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ABSTRACT

This report reviews the research on creativity assessment and on biases in creativity measures. The study attempts to clarify the relative bias of convergent and divergent ability and esthetic preference, and their relative bias to aspects of personality and educational preferences involving both subject matter and instructional method. A modified view of divergent thinking emerges which separates the creative, "artsy" student from the intelligent, scientific student. Such separation seems to be a consequence of the role of divergent thinking as a secondary indicator of the esthetic mode of thought, which in turn, seems to reflect a fundamental mode of cognition. Further study of cognitive bias promises a fuller understanding of the development, as well as the present state, of individual personality, cognition, and behavior in the school system and in society at large. (Author/LAA)

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Convergent, Divergent, and Esthetic Ability and Bias In College Students: Their Relation to Personality and Preference for Major Subject and Instructional Method

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The Background: A Brief Introduction to Creativity Testing

After several decades of IQ testing it had become clear that high IQ might be necessary, but was hardly sufficient, to explain why some persons are more creative than others. Creativity researchers then began to design tests that might tap cognitive abilities involved in creative thought, using two general approaches.

The first was to consider what is involved in creative thought, decide a priori that a particular form of mental activity is the key, and develop a test for it. Before it can be called a "creativity test," this instrument should

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2 Research was conducted by the senior author under the supervision of the junior author.

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be shown to measure a single cognitive dimension distinct from what is measured by IQ tests, and extreme scorers should prove to be unusually "creative" or "uncreative" as the word is commonly used. Such is the ideal, but researchers have often called what their tests measure "creativity" despite a lack of positive evidence, or indeed in the presence of negative evidence. Consequently, a depressingly large proportion of the creativity literature is not only useless but quite misleading.

Perhaps the first of these a priori proposals was that of J.P. Guilford (1950). Having developed a three-dimensional model of human intelligence through an extensive procedure of factor analysis, he observed that IQ tests consist almost entirely of questions testing convergent-productive abilities, that is, the ability to find a single correct answer. Guilford proposed that creative thought draws on abilities involving more fluency and flexibility, particularly those involving divergent production, the generating of many appropriate responses to an ambiguous problem.

Constructing a battery of tests seemingly evoking divergent production is not difficult, but most early "creativity tests" of this kind proved to be measuring either the same type of abilities measured by IQ tests (e.g.,

Getzels and Jackson, 1962) or a variety of abilities more or less independent not only of intelligence but also of each other (e.g., the Torrance Tests of Creative Thinking (Torrance, 1966)). Wallach and Kogan (1965) appear to have overcome these difficulties. Though their theoretical rationale was involved with ideational fluency and association, somewhat like that of Mednick (1962), their tests were very much like those developed by Guilford to measure divergent thinking, and indeed one of them was Guilford's Alternate Uses task. Not only did their five subtests (scored for frequency and uniqueness of responses) intercorrelate fairly highly, averaging .41, but they had little relation to standard intelligence measures, averaging .09. Cropley has administered the Wallach-Kogan tests to Australian (Cropley, 1968) and Canadian (Cropley and Maslany, 1969) students and found a similar tendency for divergent scores to cluster together with low cross-correlations with intelligence scores, though his subjects were considerably older than Wallach and Kogan's and the test conditions quite different. He concludes: "This implies that the tests measure a stable and internally consistent intellective mode, albeit one which is substantially related to general intelligence." (1969, p. 398)

It is rather unfortunate that Wallach and Kogan made

a point of administering their tests in a game-like, anxiety-reducing setting quite unlike that in which the intelligence tests had been given. Nonetheless, later research suggests that their results are not in any important respect artifacts of their testing conditions. Vernon (1971), Nicholls (1972), and Feldhusen, Treffinger, van Mondfrans, and Ferris (1971), have all found that a distinct divergent ability emerges under varied test conditions, though relaxed test conditions like those of Wallach and Kogan do tend to produce more independent and coherent divergent scores. It is particularly worth noting that fluency scores (obtained by simply counting the number of responses for each item) are about as good as any for measuring divergence. Other scoring methods necessitate keeping count of every particular response, or at least a large subsample, and such divergent scores become almost prohibitively tedious and cumbersome to obtain.

