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ABSTRACT

The research attempted to determine if there are creative processes which are independent of intelligence, as generally measured, and to describe these processes. An original test battery was designed and administered to 102 college music majors. The subjects were separated into the categories of a 2 x 2 x 2 factorial design by high or low ideational fluency, high or low IQ, and by level of advancement. A multivariate analysis of variance was employed to test the research hypotheses: the significant relationships established between traditional measures of creativity and the process variables imply that it may be possible to train people to be more creative. (Author)

AN INFORMATION-PROCESSING APPROACH TO THE ASSESSMENT OF CREATIVE ABILITY IN COLLEGE MUSIC MAJORS

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The need for creative thought and action in every field of human endeavor is universally recognized: the search for means of teaching creative thinking is widespread. Any article or book purporting to impart the secrets of creative teaching is eagerly read and discussed. Unfortunately, it is impossible to teach a particular process if the nature of that process is understood only by intuition. A much more thorough and scientific approach must be undertaken if the creative process is to be comprehended. This study attempted to make a beginning in this direction, by applying the information-processing techniques derived from gestalt psychology to the assessment of creative ability in college music majors.

Previous Research:

Although there is a vast amount of previous research in the field of creativity, results have been somewhat vague so far as ascertaining the cognitive processes involved in a particular act which may be termed creative. J. P. Guilford was one of the first psychologists to concern himself with creativity as process, rather than as product or as person, i.e., characteristics of an individual considered to be creative. In his research, much of it in developing tests of various

kinds of aptitudes, including thinking and reasoning abilities, creative-thinking abilities, planning abilities and evaluating abilities. Guilford has sought to explore every kind of intellectual performance. His utilization of factor analysis as a tool to isolate various cognitive abilities helped lead research in this field away from the principles of associationist theory to a new view of the individual as an "information processing organism." (Guilford, 1956, 1959) This early research led Guilford and his associates to the development of a complicated "structure-of-intellect" model of human thought processes. In his attempts to apply information theory, Guilford found that what he called the "divergent-production" group of abilities seemed to be the most relevant for creative thinking. He also noted that the several kinds of fluency, flexibility and elaboration abilities included in this category allowed for variations in creative talent associated with the medium with which the person was working, whether visual, aural, or whatever. Factors isolated along with this "ideational fluency" included those of sensitivity to problems, flexibility of set, ideational novelty, synthesizing ability, analyzing ability, reorganizing or re-defining ability, span of ideational structure, and evaluating ability.

Other attempts to isolate some pure measure of creativity which would be independent of general intelligence (see Wallach and Kogan, 1965; Barron, 1955; Getzels and Jackson, 1962; Wallach, 1970) share a strong commonality both in instruments used for assessing creative process and in the results, with what may be

termed "ideational fluency," i.e., the ability to generate a large number of original responses which still fulfill particular requirements (naming uses for bricks, writing titles for a story, etc.) being identified as a relatively pure measure of creativity. In itself, however, ideational fluency seems to be a somewhat product-oriented dimension which does not provide many clues about the nature of the underlying processes accounting for creative behavior.

Research into cognitive process which utilizes information theory appears to be a promising route to assessment of creative process, because this approach to cognitive process has been employed in explorations of social attitudes and impression formation with some success. In the field of music, information theory has been confined largely to experiments in musical analysis, but, to some extent (e.g., in studies of "preference for complexity," Griffin and Eiseman, 1972) has been related to thought processes. Cognitive process has been of increasing interest to researchers in recent years, largely as a result of the work of Jean Piaget, and the renewed influence of gestalt theory. There is strong agreement among Piaget (1955), Werner (1948), and Schroder, Driver and Streufert (1967) as to the nature of cognitive processes. Werner's orthogenetic principle provides the most succinct definition of these processes:

> Wherever development occurs it proceeds from a state of relative globality and lack of differentiation to a state of increasing differentiation, articulation, and hierarchic integration.
>
> (Werner, 1957)

In order to maintain equilibrium between himself and the environment, the individual develops increasingly differentiated and integrated cognitive structures. In doing so, he gains increased independence of psychological processes from direct physical characteristics, at the same time becoming increasingly able to subordinate concrete experience to abstract integrative principles. As the individual becomes more able to differentiate and integrate his physical and social world, he becomes increasingly free from his environment.

