the arrows.

How long will it take rat (1) to catch rat (2)?

Please explain how you got your answer.

APPENDIX B

DETAILED DESCRIPTION OF JUDGE-SELECTION PROCEDURES

APPENDIX B

Detailed Description of Judge-Selection Procedures

It is generally recognized that research into creativity has been hampered by the unavailability of objective criteria for the assessment of creative behavior. Although there seems to be a widespread belief that creativity can be assessed and that creative individuals can be distinguished from non-creative individuals, the way this belief has been implemented has been extremely diverse and subject to criticism (Rossman & Horn, 1972).

One approach to the assessment of creativity is through the evaluation of products--such as a physical object, an article or patent, or a theoretical system (Brogden & Sprecher, 1964). This approach was strongly advocated by Jackson & Messick (1964) and later by Skager, Schultz & Klein (1966), because it seems to present a way of establishing concrete reference for the evaluation of "creativity" (Skager, et al, 1966).

As Skager, et al (1966) point out, however, one of the critical factors in the application of a product-centered approach to creativity is the manner in which products are evaluated; or, who is going to judge the products? This question has been addressed in two ways. Judges have been selected on the basis of their position in the academic or business community, i.e., instructors, teachers or supervisors (Drevdahl, 1956; Karlins, Kaplin & Schuerhoff, 1969; Elliott, 1964; Helson, 1966). Or, judges have been selected both on the basis of their position, and also on their a posteriori agreement with other judges when rating or judging people or products as creative. In other words, after the judging is

fully completed, the results of that judging are used to determine which judges will be selected. Neither of these two ways is entirely satisfactory, however, for, in the first method, judgment is dependent upon a single individual and there is no way of establishing the basis for the judgments. In fact, Holland (1959) has shown teacher ratings of creativity are more predictive of academic achievement than creativity. As to the second method, Skager, et al (1966) have demonstrated that judges, even with high interjudge agreement, may be attending to diverse facets of the creative product, which, in turn, could be predictive of attributes other than creativeness for the creative person. Also, an a posteriori determination of interjudge agreement dictates that each judge must rate the same products. If products from different fields are to be evaluated by "experts" in each field, there is no way of determining interjudge consistency across fields.

Purpose

The purpose of the present study was to develop a procedure for the a priori selection of judges of creative products which could be employed irrespective of the field in which the products occur.

Rationale

The rationale for an a priori selection of judges involved the use of a conceptual definition of the criteria for a creative product. If each potential judge were given the opportunity to express his position within this conceptual definition, then individuals who expressed a high degree of similarity of position within this framework could be selected as judges and, accordingly, could be expected to employ these criteria in an identical fashion in judging creative products. Since the selection

of a judge would be made on the basis of his conceptual framework, rather than his specific attitudes toward given products, the results of this selection procedure would make it possible to establish the degree of interjudge similarity within this framework prior to any actual evaluation of products as well as to determine intrajudge consistency.

Procedures

Brief statements were prepared to which potential judges could respond. These statements were developed from the theoretical criteria for the analysis of a creative product presented by Jackson & Messick (1964). Five dimensions for the criteria of a creative product were delineated by Jackson & Messick (1964): the unusualness or originality of the product; the appropriateness of the product, both within the context of the situation in which it was produced and of the product's parts with each other; the transformation power of the product; the impact of the product on the observer; and the "condensation" properties of the product. Since each of these dimensions were appropriate to a creative product irrespective of the specific field in which it was produced, 32 statements were developed characterizing the five dimensions.

Thirty-two separate cards, each containing one statement, were prepared for inclusion in a modified Q-sort. A variation of Stephenson's (1953) Q-methodology was used in this study for several reasons. First, it was particularly well-suited to the judgmental task involved because it allowed each statement to be compared with every other statement, thereby accommodating shifts of statements from one category to another. Secondly, it was valuable for small sample sizes (Kerlinger, 1966; Guilford, 1954); and finally, it provided a method for determining judge-factors, or judge "types" (Rimm, 1961) which could then be used for the selection of judges.

To test the efficacy of these 32 statements in selecting judges, the Q-sort was administered to sixteen individuals. The one criterion used in the selection of these individuals was some expertise in selected fields, the implication being potential judgment of a creative product in that field. This sample of sixteen potential judges included artists, mathematicians, scientists, writers and music educators. Each subject was tested individually and given identical printed instructions.