Is this divergent ability the essence of creativity, as Wallach and Kogan assumed? After a careful re-analysis of the original Wallach-Kogan data, Cronbach (1968) concluded:

> "My final impression is that the [divergent] variable has disappointingly limited psychological significance. It can scarcely be considered a measure of ability or creativity; there is no evidence that high [divergent] children produce responses of superior quality in any situation. It is correlated with other measures of social responsiveness, but not strongly (1968, p. 509)."

Wallach and Wing (1969) found that divergent scores were significantly related to arguably creative extra-curricular activities of high-school students (though the peculiar nature of their sample makes their findings no more than suggestive). Cropley (1972) found that grade seven divergence scores correlated .51 (approximately as high a correlation as the reliability of the tests themselves over the same period) with activity in the next five years in art, drama, literature and music.

The alternate approach to testing creativity has been simply to find a sample of persons (artists, scientists, architects, or whatever) who are generally acknowledged to have performed high-level creative work, and then to look for what distinguishes them from the average person. Much of this work has examined biographical (Roe, 1952) or personality (Cattell, 1968) traits; the one cognitive-type "creativity test" developed in such research is the Barron-Welsh Revised Art Scale (Welsh, 1950). From a large pool of designs originally drawn up for another purpose, Barron and Welsh simply found which designs were consistently liked by working artists and disliked by the "man in the street" (i.e., college students), or vice-versa. The Art Scale, then, is simply a collection of designs which the subject indicates he likes or dislikes. Compared to

tests of deivergent production it is extremely simple to administer under varied conditions and easy to score.

Barron (1952) has found that high-scorers--generally, those who prefer complex asymmetrical designs to simple balanced ones--preferred "the modern, the radically experimental, the primitive, and the sensual" in art, while low scorers preferred "the religious, aristocratic, traditional, and emotionally controlled." High scorers describe themselves on the Adjective Checklist as gloomy, bored, unstable, bitter, pessimistic, emotional and pleasure-seeking, while low scorers describe themsleves as industrious and pleasant and have higher California Personality Inventory scores on Responsibility and Communality. Gough (1961) found the Art Scale to be the best single predictor of manifest creativity in his sample of scientists, and the selected group scored much higher on the Art Scale than did the equally intelligent control sample of uncreative architects (MacKinnon, 1962). Child (1965) found no significant relation between scores on the Art Scale and scores on Alternate Uses, a test of divergence.

These two approaches to creativity testing, then, have developed two different and unrelated tests, each with some circumstantial evidence that high scorers are more creative than low scorers. If one is a test of

creativity then the other is a test of something else. But does the evidence that, for example, high divergers are most likely to engage in dramatic or musical activities really constitute evidence for creativity one way or another?

There is evidence that it means something quite different. Hudson (1965, 1968) began research in this area by studying the importance of uneven performance on IQ tests, that is, bias toward one or another type of convergent ability. These biases proved to be far more informative than the scores themselves. Schoolboys specialising in different academic areas could be distinguished with remarkable ease; would-be historians, for example, are characterised by relativily low IQ, do better on verbal subtests, display low accuracy and spatial ability, average vocabulary, and cultural or political interests, while would-be biologists have an average IQ, accuracy, and spatial ability, a non-verbal bias, poor vocabulary, and practical or outdoor interests (1965, p. 177). Consider one of Hudson's subjects, an outstanding student of English and History:

> "On the numerical and diagrammatic parts of the intelligence test he was abjectly weak, and his overall IQ was one of the lowest I tested. He was extremely inaccurate; and his spatial reasoning was, if anything, worse than his IQ. His verbal IQ, on the other hand, was only a little below the average for a Fifth Former; his vocabulary was well above average; and his general knowledge was quite outstanding. (1965, p. 35)."

Taking into account the low level of his scores, his strong academic performance is quite incongruous, but considering the pattern of weaknesses and consequent verbal bias his success in arts subjects becomes easy to understand.

This importance of bias is perfectly in accord with the common sense notion that the more effort is concentrated on one area, the more success will result in the same area. Paradoxically, intellectual weaknesses can lead directly to mental strength. An arts student, say, who does well on every part of an IQ test will be inclined to scatter his attention in too many directions to perform as well as another student who is weak in every department save verbal ability (and who thus has a substantially lower IQ) and consequently devotes himself entirely to arts interests.

