Sponsoring Committee: Professor Philip R. Merrifield, Chairman,
Professor Roscoe C. Brown, Jr., and
Professor John Sullivan

THE STRUCTURE OF INTELLECT MODEL AS A BASIS FOR CROSS CULTURAL ANALYSIS OF TESTS

Herbert L. White

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Education of New York University

1973

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Herbert L. White

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AN ABSTRACT OF

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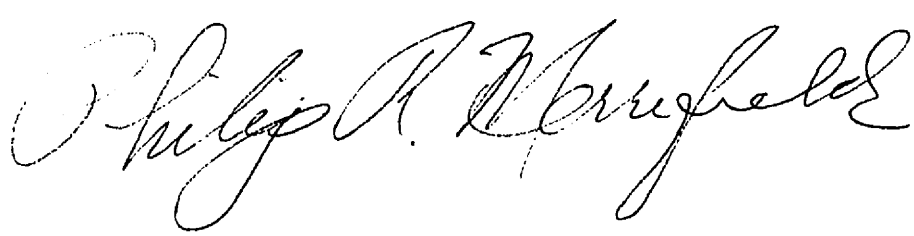

In this study two groups, one Black, one White, were compared on the manner in which a series of relations emerged among 29 variables applying to each group. Twenty-one of the variables were Structure-or-Intellect tests, seven were Civil Service sub-tests, and one was a job performance criterion. The relationships determined were: the factor structure of the 21 Structure-of-Intellect tests in each group; the relations of the Civil Service sub-tests to the factors found; and the relations of Structure-of-Intellect tests, Civil Service tests, and combinations of both, to criterion.

Most research studies in the United States which compare races and groups in level of performance on psychological tests do not deal adequately with the necessity to establish comparative validity, in the sense advocated by Irvine (1969), of the tests used to measure possible differences. This current study examines the concepts of factor validity and comparative validity and their bearing on the problem of test results in different ethnic groups. The study is, in addition, directed toward meeting the needs for: devising job selection tests that will not discriminate unfairly against minority groups; gaining greater understanding of the growth and development of intellectual abilities; investigating the possible role of behavioral and "social intelligence" tests as job selection techniques; and developing a rationale for development of valid tests in Civil Service and other settings.

It was hypothesized that, for the two groups, the relations with the criterion would be different, the addition of information from the SI model would improve prediction, the factor structures would be different, some CS tests would relate differently to factors in each group, and some CS tests would correlate positively with SI factors.

The question as to whether the same factors previously established on an American White population would emerge in the Summer Supervisor population could not be answered definitely. Instead of the traditional SI factors in pure form, there appeared four factors which seemed to be composites of the qualities attributed to the hypothesized SI factors. The configuration of the SI marker tests loading on these factors suggests that further investigation of a torus SI model previously proposed by Varela might be profitably investigated as an alternative to the cubical model now hypothesized by Guilford.

While the four factors emerged in each of the groups analyzed, the comparative validity of SI tests varied between the two groups.

The hypothesis that prediction of criteria from the Civil Service tests would be different in the Urban Corps population than the Summer Supervisor population was supported by findings based on multiple regression techniques.

In both groups, SI tests tended to correlate with the criterion more than did the Civil Service tests.

The addition of information from the SI tests appeared to im-

prove the prediction of criteria appropriate to the Summer Supervisor population, and similarly for the Urban Corps population.

While the factor components of these Civil Service Tests were partially revealed by the techniques used in this study, the Civil Service and the SI tests did not demonstrate comparative validity across the two group's studied. It is suggested that no tests be used to compare different cultural groups unless the tests have in addition to meeting other criteria, equivalent factor structures.

Further study is suggested of the SI model or an adaptation of such a model with respect to cross cultural studies, and better construction of selection tests.

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CHAPTER I

The Problem

The objective of this study was to find possible means of improving certain Civil Service selection tests through utilization of the Structure-of-Intellect Model of J. P. Guilford (1967). Improvement was sought in predictive, construct, and comparative validity[1] by applying factor analysis and multiple regression correlation techniques to a battery of tests given to Black college students and to White college students employed in two different summer programs in City government.

The battery consisted of relevant markers[2] of factors in J. P. Guilford's Structure-of-Intellect Model and of seven sub-tests taken from examinations previously used for entry level in New York City civil service.

Sub-problems

To attain the above purpose it was important to undertake answers to the problems:

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[1]Comparative Validity of a test for two populations is the degree to which the test has the same factor loadings and sources of variance in the two populations.