The instructions conveyed to the subjects that each statement could be defined as part of a creative product and directed them to sort each of the 32 statements into one of nine categories according to its "suitability" in defining a creative product in their particular field. Subjects were not told to sort the statements into a fixed distribution since it was felt that a distribution requirement would be too limiting.

Analysis

The analysis of the 32-statement Q-sort had two objectives: the first was to determine if a set of judges with homogeneous perceptions of the criteria for a creative product could be established, the second was to refine the sort in order to maximize discrimination between different "types" of judges.

To accomplish the first objective, the data from the 16-subject sort were intercorrelated, using product-moment coefficients. The resulting correlation matrix was investigated by an obverse alpha factor analysis followed by varimax rotation. This analysis yielded six "judge" factors. To clarify the solution, four subjects were withdrawn from the judge sample. This elimination of subjects was a legitimate procedure since, in an obverse or Q-technique factor analysis, a reduced rank explanation of the subject correlation matrix is sought rather than a reduced rank explanation of the item correlation matrix.

The sorts of the twelve remaining subjects were analyzed, again using the alpha factor analysis technique followed by varimax rotation, with product-moment coefficients in the correlation matrix. This analysis resulted in a three common-factor solution (Table B-1).

Each factor displayed in Table B-1 represents one set of judges which is homogeneous with respect to its perception of the criteria. As may be seen, the first set of judges consisted of two scientists, a writer, an art educator and a working artist. The second set consisted of a mathematician, a music educator and a writer. The third set consisted of a writer and a scientist. Thus, the basic methodology was effective in discriminating judge types, irrespective of the particular field in which they had expertise.

Since there were no distribution requirements on the sorts, the distribution of statements was negatively skewed. To determine the effect of non-normality on the factor solution, an obverse maximum-likelihood technique (Joreskog, 1967) was also used to analyze the product-moment correlation matrix. When three factors were used as the minimum number to be extracted, rotated and compared with the alpha factor analytic model, the same individuals were aligned in a similar pattern. This result indicated a high degree of robustness for factor patterns under violations of normality assumptions, together with a high degree of stability of judge factors across contrasting analytic techniques.

The product-moment coefficients used in the preceding analyses measured only the pattern similarity of the ratings of two judges. Since homogeneity of judgment is a function of magnitude, similarity as well as pattern similarity, magnitude similarity should be accounted for in the selection of a group of judges. Therefore, a correlation matrix

TABLE B - 1

Rotated Factors Of The 12-Subject, 32-Statement Q-Sorts[2]

		I	II	III
1	Mathematician	042	786	043
2	Physicist	606	101	-067
3	Physicist	622	-009	020
4	Physicist	012	-082	-084
5	Writer	061	-167	574
6	Music Educator	173	-348	258
7	Physicist	067	248	832
8	Writer	708	182	111
9	Artist	581	077	058
10	Music Educator	-358	-586	266
11	Writer	268	720	268
12	Art Educator	679	222	386

[2]All decimal points omitted

composed of intraclass coefficients, which are measures of both magnitude and pattern similarity (Rummel, 1972), was obtained. This matrix was subjected to obverse alpha and obverse maximum-likelihood factor analyses. In each independently rotated solution, the three factors obtained were identical in structure, although not in magnitude, to those three factors obtained when both techniques were applied to a matrix of product-moment correlation coefficients. Thus, the composition of sets of judges was unaffected by the inclusion of a measure of magnitude similarity (Table B-2).

The refinement of the sort, the second objective of the analysis, was initiated by preparing 21 additional statements which complied with Jackson & Messick's (1964) delineated criteria. Statements were added to the sort to insure an adequate sampling of the criteria as well as to provide a larger statement pool from which selection of the most discriminating statements could be made.

The entire set of 53 statements was subsequently administered to nine of the twelve original subjects with the same instructions retained. The sorts of these 53 statements were factored using an obverse alpha analysis followed by varimax rotation. Although the four factors obtained were not consistent with those of the 32-statement sorts, the judges did cluster into interpretable judge types.