Guilford began by defining divergent thinking as just another manifestation of human intelligence, comparable with the convergent abilities tests on IQ tests. Supposing that divergent ability is somewhat less related to individual types of convergent ability (e.g., numerical or verbal ability) than they are to each other, one would predict that bias along the divergent-convergent dimensions would have even more striking effects than bias between

one or another convergent abilties. This is just what Hudson found.

Initially Hudson had hoped that divergence tests would measure a kind of background level of ability against which the biases toward one or another convergent ability would operate. Instead it provided an even better measure of bias. Arts specialists characteristically do poorly on IQ tests and well on divergent ones; science specialists, the reverse. These differences in subject choice were accompanied by personality differences; divergers are more unconventional, interested in people and esthetic matters, openly expressive of libidinal desires, whereas convergers are more conventional, restrained, precise, and inclined toward outdoores and practical activities. The difference in choice os subject matter apparently follows from these more general personality differences, as schoolboys share common images of "Science men" (reserved, impersonal, and generally convergent) and "Arts men" (warm, flashy, and divergent), and they select a course of study that matches their existing dispositions with an appropriately stereotyped field (Hudson, 1968).

Bias of ability may be innate, or perhaps emerges in early childhood (Hudson speculates that divergers are likely to come from families that value interpersonal

warmth highly, and convergers from families which stress objective achievement).

At any rate, by early adolescence bias of ability has much more explanatory value for nearly every aspect of personality, values, or activity than does the general level of intelligence. Knowing that a man has an IQ of 160 tells us that he may be outstanding in any of many fields, but knowing in which sub-categories he is better than his average and in which he is worse permits us to guess whether he will use his ability to study quaestors or quarks, put his office in order or flirt with his secretary, pick a good Greek restaurant or grow bonzai trees. Indeed, most of the apparent predictive value of the individual IQ scores follows from the fact that unusually high or low scores are a good crude indicator of bias of ability; since the correlation between convergent and divergent scores is low most high convergers will not chance to be high divergers as well, and so will have some degree of convergent bias.

These findings explain the relationships between divergence and "creative" interests reported by Wallach and Wing (1969) and Cropley (1972), and explain them away as evidence for creativity. High scorers on divergent tests are divergently biased and would be expected to involve themselves more in esthetic and interpersonal activities. The distinctive activities reported of divergent students show that they are more "artsy", not that they are more creative.

There remains, then, the "esthetic preference" factor

measured by the Art Scale, which is independent of convergent and divergent intelligence and has, perhaps, something to do with creativity.

It seems that so far as convergence and divergence are concerned, it is the relative bias of the individual toward one or the other that is interesting, more interesting than the variables themselves. What of estheticism and conventional intelligence and their relative bias? Or for that matter, what of estheticism and divergent intelligence?

Method

The study reported here is an effort to clarify the relative bias of convergent and divergent ability and esthetic preference (hereafter termed the "source variables") and their relative bias to aspects of personality, and to educational preferences involving both subject-matter and instructional method.

A form of the Barron-Welsh Revised Art Scale (altered by adding null items to minimize response bias), a slightly abridged form of the Wallach-Kogan (1965) test (scored as a weighted combination of number and originality of responses), and Raven's Advanced Progressive Matrices (a test of convergent ability) were administered to 205 college students (121 female, 84 male) who volunteered

from courses in a wide variety of departments. Subjects were paid $5.00 on completion of the cognitive tests, the Omnibus Personality Inventory Form F (Heist and Yonge, 1968) and a lengthy form constructed for this study assessing attitudes toward eight fields of study and sixteen instructional methods (available on request).

Since earlier work has suggested that differences along certain cognitive dimensions imply a wide variety of corresponding differences in personality and academic preferences, the primary aim of this study was to find, for each source variable and for each bias, a characteristic profile of personal-academic inclinations. This was obtained by a simple t-test procedure, comparing high and low scores on each cognitive variable with respect to each OPI scale and academic subject. Altogether there were six comparisons for each pair comparing higher- or lower-than-average, or extreme high and low scorers, among males, females, and both combined. The one disadvantage to this procedure is that among such a large number of t-tests there are almost certain to be a number of spurious significant relationships (at the .05 level of significance, two-tailed, used as the minimum in this study). However, the aim of the analysis is to detect patterns of relations between variables, so that the effect of random false

significances should be to obscure true underlying patterns rather than creating false ones.