These propositions are supported in the theory of conceptual development of Harvey, Hunt and Schroder (1961) as well as Schroder, Driver and Streufert (1967). For them, a matrix of inter-related concepts serves the cognitive function of providing a system of ordering through which the individual can break down and organize his environment, differentiating and integrating it into its many psychological facets. Differentiation and integration are viewed, as they are by Werner (1957) and Langer (1969), as the spychological process or activity which enables the individual to gain greater

freedom from perceptual constraints, as detemined by the level of concreteness or abstractness of a given individual conceptual system.

Purpose:

In keeping with the established need for research in this area, the purpose of the investigation was two-fold: (1) to determine if there are creative processes that are independent of intelligence; and (2) if so, to provide a description of these processes.

Procedures:

The subjects taking part in the study were a randomly selected group of 52 first-year and 50 advanced music majors enrolled at two colleges in Virginia. The subjects were placed in the categories of the 2 x 2 x 2 factorial design by high or low IQ, first-year or advanced level of study, and by high or low scores on the ideational fluency measures of the test battery.

An original battery of measures was administered to each subject individually. All directions and explanations were presented on audio tape. To assure that no restriction of time allowed for a given task was implied, the subject was directed to turn off the tape after each request for responses, both in the ideational fluency measures and in the process measures, and to take as much time as he desired to make responses before turning on the tape and proceeding to the

next stimulus. This procedure was repeated for each of the four ideational fluency measures, the five listening measures (for differentiation and discrimination) and the two composition (integration) measures. Responses were written on sheets of lined paper provided; the subject's name appeared only on the outer envelope and not on any of the response sheets.

The stimulus materials for the ideational fluency tasks were based on the work of Guilford (1960), Torrance (1966a, 1966b, 1966c) et al. The first task required the generation of a list of unusual uses for the metronome and the second unusual applications for the subject's musical training. For the third task, the subject was directed to listen to the piece of music on the tape, and then to write as many titles as possible appropriate to this composition. The stimulus piece of music was an obscure "Prelude" written by Czerny, and is so vague in style and form that virtually any title might be deemed "appropriate." The final task in this group was one taken directly from the Guilford measures--the listing of "round things."

The process variables were assessed by means of five sets of three musical examples. The subject was asked to listen to the first group of three examples, then to stop the tape and to write down which two of the three he thought were the most similar, giving explicit reasons for his choices.

It was stressed that there was no one "correct" answer to this task and that the reasons for the choices made were very important. In each set of examples, played on the piano by the experimenter, certain dimensions were held constant and others changed. For example, in the first set, tempo varied from fast to slow to moderate in the three examples; rhythm was dotted in the first and third examples and even in the second; harmony was minor in the first and third, and major in the second; dynamic level was changed from P to F to MF; and the tonic base from C to G to E. Since the subject had to remember what had transpired in one example while listening to the next, the individual examples were kept quite short.

The final two tasks were compositions constructed from visual stimuli: the first a thematic of a pentatonic scale and the second a brief rhythmic pattern. The subject was directed to write a brief composition employing the stimulus "in some manner."

Scoring:

Scoring of the protocols was done without the knowledge of the subject's name or level of advancement. The four ideational fluency measures were scored by means of statistical infrequency of a given response. Identical or very similar responses were grouped, and written on file cards for convenience in determining how many times a particular response was made. The responses which were given by only one or two persons

taking part thus were given higher scores proportionately than those which were given by a larger percentage of the subjects. Precedent for this method of scoring was found in the work of Wallach and Kogan (1965).