[2]Marker--a test which has consistently been highly related to a factor and which can help to establish the same factor in future factor analyses.

1) How do tests designed after the Structure-of-Intellect Model compare in predictive capacity with the selected Civil Service tests?

2) Are different predictive equations required for the two ethnic groups?

3) With respect to each group, how will the selected Civil Service sub-tests generally load[3] on Structure-of-Intellect factors or other discernible factors that emerge, and what are the implications of these findings for the improvement of sub-tests? One area of interest, for example, is the relationship of behavioral factors in Guilford's model, sometimes referred to as factors of social intelligence, to those civil service tests designed to predict good judgment in job situations.

4) From the point of view of multiple factor analysis, are the factor structures of test batteries given to the two ethnic groups comparable?

Need for the Study

The Structure-of-Intellect Model as a possible basis for the design of specialized selection and guidance instruments has not been recognized or studied to the degree or depth which it seems to deserve. An analysis of the SI Model tests given to two different cultural groups in relation to industrial

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[3]Load is a term used to describe the correlation of a test with a factor.

selection and training goals is one phase of this study.

More investigation of "comparative validity," a concept introduced by Irvine (1969), is needed. Tests have comparative validity when their factor loadings and measured sources of variance for different cultures and subcultures agree in kind and amount. In any comparison of groups, at least two questions usually must be asked. First, is there a statistically significant difference in the attribute measured? Second, if there is a difference, of what is it a function? If the attribute is one such as height or weight where a really standard measuring instrument can be used, then the first question can be answered with some certainty within the range of statistical theory. But suppose some conceivable instrument measured literary appreciation in cultural group A and measured (in factor analytic terms, "loaded on") reading speed as an independent factor in a less-schooled cultural group B, how do we compare the test scores from the two groups? This would be analogous to the same test loading univocally high on hypothetical factor I in group A and univocally high on hypothetical factor II in group B. In such a case how could scores be compared, much less be used as a basis for asserting significant differences? It follows then, that to compare groups, and to answer the first question as to a statistically significant difference, it is first necessary to demonstrate that the test instrument applied to both groups measures the same definable factors, that it has comparative validity.

Multiple factor analytic studies, specifically those generated by SI factor theory, offer an opportunity to determine whether tests are measuring the same or different things in different groups. In addition, if it is possible to isolate and study particular abilities, then the particular human interactions and experiences which depress or advance the learning of these abilities might be discovered. The SI model is helpful in this respect because it presents the possibility of a molecular understanding of the learning and growth of cognitive and other intellectual skills and permits the possibility of relating differential construct validities of tests to statistical validity, while the undifferentiated, single entity, "G" or general factor approach seems unproductive. Therefore, the current study, employing factor analytic and multiple regression techniques to examine and develop "comparative validity" of tests applied to different cultural groups, contributes to a need for better models for validity research.

Much more needs to be known about devising selective procedures which will not discriminate against minority groups. It would seem, for reasons implicit in the above requirements for validity and in a multiple factor approach, that studies and adaptations of the SI model can contribute to this goal better than Spearman's general factory theory. Spearman's G was one construct employed by Jensen (1969) in arriving at his conclusion that there are significant innate differences in intelligence between Whites and Negroes. Implicit in Jensen's

position, however, is the unsupported assumption of comparative validity of the tests whose scores provide the basis for his conclusions. Shuey's work (1966) also contains this broad assumption of comparative validity. Yet it is reasonable to expect that one methodological requirement in an approach to the problem of measuring racial or group differences should be at least a demonstration of the comparability of the measuring instruments used. While the current investigation is a step in the direction of obtaining better models for investigation of this and other kinds of validity, the provision of such models would not answer other serious questions on method and theory raised by other scientists (Cronbach, 1969; Deutsch, 1969; Hunt, 1969; Hunt, 1972) who suggest that Jensen's conclusions are premature.

More needs to be known about the role of behavioral and "social intelligence" test factors in predicting performance on the job, in social institutions, and about their suitability for a Black population. While testing for these factors in an objective and valid manner obviously presents obstacles, they are intrinsically related to job performance and criterion ratings. The battery of tests in the current study, in an attempt to meet this need, includes SI tests designed to measure behaviorial factors as defined in the SI Model. These have been referred to in the literature as measures of "social intelligence" (Hendricks, Guilford, and Hoepner, 1969).