Results and Discussion

Test scores for this sample did not conflict with previous research. Scores on the four divergent subtests correlated at least .56 with each other and .81 with the total score, resulting in a highly unitary measure. There were no significant correlations (none exceeded .15) between convergent, divergent, and esthetic scores; however, the total results mask a marginally significant correlation between divergent and esthetic scores in males ($r = .21$) and between convergent and divergent scores in females ($r = .23$) which can probably be explained as a product of conventional sex-role expectations (Yeas, 1972). In any event, these correlations are lower than most of those reported previously, and the source measures may reasonably be treated as independent.

Significant positive or negative relations between cognitive and dependent variables in any of the six comparisons (all subjects or extreme scorers among males, females, or both) are shown in Table I (abbreviated variable names appear in full in Table V). Examination reveals a strikingly simple pattern; the variables are arranged

accordingly in Table II, where doubtful cases with only one significant relation per cell are omitted. Variables which relate positively to esthetic scores also relate positively to divergence-relative-to-convergence, and negatively to convergence, convergence-relative-to-estheticism, and occasionally also divergence-relative-to-estheticism, and vice-versa. Divergent scores may relate positively with either "esthetic-positive" or "convergent-positive" variables. The pattern is a simple bi-polar dimension, esthetic at one extreme, convergent at the other, with divergence lying somewhat between, thus:

E--------D--------C

Divergence probably has effects more similar to those of estheticism than to those of convergence; hence the esthetic-convergent bias is more frequently significant discriminator than the divergent-convergent, and the esthetic-divergent bias discriminates least frequently of all.

The marginal relations are added to Table II to form Table III. All but one (divergent-esthetic bias for Impulse Expression) of these doubtful cases are significant in exactly the expected direction, so that they can reasonably be used as additional evidence in describing the overall pattern. Most of the personality and subject-matter variables can thus be classified as either "esthetic-positive"

(characterized by high OPI scores on the Thinking Introversion, Estheticism, Complexity, Autonomy, Impulse Expression, and Altruism subscales, and by a relatively high ranking of Anthropology, English, History, and Philosophy) or as "convergent-positive" (with high OPI scores on the Theoretical Orientation, (low-) Anxiety Level, Practical Orientation, Masculinity, and Response Bias subscales, and a relatively high ranking of Biology, Mathematics, and Physics).

Not all student traits fall into one of two types, of course. There is no place along the convergent-esthetic dimension for rankings of Psychology or OPI scores on Religious Orientation or Personality Integration, for instance; in the first case, probably because the label "psychology" is vague enough to cover everything for the existantial and self-realizing thought of Laing and Maslow to the most rigorous and technical neuroendocrinology, and in the latter case probably because it is by now conventional among college students to be a bit alienated and irreligious in practice. Still, the esthetic/convergent dichotomy is quite a far-reaching one, a dichotomy which finds a place for seven of the eight subjects rated and twelve of the fourteen personality factors on the OPI.

A few words should be said about the unexpected

findings concerning divergent thinking. The characteristically divergent traits found by Hudson--preference for Arts subjects and artistic pursuits, for people rather than things, for feeling rather than logical reasoning--seem to be characteristic of bias toward estheticism, picked up by the divergence bias because it too differs (less strongly, however) in the same direction relative to convergence. But is there anything characteristic of divergence apart from its secondary role in the esthetic/convergent dichotomy? Examining the variables to which it relates--positively to ranking of Philosophy, OPI Estheticism, Complexity, Theoretical Orientation, Impulse Expression, (low-) Anxiety Level, perhaps Thinking Introversion and ranking of Mathematics, and negatively perhaps with Practical Orientation--the common element that is suggested is an inclination toward abstraction and away from the concrete.

Table IV shows the relation of preference for different instructional methods to the personality and subject-preference as well as the cognitive variables. It is clear that these too can for the most part be classified as either esthetic-positive or convergent-positive. The most convergent-positive methods include a lecture course with a precise, methodical, well-organized professor, either with (L1) or without (L2) class conferences, a learning

dyad following a set course plan with a similar rigorous and dependable student (L11) and computer instruction (L13); the most esthetic-positive methods include a student-dominated seminar with a related, easy-going, and stimulating professor (L8), a student-run learning dyad with a similar free-wheeling student (L10), and an individual study course following the interests of the individual student (L16). Evidently the controlling factor is locus of control--the convergent-positive methods decide in advance what and how the student will study, while the esthetic-positive methods leave the decision more or less up to the student himself. The other methods, more difficult to place, either confound these elements, combining flexible persons with rigid course plans (or vice-versa), or are rather ambiguous as to where the locus of control lies.