The scoring procedure for the dependent variables, assessed by the music listening and composition measures were based on the method developed by Schroder, Driver and Streufert (1967). For the purposes of this study, the protocols of each subject for each of the five listening measures were analyzed with each dimension identified by a subject for a particular measure counted: the total number of dimensions listed formed a measure of differentiation. For example, if the protocol of a given subject for a particular example read something like:

> For II-A, I thought nos. 2 and 3 were more similar because they are both fairly slow and both are in a minor key . . .

the dimensions of "tempo" and "harmony" would be scored as having been differentiated by the subject.

In similar fashion, the discrimination measure was found in the protocols when a subject made distinctions within a given dimension. For example, if he wrote:

> In II-A, I thought nos. 2 and 3 were more similar because they are both fairly slow, but no. 2 was slower than no. 3 . . .

he would then be scored as having discriminated within the dimension of tempo. A separate scoring sheet was employed for each of the five listening measures, with differentiation and discrimination scores computed for each measure as well as for total differentiation and discrimination for each subject.

An integration measure is difficult to score objectively from the protocols for the listening measures, but the composition measures were ideally suited for this purpose. A musical composition is, of course, the putting together of the various dimensions in such a manner that an integrated whole results. The stimuli given for the compositions left considerable freedom for the student to display his ability. The integration score was determined by noting how many dimensions the subject was able to utilize in his composition and the length during which he was able to control the selected dimensions. The student less able to integrate the various dimensions into a meaningful whole would be likely to choose fewer dimensions and to manipulate them for a shorter time (i.e., length of composition) than the student who was more able to control the many facets of a more complicated and sophisticated composition. A weighted integration score was thus obtained by multiplying the total number of the dimensions differentiated by the number of measures of the composition. Average scores for number of dimensions, number of measures and weighted scores were also computed.

Inter-rater reliability was obtained for the dependent variable scoring procedures by having a person other than the researcher independently score a randomly chosen group of fifty per cent of the protocols for each measure. The relationship of the two judges on each variable was obtained by using a Pearson Product Moment Correlation. The second judge, like the first, was completely unaware of name or level of advancement of any of the subjects whose protocols he was scoring. Inter-rater reliability coefficients were obtained for differentiation in listening tasks, .87; for discrimination in listening tasks, .82; and for integration in musical compositions, .99.

The subjects were separated into the various categories of the design by high or low ideational fluency ("high" referred to the median point or above in the scores for average ideational fluency); high or low IQ (as determined by the median point in the SAT scores; and by first-year or advanced level of education. A multivariate analysis of variance was employed to test the research hypotheses, which stated that a difference would be found in the dependent variables as a function of the level of ideational fluency, the level of IQ, and the level of advancement.

Cell means for the distribution of subjects in the categories of the design are shown in table 1. First-year students whose scores exhibited high ideational fluency and

Table 1. Distribution of Subjects in Categories

		Level (First Year)	Level (Advanced)
High Ideational Fluency	High IQ	11	19
	Low IQ	13	6
Low Ideational Fluency	High IQ	9	12
	Low IQ	19	13

high intelligence numbered 11; high ideational fluency scores and high intelligence, 9; and low ideational fluency and low IQ scores, 19. In the advanced level, 19 students had high scores in both ideational fluency and IQ; 6 exhibited high ideational fluency and low intelligence; 12 had low ideational fluency coupled with high IQ scores; and 13 had low ideational fluency scores and low IQ scores.

Results:

The three research hypotheses were tested using a multivariate analysis of variance, while a univariate analysis of variance was used to test each individual dependent variable with each independent variable. For all the multivariate tests of the hypotheses .05 alpha level with the appropriate degrees of freedom was used.

The results of the multivariate analysis of variance are presented in Table 2. As can be observed, no significant interactions exist between the independent variables, and so a direct interpretation of each of the hypothesized main effects can readily be made.

The hypothesized difference in the dependent variables as a function of the level of ideational fluency proved to be statistically significant, with F of 1.972 and P less than .03. The results of the multivariate analysis of variance as well as the results of the univariate F tests of each individual dependent variable are presented in Table 3. As

can be observed from this table, the integration measures are clearly the most significant when the individual dependent variables are considered. The third differentiation task and the third discrimination task, both with scores derived from the same listening measure, are the least significant. For this reason, an additional test was made, with this measure omitted; however, the results were little changed, as shown in Table 4. With the third listening measure deleted, the multivariate F becomes 2.069, with P less than .028. In either case, there is a clear relationship displayed between the level of ideational fluency and the process variables.