A rationale around which to construct test items and tests with some probable prior assurance as to the attributes they measure is needed not only by civil service test-makers, but by all test constructors. The SI Model seems to provide such a possible basis. It seems, in addition, to provide a marker structure for the analyzing of tests, criteria, and ability components needed in tasks and jobs. It can become a valuable analytical tool. As the SI Model gains validity, an improved and different approach can be taken to the analysis of some jobs or occupations. The job can be broken down into measurable, separate elements to be rated and included as scores on rating scales and factor analyzed in a battery of marker tests hypothesized to relate. The loadings of job elements on marker factors can then give a better understanding of the abilities best combined to do this job. In this manner training programs can be directed toward the development of specific abilities; or tests compared to those used for analysis can be used for selection in cases where no training programs are feasible. Job analysis, criterion analysis, task analysis, test construction, and training programs can be improved.

Definitions

Structure-of-Intellect Model of J. P. Guilford

The SI Model is a systematic factor classification structure and theory which includes known intellectual factors. It is a multiple-factor theory, hypothesizing the existence of 120

intellectual abilities which are statistically independent of each other. Each ability consists of three connected elements: (1) the application of a particular mental process (e.g., memory) to: (2) information which is couched in a particular kind of content (e.g., symbolic, or semantic) and which is (3) delineated according to a specific format (i.e., units, classes, or relations). An example of an SI factor, then, would be the ability designated as Memory of Symbolic Units. Further elaboration of the model will be found in Chapter II, Rationale Based on Selected Literature.

Structure-of-Intellect Factors Investigated in this Study

Eleven factors from the Structure-of-Intellect Model were chosen for this study on the basis of a logical analysis of the Civil Service sub-tests; accordingly descriptions of these factors are presented in Chapter III, Procedures, pages 26 to 38.

Civil Service Tests or Sub-Tests

Prototypes of seven kinds of Civil Service sub-tests were studied. These were sub-tests given and weighted differently for, several entry level job titles. The characteristics of these tests are described in Chapter III, Procedures, under Analysis and Selection of Tests, pages 26 to 38.

Structure-of-Intellect Tests

Structure-of-Intellect tests are so designated because

they have correlated high enough with Structure-of-Intellect factors in previous studies (Guilford, 1967) to be considered measures of SI factors. A listing and description of the tests used in this study are found in Appendix A. The reasons for their selection are discussed, together with Civil Service tests, in Chapter III, Procedures, under Analysis and Selection of Tests, pages 26 to 38.

City Summer Supervisors

A testing group made up primarily of summer work college students, who, in the general context of American culture have come to consider themselves and have been considered, regardless of degrees of racial mixture, members of that group in America currently referred to as "Negro" or "Black." In this study, the group is designated as "Summer Supervisors."

Urban Corps Students

A test population consisting predominantly of students who in the general context of American culture have come to consider themselves and have been considered, regardless of racial mixture, members of that group referred to as "White." In this study, the group is designated as "Urban Corps."

CHAPTER II

A Rationale Based on Selected Literature

In this chapter, Structure-of-Intellect abilities are described in greater detail and the model is compared with a modification suggested by Jacobo Varela. Then, after discussion of the relationship of factor studies and the concept of comparative validity to ethnic differences in test results, the hypotheses are presented.

Aptitudes in the Structure-of-Intellect Model

In the model, each ability may be described in terms of three major dimensions; each involves a kind of intellectual operation, a kind of intellectual content, and a kind of product. Memory is, for example, an intellectual "operation," and memory of words is an intellectual "operation" on a semantic "content." This particular semantic content, words, may be described as having a "unit" rather than a "relations" character since the ability specified is that of remembering single words and not sentences. Therefore the ability discussed is called, in the Structure-of-Intellect system, memory of semantic units and not memory of semantic relations, which is another ability in the system. In addition to memory, there are four other intellectual operations: cognition,

divergent production, convergent production, and evaluation, a total of five operations. Content is of four kinds: figural, symbolic, semantic (given in the example), and behavioral. The third major descriptive category, products, specifies whether the ability applies to units (as shown in the example of memory of semantic 'units'), classes, relations, systems, transformations, or implications. The combinations of the five operations with the four contents and six products results in 120 separate combinations, each with three SI characteristics. The model is usually portrayed as a 5 x 4 x 6 three dimensional rectangular solid with 120 cells, with an SI ability in each cell. The existence of a large number of such abilities has been supported by factor analytic research sponsored primarily by J. P. Guilford (1967). The remainder of the hypothesized SI abilities have not been established yet.