Conclusion

There emerges from this study, then, a modified view of divergent thinking. Its major significance in previous studies as a mode of thinking separating the "creative" or "artsy" student from the "intelligent" or "science-oriented" student seems rather to be a consequence of its role as a secondary indicator of the esthetic mode of

thought (as measured by the Revised Art Scale). The rather more minor significance of divergent thinking *per se* is apparently quite different and worth examining for its own sake.

Esthetic preference seems to reflect a rather fundamental mode of cognition. Though it does not seem to fit in any of Guilford's (1950) 120 intellectual pigeonholes, it evidently ranks with Guilford's convergent production as a major factor in attitudes and behavior. A sizeable minority of students, of course, have a similarly high or low level in both these modalities; since they have no particular cognitive bias along this dimension their preferences and behavior must be determined by and reflect other factors altogether. Still, a large proportion do have a substantial bias, enabling fairly accurate predictions of a wide variety of behaviors. It comes as no surprise that students studying different subjects differ considerably from one another (e.g., Feldman and Newcombe, 1969, Newcombe and Nelson, 1966) but cognitive bias is worth looking at because it promises to explain the causes of these differences. Biographical studies of scientists (Roe, 1954, McClelland, 1963) and Hudson's work with schoolboys (1968) show closely that personality differences seemingly closely related to cognitive bias

appear quite early in life and thus precede and determine self-selection and classification in later life. Further study of cognitive bias promises therefore a fuller understanding of the development as well as the present state of individual personality, cognitive, and behavior in the school system and society at large.