To ascertain the behavior of the technique in an undefined sample, the 53-statement Q-sort was administered to twenty graduate students in education. All of the individuals in this sample were working on a Master's degree in elementary education so there was little expertise in any one field. The sorts of these subjects were factored, and again using the obverse alpha technique followed by varimax rotation. This

TABLE B - 2

Rotated Factor Patterns Resulting From Intraclass Correlation Matrix

	ALPHA			MAXIMUM-LIKELIHOOD		
	Factor I	Factor II	Factor III	Factor I	Factor II	Factor III
1 Mathematician	.070	.455	.155	.173	.956	.237
2 Physicist	.403	.188	-.125	.392	-.280	.077
3 Physicist	.489	.112	.016	.533	-.082	.009
4 Physicist	.176	.039	-.126	.128	-.194	.046
5 Writer	.111	-.221	.567	.027	-.187	.416
6 Music Educator	.124	-.047	.232	.122	.457	.206
7 Physicist	.065	.298	.812	.046	-.027	.999
8 Writer	.698	.274	.066	.708	-.039	.161
9 Artist	.775	-.034	-.004	.720	-.129	.015
10 Music Educator	-.138	-.533	.192	-.272	-.214	.043
11 Writer	.207	.757	.246	.324	.286	.463
12 Art Educator	.714	.195	.342	.730	.127	.317

administration resulted in an eight factor solution, but the interpretability of these factors for the selection of judges of creative products in a given field was questionable. One reason may have been that there was no specific field or product to which the subjects could relate the statements.

To eliminate some of the statements, factor score estimates were obtained for each statement from both the expert and unrestricted samples. Those statements with restricted factor scores, i.e., standardized factor scores ranging between ± 1.9 standard deviations from the mean, across all factors, indicative of constrained variance in defining creative products, were removed from the sort. Additionally, those statements supporting a full range of factor scores in the unrestricted sample exclusively were eliminated since it was these statements that were least effective in distinguishing one "type" of judge from another. This procedure resulted in a final Q-sort of 29 statements. As with all the sorts, the number of statements in the 29-statement sort from each of Jackson & Messick's (1966) five dimensions was proportional to the complexity of the dimension.

Reliability of the Sort

Since the original 32 items were included in the 53-item sort, it was possible to calculate the intrajudge consistency on these 32 items, and thereby estimate the test-retest reliability of this technique. In this instance, depressed estimates of intrajudge consistency would be expected because the original 32 statements should interact with the additional 21 statements of the second sort, changing the perception of the original 32 statements. Despite this handicap, the coefficients of intrajudge consistency for each of the nine judges were significant at

or beyond the 5% level of significance, with a median coefficient of .51 and a range of .34 to .87. With intraclass coefficients as lower bound estimates of individual judge reliability (Cronbach, Rajaratnam & Gleser, 1963), the reliabilities ranged from .29 to .56, with a median value of .44.

Discussion

To maximize homogeneity of judgment, judges would have to be selected from within an established cluster. The determination of a single cluster of judges could, however, be a function of either the analytic properties of that cluster or the mode of perception represented by that cluster.

The utilization of the analytic properties of a cluster may be illustrated in the case of the 12-subject, 32-statement Q-sort. Those five individuals with significant loadings on the first factor would be selected as the set of judges, since this factor accounted for a proportionately greater amount of variation than did the other factors. This was determined by an extended Scree (Cattell, 1966) test and by the statistic established by Kendall (1957) which tests the hypothesis that all the latent roots after the first are equal (Laforge, 1965) (χ^2 = 29.86, n.s.). The selection of this set of judges was also supported by the maximum-likelihood procedure which indicates the number of factors which are sufficient to characterize the data. In this case, a one-factor solution was a "proper" (Jöreskog, 1967) solution, the single factor being the one with the same five judges loading on it.

The particular judge sample chosen would include two scientists, a writer and two art experts. If more judges were needed, a new pool of potential judges would have to be nominated, given the Q-sort and then

analyzed in conjunction with individuals already selected. Optimal retrievability would be assured, moreover, in the event a new pool of judges was added to the sample.

As was previously mentioned, a particular mode of perception could also be the basis for selecting a single cluster of judges. This mode could be determined by obtaining estimated factor scores for each statement. Those statements with algebraically highest and lowest factor scores for each cluster of judges would then provide a foundation for interpreting the perceptions of judges aligned on each factor. The probability of retrieving a specific cluster selected in this way would be reduced, however, if additional judges were added to the sample.

If homogeneity of judgment were not necessary, judges could be selected from all the judge-factors retained in the common factor solution. A particular individual would be selected because he had a significant loading on any of the retained factors. A factor would be retained in the common factor solution if it were one on which at least three individuals had their highest loadings.[1] Although judges with different perceptions of a creative product would result from this procedure, the differences in perception between clusters of judges would be predictable and could be taken into consideration when interpreting the results of a study.

Conclusions

This study has presented a method for the a priori selection of judges of creative products. The method would facilitate a product-centered approach to the evaluation of creativity as advocated by

---

[1] This is termed the Keil-Wrigley criterion for the definition of the largest number of common factors (Kerlinger, 1966).