Each ability in the SI Model is described by a three-letter code system. The letter in the first position refers to an operation, that in the second position to a type of content, and that in the third position refers to a type of product. Meanings of letters are given below:

Operation or Process	Content	Product
C - cognition	F - figural	U - unit
D - divergent production	S - symbolic	C - class
N - convergent production	M - semantic	R - relations
E - evaluation	B - behavioral	S - system
*M - memory		T - transformation
		I - implication

*Not used in study.

A Modification of the Structure-of-Intellect Model

An interesting modification of Guilford's Cubical SI Model has been suggested by Jacobo A. Varela (1969) on the basis that categories in the separate dimensions may be related or continuous rather than separate or independent in the manner that Guilford hypothesizes. He calls attention to a difficulty found in differentiating evaluative abilities from corresponding cognitive abilities and asserts that the "difficulty in devising tests for operations termed 'memory' that are uncontaminated by cognition, is a recognition of the close relationship between those two categories (p. 332)." Varela also feels there is "evidence of continuity from one product dimension to the next (p. 334)." He therefore advocates a torus or "doughnut" representation of interrelationships among the SI factors as an alternative to the rectilinear, boxlike model that Guilford has used. The torus is to a greater extent geometrically isomorphic with Varela's hypothesis of dependent relationships between a) cognition and evaluation, b) cognition and memory, c) evaluation and convergent production, and other operations which show up as adjacent volumes in the torus; while the closed curve in the product dimension, as shown in the torus, would indicate a relationship between a) units and implications, and b) units and classes. The author feels there "is a certain continuity from units to classes, classes to relations, etc., ending

with implications' (p. 334)." He states, however, "There is even further evidence of proximity between units and implications such as sign changes test, which has loadings of .35 on units, or letter 'U' with .55 and .31 loadings in units and implications, respectively (Hoepner et al., 1964) (p. 335)." Having thus advocated a continuous relationship between these products and also a relationship between units and implications despite their apparent disparity, Varela further supports his theory by stating: "Since units enter into classes (units can be considered as one-member classes), there is logic in having classes next to units. The problem of having classes and implications next to units can be solved by curving the product dimension until implications appear above units (p. 335)." Varela accomplishes this change in his torus model. There seem to be implications beyond those specifically raised by Varela's discussion. One is that a logical dependency may exist between categories of the product dimensions; and, if so, this would conflict with the statistical independence of SI categories sought by Guilford, without destroying their conceptual use as categories for classifying abilities. In addition, it is certainly conceivable that dependent or hierarchial relations may apply to categories in one dimension while a structural independence may characterize those in another dimension.

Ethnic Differences on Tests in Factor Studies

Most studies of ethnic group differences in test

performance have, until recently, implicitly accepted the tests as equivalent in factor structure. As pointed out earlier, comparisons by Shuey (1966) and Jensen undoubtedly make this assumption and even firm environmentalists have seldom shown evidence of considering the possibility that two different cultural groups compared on the same test might be using different capacities to attain the same average mark. Not until recently have investigators concentrated to any degree on the concept of differential predictive validity of tests, an idea quite distinct from that of comparative validity in that it emphasizes the correlation between a test and criterion rather than the discovery of sources of variance of tests given to different populations. Its weakness is exemplified by the case in which two populations have the same validity coefficients for a test but the common variance of the test with the criterion is attributable to different factors. Several early studies following the vein of differential validity (Lopez, 1966; Kirkpatrick, Ewen, Barrett, and Katzell, 1968) indicated that race and culture were moderator variables in the relationship between tests and criteria. Recently Boehm (1972) has attempted to refute these findings with an analysis of 13 studies in which performance by Blacks and Whites were compared on both tests and criteria in an employment selection setting. Her conclusion was that "differential validity is a rare occurrence in the data now available although there are a fairly large number of cases of single group validity to support