In the case of the second hypothesis, that there would prove to be a difference in the dependent variables as a function of the level of intelligence, the results proved to be not significant statistically, with F of 1.253 and P less than .255, as shown in Table 5. Within the limitations of this study, intelligence per se does not seem to have a direct bearing upon the process variables of differentiation, discrimination, and integration.

The third hypothesis made, that there would be a difference in the dependent variables as a function of level of advancement, did prove to be statistically significant, as shown in Table 6, with F of 3.701 and P less than .001. It is interesting to note in examining the univariate tests of significance for each individual dependent variable, that all of the

Table 2 Results of the Multivariate Analysis of Variance for the Independent Variables

	Multivariate F	df	Significance Level
Main Effects			
Ideational Fluency	1.972	14, 81	P less than .030
I. Q.	1.253	14, 81	P less than .255
Level of Advancement	3.701	14, 81	P less than .001
Interactions			
Level X I. Q.	1.242	14, 81	P less than .262
Level X Fluency	1.271	14, 81	P less than .244
I.Q. X Fluency	1.046	14, 81	P less than .418
Level X I.Q. X Fluency	.758	14, 81	P less than .710

Table 3 Multivariate Test of Significance and Univariate F Tests for the Level of Ideational Fluency with Each Dependent Variable

Level of Ideational Fluency	Multivariate F 1.972	df 14, 81	Significance Level P less than .030
Process Variable	**F Test**	**df**	**Significance Level**
Differentiation Task A	1.460	1, 94	P less than .230
Differentiation Task B	2.905	1, 94	P less than .092
Differentiation Task C	.274	1, 94	P less than .602
Differentiation Task D	2.806	1, 94	P less than .097
Differentiation Task E	5.619	1, 94	P less than .020
Discrimination Task A	2.965	1, 94	P less than .088
Discrimination Task B	1.767	1, 94	P less than .187
Discrimination Task C	.112	1, 94	P less than .739
Discrimination Task D	7.903	1, 94	P less than .006
Discrimination Task E	2.844	1, 94	P less than .095
Integration Task A Dimensions	9.937	1, 94	P less than .002
Integration Task A Measures	2.446	1, 94	P less than .121
Integration Task B Dimensions	8.857	1, 94	P less than .004
Integration Task B Measures	4.257	1, 94	P less than .042

Table 4. Multivariate Test of Significance and Univariate F Tests for Level of Ideational Fluency and Process Variables with Third Listening Test Deleted

Level of Ideational Fluency	Multivariate F 2.069	df 12, 83	Significance Level P less than .028
Process Variable	**F Test**	**df**	**Significance Level**
Differentiation Task A	1.460	1, 94	P less than .230
Differentiation Task B	2.905	1, 94	P less than .092
Differentiation Task D	2.806	1, 94	P less than .097
Differentiation Task E	5.619	1, 94	P less than .020
Discrimination Task A	2.965	1, 94	P less than .088
Discrimination Task B	1.767	1, 94	P less than .187
Discrimination Task D	7.903	1, 94	P less than .006
Discrimination Task E	2.844	1, 94	P less than .095
Integration Task A Dimensions	9.937	1, 94	P less than .002
Integration Task A Measures	2.446	1, 94	P less than .121
Integration Task B Dimensions	8.857	1, 94	P less than .004
Integration Task B Measures	4.257	1, 94	P less than .042

Table 5 Multivariate Test of Significance and Univariate F Tests for the Level of I. Q. with Each Dependent Variable