Jackson & Messick (1964) and Skager, et al (1966), and it appears to be relevant for the selection of judges of creative products irrespective of the field in which the products occur. This study has also demonstrated that, for a limited sample of potential judges, perceptions of criteria for a creative product are not uniform within a given discipline. Although this particular result requires further investigation with, perhaps, a larger sample of potential judges, it does indicate that expertise in a given discipline is a necessary but not a sufficient criterion for the selection of judges of creative products. Furthermore, the technique, a variation of Q-methodology applied to a conceptual definition of criteria, could be useful in any situation in which judges are required and for which criteria may be delineated.

APPENDIX C

COGNITIVE ABILITIES HYPOTHESIZED BY GUILFORD AS INDICATIVE OF CREATIVE ABILITY; THE SOI SYMBOL FOR EACH ABILITY; AND A BRIEF DESCRIPTION OF EACH ABILITY

APPENDIX C

Cognitive abilities hypothesized by Guilford as indicative of creative ability; the SOI symbol for each ability; and a brief description of each ability (Guilford and Hoepfner, 1966, pp. 45-50).

DFU - divergent production of figural units (Figural fluency): the ability to produce many simple figures that conform to given specifications.

DFC - divergent production of figural classes (Spontaneous flexibility): the ability to classify the same items of figural information in different ways.

DFS - divergent production of figural systems (Figural expressional fluency): the ability to produce composites of figural information in different ways.

DFT - divergent production of figural transformations (Adaptive flexibility): the ability to produce changes in figures that alter the meaning, significance, or use of elements.

DFI - divergent production of figural implications (Figural elaboration): the ability to elaborate upon given figural information.

DSU - divergent production of symbolic units (Word fluency): the ability to produce words to satisfy some literal requirement.

DSC - divergent production of symbolic classes: the ability to group symbolic items of information in different ways, according to different attributes.

DSR - divergent production of symbolic relations: the ability to relate symbolic items of information in different ways.

DSS - divergent production of symbolic systems (Expressional fluency): the ability to organize sets of symbolic information into different systematic arrangements.

DSI - divergent production of symbolic implications (Symbol elaboration): the ability to produce varied implications (things suggested) from given symbolic information.

DMU - divergent production of semantic units (Ideational fluency): the ability to produce many elementary ideas appropriate in meaning to given requirements.

DMC - divergent production of semantic classes (Spontaneous flexibility): the ability to produce a variety of class ideas appropriate to a given idea.

DMR - divergent production of semantic relations (Associational fluency): the ability to produce a variety of relations or of analogies to given information.

DMS - divergent production of semantic systems (Expressional fluency): the ability to organize elementary ideas into complex ideas.

DMT - divergent production of semantic transformations (Originality): the ability to produce unusual, remotely connected, or clever responses, involving reinterpretations of redefinitions.

DMI - divergent production of semantic implications (Elaboration): the ability to produce many antecendents, concurrents, or consequences of given meaningful information.

EMI - evaluation of semantic implications (Sensitivity to problems): the ability to anticipate the needs of or the consequences of a situation.

NMT - convergent production of semantic transformations (Redefinition): the ability to produce new uses for objects, different definitions of information.

APPENDIX D-

TESTS WHICH WERE USED TO MEASURE EACH OF THE SOI FACTORS INDICATIVE OF CREATIVE ABILITY; A BRIEF DESCRIPTION OF EACH TEST; AND THE DETERMINE RELIABILITY OF EACH TEST

APPENDIX D

Tests which were used to measure each of the SOI factors indicative of creative ability; a brief description of each test; and the determine reliability of each test (Guilford & Hoepfner, 1966, pp. 45-53).

Make a Figure Test *** (.65). Given two elements (lines) combine them in different ways, the scores being the number of different ways produced.

Alternate Letter Groups *** (.42). In a set of given letters. e.g., AHVTC, produce subsets having a common figural property.

Making Objects * (.46). Given a small set of familiar geometric figures, such as a circle, a triangle, a trapezoid, combine them in ways to produce specificified objects, such as a lamp, a clown, or a face.

Match Problems IV * (.48). Given a set of adjacent squares, the sides of which are said to be made of matchsticks, remove some number of matches to leave a specified number of squares.

Decorations * (.57). Given in outline form some articles of furniture or clothing, add decorative lines.

Word Fluency * (.59) List words, each containing a specified letter.

Number Rules *** (.67). Given a certain number, arrive at another given number by applying other numbers and operations, e.g., starting with 2 in how many ways can other numbers be related to it to arrive a 6 ?