TABLE I

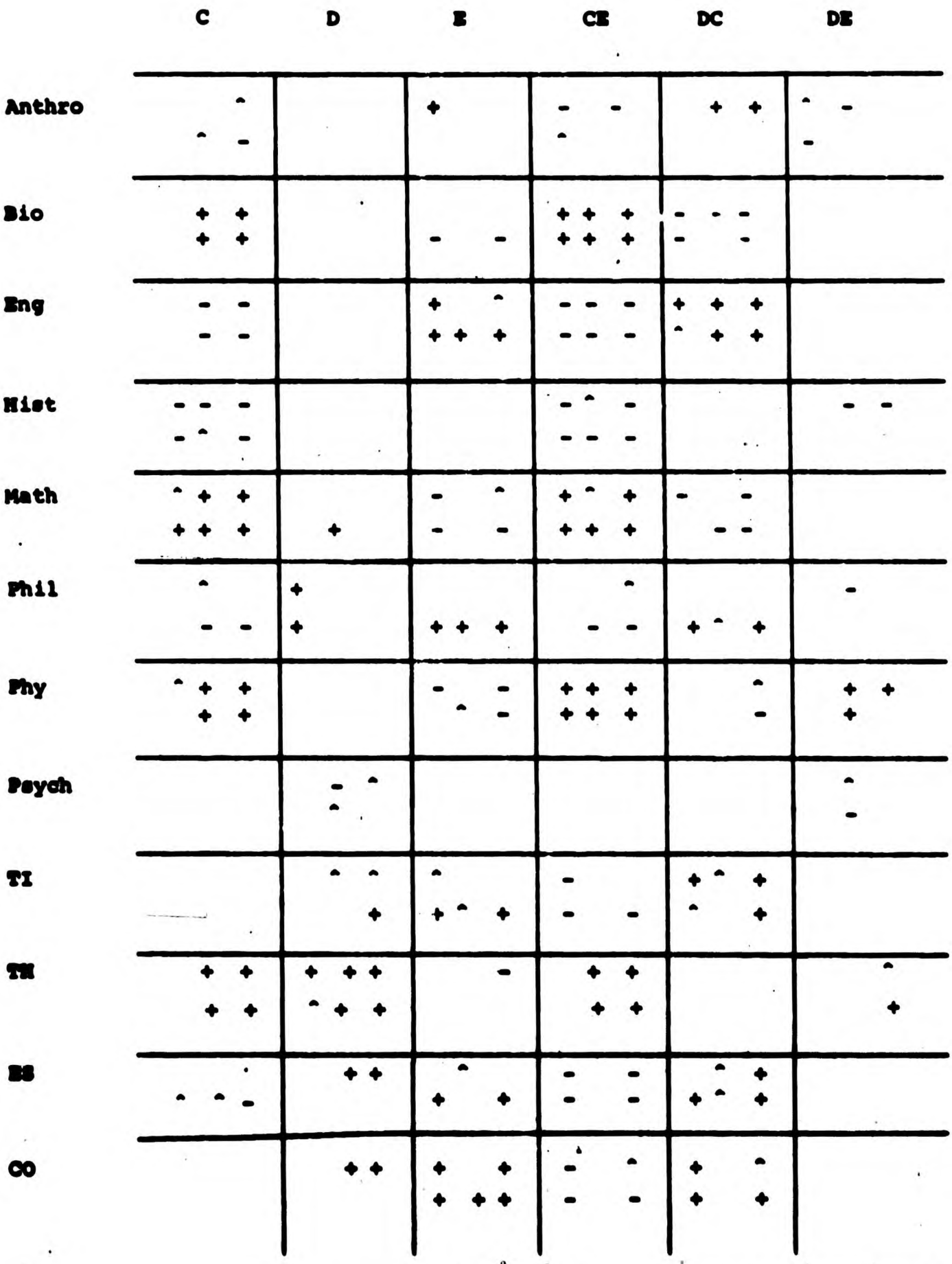
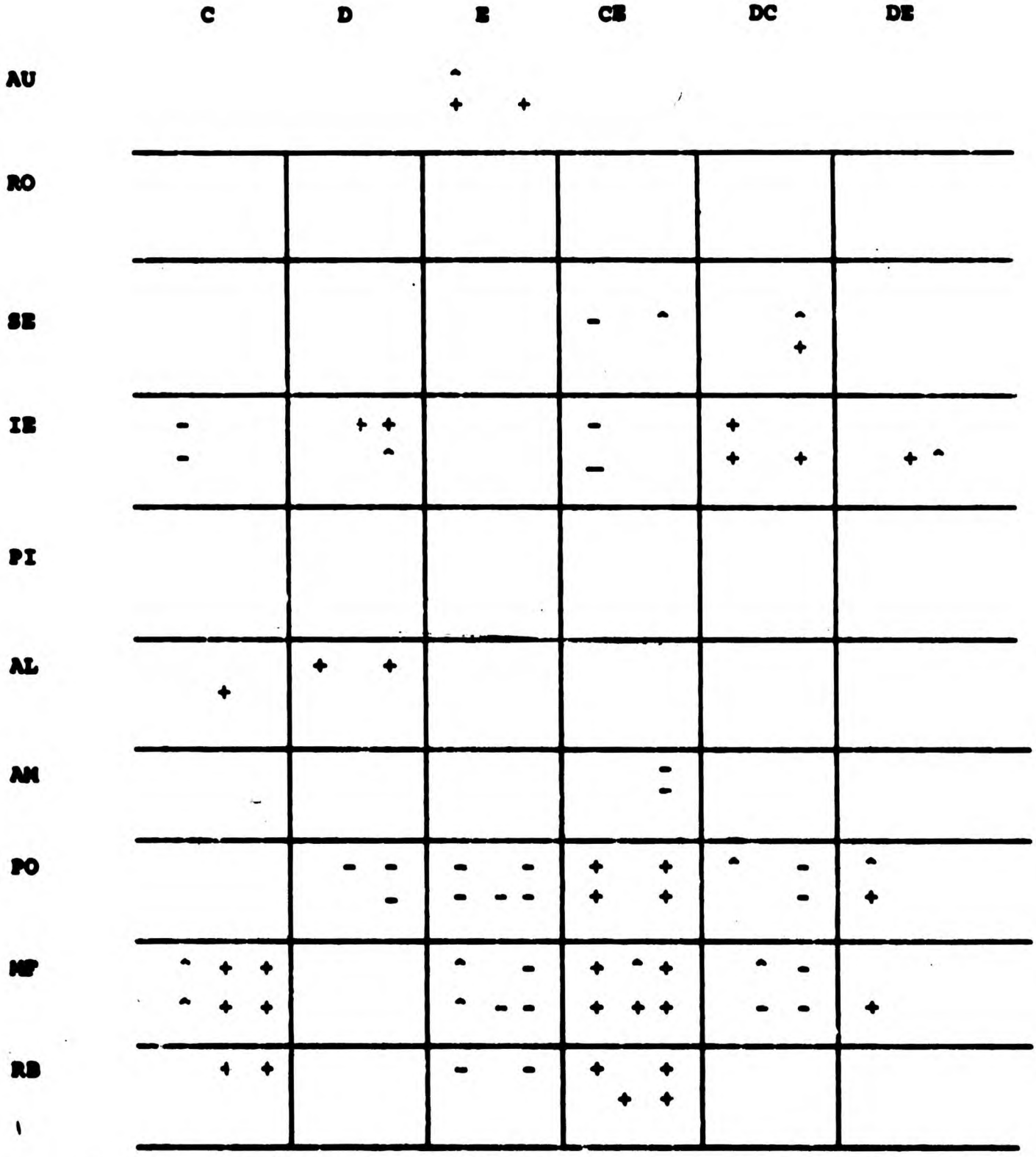