Level of I. Q.	Multivariate F 1.253	df 14, 81	Significance Level P less than .255
Process Variable	**F Test**	**df**	**Significance Level**
Differentiation Task A	.004	1, 94	P less than .951
Differentiation Task B	.016	1, 94	P less than .901
Differentiation Task C	.139	1, 94	P less than .710
Differentiation Task D	1.043	1, 94	P less than .310
Differentiation Task E	.007	1, 94	P less than .932
Discrimination Task A	.281	1, 94	P less than .597
Discrimination Task B	.964	1, 94	P less than .329
Discrimination Task C	.003	1, 94	P less than .958
Discrimination Task D	1.009	1, 94	P less than .318
Discrimination Task E	1.339	1, 94	P less than .250
Integration Task A Dimensions	1.943	1, 94	P less than .167
Integration Task A Measures	7.199	1, 94	P less than .009
Integration Task B Dimensions	1.069	1, 94	P less than .304
Integration Task B Measures	1.195	1, 94	P less than .277

Table 6 Multivariate Test of Significance and Univariate F Tests for the Level of Advancement with Each Dependent Variable

Level of Advancement	Multivariate F 3.701	df 14, 81	Significance Level P less than .001
Process Variable	**F Test**	**df**	**Significance Level**
Differentiation Task A	.064	1, 94	P less than .80[illegible]
Differentiation Task B	1.681	1, 94	P less than .198
Differentiation Task C	1.784	1, 94	P less than .185
Differentiation Task D	5.598	1, 94	P less than .020
Differentiation Task E	1.642	1, 94	P less than .203
Discrimination Task A	4.799	1, 94	P less than .031
Discrimination Task B	10.204	1, 94	P less than .002
Discrimination Task C	4.990	1, 94	P less than .028
Discrimination Task D	9.063	1, 94	P less than .003
Discrimination Task E	14.387	1, 94	P less than .001
Integration Task A Dimensions	16.439	1, 94	P less than .001
Integration Task A Measures	1.743	1, 94	P less than .190
Integration Task B Dimensions	20.631	1, 94	P less than .001
Integration Task B Measures	19.365	1, 94	P less than .001

individual tests of discrimination except the first one were statistically significant individually. As was the case in the analysis of the effects of level of ideational fluency, the integration measures proved to be the most stnsitive of the process variables.

Conclusions:

Ideational fluency is the measure identified by previous creativity research as the one measure which appears to be independent of intelligence and thus may be considered a pure measure of creativity. Since the present study shows a significant relationship between ideational fluency and the process variables of differentiation, discrimination and integration, it would seem that the process variables are also measures of creative process. Ideational fluency is, by its nature, a creative product. The cognitive process or processes which give a person the ability to make high scores on tests of ideational fluency, cannot themselves be determined by an examination of the responses, even though the responses may be identified as "creative" or "non-creative." Since the process variables of the present study are highly related to the measures of ideational fluency, then the possibility is clear that training in these abilities may also increase the quality of creative products of those trained.

The results in this study of the examination of the effects of the level of IQ with the process variables showed

no statistical significance. This finding reinforces the results of the previous research in the field of creativity which isolated ideational fluency as an orthogonal factor from intelligence. In examining the univariate F tests for the relationship of IQ and the individual process variables, the only one which was statistically significant was the Integration Task A measure. This task had to do with the exact number of measures employed in the first composition written (i.e., the length of the composition). Since this task is highly related to skill, this fact might explain the relationship, but it is interesting to note that the other composition, Integration Task B measure, is not significant, and, in neither composition measure is the number of dimensions employed significant with level of achievement. The process variables, like ideational fluency, are apparently measuring some quality other than intelligence or level of achievement alone.

The level of advancement, first-year or advanced students, was significant with the process variables, with P less than .001. Only five of the fourteen individual process variables were not significant when considered alone with the level of advancement. Apparently, the courses which the advanced students have had have greatly increased the ability of these students to differentiate, discriminate and integrate stimuli. Since these courses, particularly those in music theory,

obviously are supplying training in differentiation, discrimination, and integration of stimuli, the high degree of significance between these variables and the level of advancement is entirely to be expected.

The significant relationships established between traditional measures of creativity and the process variables of the present study offer many exciting vistas for future lines of inquiry. The implications that it may be possible to train people to be more creative and more productive in their life's work, not only in the field of music, but also in practically any field of endeavor, is a particularly rewarding prospect.

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