Make a Code *** (.33). Using any letters and numbers produce variety of code systems, each with a different principle.

Symbol Elaboration *** (.54). Given two very simple algebraic equations, e.g., B - C = D and F = A + D , produce other equations that can be derived from them.

Ideational Fluency * (.71). Given one or more class specifications or attributes for a class, list members of the class, e.g., "things round", or "fluids that will burn".

Utility Test * (shifts) (.59). List all realistic uses for a common item, but scored in terms of the number of times E shifts from one category of uses to another in successive responses. This score is usually almost independent of the fluency score.

Associational Fluency I * (.44). List words meaning about the same as a given word.

Simile Interpretations*(.54). Give different explanatory statements about the same simile, e.g.,A woman's beauty is like the autumn; .....

Plot Titles*(.44). Given a short story, list different appropriate titles. Only titles rated as "clever" are counted.

Possible Jobs*(.64). Given a symbolic design, e.g., a rising sun, list different occupations or groups of people for which this symbol might stand.

---

* Sheridan Psychological Corporation.

*** Copyright J.P. Guilford.

APPENDIX E-

A BRIEF DESCRIPTION OF EACH OF THE SIXTEEN PERSONALITY SCALES ASSESSED BY THE 16 PERSONALITY FACTOR QUESTIONNAIRE: THEIR DEPENDABILITY COEFFICIENTS: AND THEIR STABILITY COEFFICIENTS

APPENDIX E

A brief description of each of the sixteen personality scales assessed by the 16 Personality Factor Questionnaire; their dependability coefficients; and their stability coefficients. (Cattell, Eber, & Tatsuoka, 1970).

Low Score Description	Scale	High Score Description	Dependability Coefficient	Stability Coefficient
Reserved, Detached, Critical, Aloof	A	Outgoing, warmhearted, easy-going, participating	.84	.80
Less intelligent, concrete thinking	B	More intelligent, abstract-thinking, bright	.58	.43
Affected by feelings, emotionally less stable, easily upset	C	Emotionally stable, faces reality, calm, mature	.78	.66
Humble, mild, accomo-dating, conforming	E	Assertive,aggressive, stubborn, competitive	.80	.65
Sober, prudent,serious taciturn	F	Happy-go-lucky, impulsively lively, enthusiastic	.79	.74
expedient, disregards rules feels few obligations	G	conscientious, persevering, staid moralistic, straight-laced	.81	.49
Shy, restrained, timid, threat-sensitive	H	Venturesome, socially bold, uninhibited, spontaneous	.83	.80
Tough-minded, self-reliant realistic, no-nonsense	I	Tender-minded, clinging, over-protected, sensitive	.77	.85
Trusting, adaptable, free of jealousy, easy to get along with	L	Suspicious, self-opinionated, hard to fool	.75	.75

Low Score Description	Scale	High Score Description	Dependability Coefficient	Stability Coefficient
Practical, careful, conventional, regulated by external realities, proper	M	Imaginative, wrapped up in inner urgencies, careless of practical matters, Bohemian	.70	.67
Forthright, natural, artless, unpretentious	N	Shrewd, calculating, worldly penetrating	.61	.35
Self-assured, confident, serene	O	Apprehensive, self-reproaching worrying, troubled	.79	.70
Conservative, respecting established ideas, tolerant of traditional difficulties	Q_1	Experimenting, liberal, analytical, free-thinking	.73	.56
Group-dependent, a "joiner" and sound follower	Q_2	Self-sufficient, prefers own decisions, resourceful	.73	.57
Undisciplined, self-conflict follows own urges, careless of protocol	Q_3	Controlled, socially precise, following self-image	.62	.36
Relaxed, tranquil, unfrustrated	Q_4	Tense, frustrated, driven, overwrought	.81	.66

APPENDIX F

CONSTRUCT VALIDATION OF THE THINKING INTEREST SURVEY

APPENDIX F

Construct Validation of the Thinking Interest Survey

One way to achieve construct validity for an instrument is through factor analytic techniques. The objective of factor analysis as applied here, is to reduce the number of items by accounting for relationships that exist among these items. To do this, subscales, i.e., factors with maximum internal consistency were developed for which each of the original items had some specific weighting. Construct validity for an instrument is achieved if the weightings, or, more technically, the factor pattern coefficients, afford psychological interpretability for each of the mutually exclusive subscales of items. The factors thus constructed determine the dimensionality of the instrument.