TABLE I (cont'd)



In each cell relations for males appear on the left, for females in the center, and for the total grop on the right; upper file compares all scorers, lower file extreme scorers.

+ indicates positive relation, - indicates inverse relation, ^ indicates significance in appropriate direction (at .05 level) using one-tailed test only.

Abbreviations are written out in full in Table V.

TABLE II

	AU	AM	HIST	ARTHRO	TI	ENG	ES	CO	PHIL	IE	AL	TH	MATH	PHYS	BIO	RE	MU	PO
C			-			-			-	-		+	+	+	+	+	+	
D							+	+	+	+	+	+	+					
E	+	+			+	+	+	+	+				-	-	-	-	-	-
CE		-	-	-	-	-	-	-	-	-		+	+	+	+	+	+	+
DC				+	+	+	+	+	+	+			-		-		-	
DE			-	-									+					

Abbreviations are spelled out in full in Table V.

TABLE III

	AU	AM	HIST	ARTHRO	TI	ENG	ES	CO	PHIL	IE	AL	TH	MATH	PHYS	BIO	RE	MU	PO
C			-	-		-	-		-	-	+	+	+	+	+	+	+	
D					+		+	+	+	+	+	+						
E	+			+	+	+	+	+	+			-	-	-	-	-	-	-
CE		-	-	-	-		-	-	-	-		+	+	+	+	+	+	+
DC				+	+	+	+	+	+	+			-	-	-		-	-
DE			-	-					-	+		+		+			+	+

Abbreviations are spelled out in full in Table V.

TABLE IV

LEARNING METHODS

	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16
C								-		-					-	
D	-										-					+
E								+							-	+
CE								-		-	+		+			-
DC	-							+		+	-					+
DE																
Anthro			-													
Bio				-				-	+				+			-
Eng	-	-					+	+		+	-	-	-		-	
Hist							+	+								
Math	+	+						-		-	+		+			
Phil		-						+		+			-			
Phy		+						-		-			+			
Psych							-									
TI	-	-				+		+		+	-	-	-			
TM					+											
BS	-							+		+	-		-	+		+
CO	-	-			-			+		+	-		-			+
PO	+	+			-			-		-	+		+			-
MP		+	-		+			-		-	+		+			-
RB		+	-		+			-	-	-						

Plus signs indicate positive relationship between expressed liking for learning method and predictor variable, significant at .05 level
Minus signs indicate Inverse Relationship
Abbreviations are written out in full in Table V.

Table V

C	Convergent Score
D	Divergent Score
E	Esthetic Preference Score
CE	Convergent bias Relative to Estheticism
DC	Divergent bias Relative to Convergence
DE	Divergent bias Relative to Estheticism
Anthro	Ranking of Anthropology
Bio	Ranking of Biology
Eng	Ranking of English
Hist	Ranking of History
Math	Ranking of Mathematics
Phil	Ranking of Philosophy
Phy	Ranking of Physics
Psych	Ranking of Psychology
TI	Thinking Introversion
TH	Theoretical Orientation
Es	Estheticism (as defined on OPI)
Co	Complexity
Au	Autonomy
RO	Lack of Conventional Religious Orientation
SE	Social Extroversion
IE	Impulse Expression
PI	Personal Integration
AL	Lack of Expressed Anxiety
AM	Altruism
PO	Practical Orientation
MF	Conventional Masculinity
RB	Response Bias

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