To determine the dimensionality of the Thinking Interest Survey in the sample under investigation, the 70 dichotomous items were intercorrelated using phi coefficients. The resulting matrix of interitem phi coefficients was subjected to an alpha (Kaiser & Caffrey, 1965) factor analytic procedure, which yielded 25 factors with eigenvalues $\geq$ 1.00 and collectively accounted for 56% of the variance of the 70 items.

Although the 25 factors constructed by this analysis could have been interpreted as the dimensionality of the TIS, it was felt that a second-order factor solution was necessary to achieve greater parsimony and afford a more psychologically interpretable set of dimensions of cognitive style.

Accordingly, the 25 factors were rotated to an oblique position following the Harris-Kaiser (1964) independent clusters procedure. This

type of rotation relaxed the orthogonality constraints but increased the internal consistency of each of the 25 factors, thus permitting a stable, second-order factor solution. The 25 x 25 first-order, interfactor correlation matrix was established and subjected to an alpha factor analysis (Kaiser & Caffrey, 1965) which yielded seven factors with eigenvalues $\geq$ 1.00. The seven factors were rotated to the varimax criterion resulting in seven orthogonal second-order factors, or scales.

Since the second-order factors or scales were composed of weighted combinations of first-order factors, or subscales, rather than items, they could not be interpreted directly, as interpretation had to be made directly from items. To determine item weightings on the scales, it was necessary to consider simultaneously the item weights on the subscales in the oblique solution and weights of the subscales on scales in the orthogonal solution. Technically, this was done by regressing the oblique first-order factor pattern coefficient matrix onto the orthogonal second-order factor pattern coefficient matrix, the results of which are displayed in Table F-1. Items with weights $\geq |.30|$[1] on first-order oblique factors were considered significantly different from zero, and, first-order factors with weights $\geq |.30|$[1] on the orthogonal second-order factors were considered significantly different from zero. Thus, items could have been used in interpreting a second-order factor if their combined weight on a second-order factor were $\geq |.09|$; evidence of association with a factor, or, at or near 0.00; evidence of independence with a factor. In actuality, the former dependence criterion was made more stringent and only those items with a combined weight $\geq |.16|$ were taken as associated with a factor and used to interpret the second-order factors--the independence criterion was unmodified.

---

[1] This represents the 99% confidence region, approximately three times the standard error of the factor weight.

TABLE F-1

MATRIX RESULTING FROM REGRESSING OBLIQUE FACTOR PATTERN MATRIX
UPON SECOND ORDER ORTHOGONAL FACTOR PATTERN MATRIX

-.01442	.09496	.00511	.12525	-.01615	-.08388	-.08924
.00614	-.19860	-.00572	-.01041	-.13298	-.10862	.01666
.06094	.02705	.15176	.00121	.28060	-.03011	.00036
-.07626	.08343	-.07766	.05272	-.01313	.01078	.06358
-.14647	-.01849	-.06941	.07488	.03817	.12202	.03303
.00992	-.11446	.07220	.02415	.00786	-.01019	.11304
.03059	.03658	-.04893	.02433	.02335	.37621	.17406
-.11575	-.08191	.09152	.02200	-.10596	.04696	-.18625
-.02113	-.11040	.06325	.02176	.15332	.13947	.09127
-.05178	-.02125	.09480	.24438	-.10192	.08195	.06977
.02544	.05554	.06636	.16714	.24285	.08808	.07735
.09344	-.10264	.03273	.02966	-.03389	.05845	.08104
-.13420	.11945	-.07629	-.00285	-.10705	.14194	.06031
.04485	.03305	-.00235	.09204	.04929	.02655	.11184
.06589	-.08469	-.11263	-.00458	.21433	-.05385	.13432
.02861	-.05409	.03952	.02129	.11782	-.12747	-.02216
.04831	-.09253	-.09551	.24485	-.01197	-.05765	-.01833
-.02459	.01248	-.04387	-.02387	.15266	.03793	.08431
-.00504	.08224	-.07282	-.01958	.15820	.08967	-.24313
-.13091	-.05083	-.03723	-.07888	.06203	.00013	.13175
.03304	.02758	-.09893	.02849	.02677	.19258	-.10328
-.00665	.13047	-.16416	.09180	.17855	-.09497	.27573
-.02789	.11901	-.07960	-.02412	.10734	.00790	-.12190
-.17626	-.04271	-.01927	-.00152	.11373	.01896	-.19421
.07446	-.10391	-.09642	-.03342	.09846	.03090	.09793
.13457	.01817	-.01285	.09428	.02215	.04634	.00383
.10914	-.24218	.01981	-.05377	.01775	-.00720	-.03224
-.15522	.04658	-.00224	.05663	.03921	.05834	.05198
.10529	-.02971	-.05139	.07608	.06695	.15988	.03507
-.00933	-.17954	.11358	.04472	.01752	.04868	-.12798
.00642	-.09065	.03317	-.08226	-.03170	-.05180	-.03083
.00628	.01009	.03248	.20316	-.01282	.06653	.19429
-.03540	-.03158	-.07990	-.03949	-.06357	.26266	-.07220
-.13251	-.00502	.04405	-.00880	.06034	.03584	-.00960
.05835	-.08403	.05879	.15299	-.05596	.00431	-.09282
-.10295	-.05679	.07676	-.00498	.19522	-.06254	-.00081
.14757	.03110	.03158	.18759	.02760	-.07778	-.20726
.08496	.08235	.00570	.12813	.01535	.06521	-.08280
-.10709	-.10946	-.02735	-.02327	.08258	-.05259	.13738
.06158	-.26859	.00161	-.07811	-.09978	-.02879	.05479

TABLE F-1 (Cont.)

.01285	-.14051	.01183	.05230	.01093	.04458	.04871
.01859	-.01389	.02118	.20935	-.03710	-.02170	.01764
-.00438	-.00168	-.02317	.05670	.03647	-.23828	.00709
-.04273	.02524	.07134	07184	.05301	.03199	-.25719
-.03501	.04930	.07783	-.02823	.24760	-.05905	-.00310
-.02627	-.24765	.03327	-.00670	-.00348	-.06649	.03235
.00142	-.16081	-.03905	.03822	-.00849	-.03484	-.01203
.08612	-.01727	-.13328	-.14508	-.06600	.02829	-.11949
.09335	-.08911	-.22018	-.12295	.15437	-.10443	.32717
-.15514	.03323	-.03393	.06273	.01715	.08460	-.07147
.02330	-.01840	-.12789	-.07033	.04849	-.01063	.19173
.18674	-.07603	-.00941	-.00216	.16008	-.07783	.04633
-.00412	-.15546	.11732	.02564	-.00838	.02170	-.00740
.03083	-.00802	.01046	.16390	-.00237	-.03289	.19468
-.09018	-.06524	-.19946	-.01844	.08066	-.06100	-.07575
.04933	-.22563	-.01947	.01428	-.06948	-.05033	-.07124
.00486	.03900	.07248	.07873	.05936	.37553	.14205
.05452	-.09170	-.00645	.05407	.00099	.06104	-.07747
.10411	-.00528	-.10320	-.02735	.02529	-.09533	-.02849
-.03218	.01709	-.29108	.04876	-.05582	.04587	-.05928
-.04761	.01464	-.16840	.09271	.05779	-.11900	-.09060
.15059	-.03132	.02663	.00420	.02913	-.06960	-.12174
-.00905	.00292	-.22754	.00703	.00820	-.03101	-.09193
-.05169	.01342	-.14080	.02408	-.00050	-.06217	.00017
.06016	-.18821	-.08370	-.03063	-.02074	.07294	-.08066
-.01753	-.09105	-.09089	-.04538	.10515	.18576	.03909
-.00179	.08761	.05231	.01170	.06788	.07522	-.04613
-.00523	.00110	-.13847	.19983	.00616	.00859	-.00197
-.14233	.03267	.04241	.01795	.09361	-.07169	-.03438
.06889	-.11089	-.06488	-.14327	.03197	-.01371	-.03443

Lower bound reliability estimates (i.e., h^2), together with five typical items, appear tabled with interpretations of the second-order factors.

Scale I - Tolerance of Ambiguity

52	You frequently take time out just to meditate about things in general.	0.19
24	You don't like to work on a problem unless there is the possibility of coming out with a clear-cut and unambiguous answer.	-0.18
28	Things are either black or white, there are very few gray areas in life.	-0.16
50	You believe there are two ways to attack any problem: right and wrong.	-0.16
62	The most challenging kinds of questions are those which have a variety of answers.	-0.16

This scale represents an interest in uncertainty and an affinity for ambiguity.

Scale II - Interest in Logical Thinking .61

40	Before making a decision, you like to gather all the information you can find.	0.27
46	You like to choose one method of solution to a problem and follow it through.	0.25
27	Before making a decision, you like to consider all of its ramifications.	0.24
56	You like to analyze a situation thoroughly before entering into it.	0.23
2	You never lose sight of the goal you are working toward while solving a problem.	0.20

This scale represents an interest in logical, goal-directed thinking. Individuals who score high on this scale would take a logical, rational approach to problems or situations in order to attain a goal.

Scale III - Interest in Initial Alternative Thinking Leading to Rigidity .65

60	Once you make a decision, you stick to it no matter what.	-0.29
63	People who make "snap" decisions are usually wrong.	-0.23
49	You are philosophically inclined.	-0.22
55	Out thinking would be a lot better if we would just forget about words like "probably", "approximately", and "perhaps".	-0.20
61	The best way to solve a problem is to find a mathematical formula that fits it.	-0.17

The items weighted on this scale indicate an interest in looking at various alternatives when the individual is initially faced with a decision or a problem. Once the decision or the problem has been thought through, however, there appears to be an affinity for very rigid acceptance of the decision or solution, and a subsequent disregard for alternatives.

Scale IV - Interest in Problem Solving .70

17	You like to put problems in the form of equations to solve them.	0.24
10	You like to solve mathematical puzzles such as magic squares.	0.24
42	You would rather solve an algebra problem than a crossword puzzle.	0.21
32	People who think in mathematical terms interest me.	0.20
68	Once it is understood, almost anything can be reduced to a mathematical equation.	0.20

The items in this scale clearly represent an interest in problem solving, although it is not a general interest in problem solving; rather, it is an interest in problem solving only if the problems are in mathematical form.

Scale V - Interest in Reflective Thinking .80

- 3	You would like to look for errors of reasoning in an argument.	0.28
- 45	You are frequently "lost in thought" even when you are supposed to be taking part in a conversation.	0.25
11	Sometimes in your thinking you wish you could stay on the subject better than you do.	0.24
15	You like to talk to friends about the soundness of various ideas or theories.	0.21
22	You would like to study the philosophy of science.	0.18

These items, along with the other items with significant weights on this scale, represent an interest in analytic, speculative thinking. People scoring high on this scale would have an affinity for seeking out, pondering over and contemplating various aspects of other people or of given situations.

Scale VI - Interest in Diversity .52

- 7	You would like to study a little about each of a lot of things, rather than a lot about one or two things.	0.38
57	You would like to read many books on different subjects rather than many books on a single subject.	0.28
33	You like discussions which change topics rapidly.	0.26
43	You dislike people who keep jumping from one subject to another all the time in their conversations.	-0.24
21	You like conversation that easily flits about from one thing to another.	0.19

This scale represents an interest in diversity which appears to cut across all aspects of social interactions or individual pursuits. An individual with a high score on this scale would have an affinity for diversity in people, subject-matter or conversation.

Scale VII - Interest in Perseverative Thinking .60

49	You are philosophically inclined.	0.33
22	You would like to study the philosophy of science.	0.28
44	You don't like a supervisor who leaves you uncertain about his instructions.	-0.26
19	When you start to think about a problem, your thoughts tend to go off in all directions.	-0.24
37	While working on a problem, you often find many tangential aspects to the problem.	-0.21

This scale represents an interest in non-specific thinking. It has been labeled perseverative thinking because there was no aspect of termination of thought and there seemed to be a negative affinity for thought terminating in action.

APPENDIX G

TESTING SEQUENCE, NUMBER OF PARTS FOR EACH TEST AND TIME ALLOTTED FOR EACH PART, WHEN APPROPRIATE.

APPENDIX G

Testing sequence, number of parts for each test and time allotted for each part, when appropriate.

Utility Test	Parts 1 and 2	5 min.
Decorations	Parts 1 thru 4	3 min.
Match Problems	Parts 1 and 2	5 min.
Making Objects	Parts 1 and 2	3 min.
Word Fluency	Parts 1 and 2	2 min.
Thinking Interest Survey	70 items	
Seeing Problems	Parts 1 and 2	2 min.
Plot Titles	Parts 1 and 2	3 min.
Possible Jobs	Parts 1 and 2	5 min.
Associational Fluency	Parts 1 and 2	2 min.
Simile Interpretation	Parts 1 and 2	3 min.
Alternate Letter Groups	Parts 1 and 2	3 min.
Make - a - Code	Part 1	5 min.
Remote Associates Test	30 items	40 min.
Number Rules	Parts 1 and 2	5 min.
Make - a - Figure Test	Parts 1 and 2	2 min.
Symbol Elaboration	Parts 1 and 2	3 min.
16 Personality Factor Test	187 items	

* * * * *