this finding." She made a distinction between "single group validity" and "differential validity" by describing the first case as one in which the test results of only one of the groups correlate significantly with the criterion while those of the other group do not, and the difference between the two validities is not statistically significant. She defines differential validity as the case in which two validity coefficients, both or one of which differ significantly from zero, also differ significantly from each other. Using these standards, she found 27 cases in which validity coefficients were significant for both Black and White groups, 33 cases in which validity coefficients were valid only for one of the groups and 7 cases defined as significantly different in validity. A study by Campbell (1972), not published in its entirety yet, concludes that aptitude tests which have validity in relation to job performance for one ethnic group generally show validity for other ethnic groups as well. The recent trend, therefore, has been against moderator variables in test performance, against the importance of the concept of differential validity and has been independent of considerations of comparative validity. The Campbell and Boehm studies are in agreement that the predominantly lower test performance by Blacks is projected rather directly into lower criterion performance. While Boehm states that such results "reflect long-standing social practices that have disadvantaged the Negro over a period of generations," the Campbell study is noncommital as to cause. Regardless of

whether one accepts cultural determinants as a crucial basis for racial differences in performance or whether one accepts Jensen's hypothesis of genetic inferiority, these studies attempt to support basically the conclusion that race itself is a valid predictor variable. Accordingly, if left to personnel policies advocating selection by these tests, Blacks and several other minorities would be screened out with the assertion that such screening is "valid." These implications raise serious questions of theory, method, and values in testing. One methodological and theoretical problem certainly seems to apply. Since all such studies do not attempt to demonstrate comparative validity in the Irvine sense, they implicitly accept the investigated tests as equivalent in factor structure for both groups. If any test used, however, does not have an equivalent factor structure in both populations, scores are not comparable on the test for the two groups. This principle also applies to criterion scales.

The concept of comparative validity is rooted in the fact that while abilities found by means of multiple factor analysis are relatively stable across groups, very distinct group differences in culture, education, and experience can lead to different factor structures, and relationships of tests to factors, in such groups. J. P. Guilford (1967) observes that:

> The question often arises about the existence of factors to be found alike in different populations with different cultures. There is a suspicion that the poser of this question may be a strong believer in the hereditary determination of all intellectual abilities and hence expects to find the same factors in all human populations, if they represent genuine abilities. If he did not find this to be the case, he would regard factor analysis to be discredited as a method. Now the result of an ordinary (R) factor analysis by itself tells us nothing about how psychological factors come about in a population; they could be determined entirely by heredity, entirely by environmental influences, or by some combination of both. They could in fact be heavily determined by the culture in which the individuals have lived. In the last-named case, some factors might be evident in one culture and not in another. This fact would in no way discredit factor analysis but would extend its usefulness in comparing cultures (p. 38).

One operation for establishing comparative validity of a group of tests in two different cultural populations is to do multiple factor analyses on the tests in the two populations in order to discover whether the same factors emerge in the two groups, and then to compare factor loadings of the test to see whether loadings are comparable, i.e., to discover whether the sources of variance on the tests are the same within each factor space.

A study by Irvine (1969) illustrates factorial analysis applied to over five thousand African subjects taking psychological tests. The results "suggest that, although tests tend consistently to group themselves in ways explicable in terms of western constructs such as 'g,' v: ed, and n:ed, sources of variance exist unique to the environment of the society in which the tests are administered (p. 20)." In another study, El-Abd (1970) factor analyzed 14 SI marker tests given to two African groups with the result that the seven designated factors emerged in each group with an additional unidentified factor. The tests were given to a group of 104 high school certificate boys and to another group of 155 college undergraduates. El-Abd's objective was to demonstrate that the same kinds of intellectual factors can be found in racially different groups which have been exposed to fairly equivalent educational environments. His results seem to be consistent with those of Irvine (1969) to the extent that on some tests Irvine found little difference in either factor structure or means in those few instances where both African and English subjects were completely exposed to the English educational system. To what extent El-Abd's data is inconsistent with Varela's hypothesis of a torus model, is difficult to assess, since neither the eigenvalue profile nor the standards used to estimate the number of factors are in the published study.

A factor analytic study by Vandenberg (1959) of thirty-five tests on 92 students from China studying at United States Universities compared results from 20 of the tests which were in common with a previous PMA study done by Thurstone on American students. He concluded that "cultural influences play a role in the process leading to the formation of the abilities underlying some of the factors, but that at least several potentialities exist in the adult human neurophysiological organization that are independent of one another and to some extent, independent of the particular kind of cultural, linguistic, and educational background of the subjects tested" (p. 302) " These potentialities he found in both groups tested. Guthrie (1963), in a study on a Philippine group, generalized from his results that "the most frequently identified ability factors can be identified in this population. There are, however, verbal factors specific to the language in which the test is given. Other factors emerge which are possibly the product of instructional methods (p. 102)." He further states ". . . crosscultural studies of the structure of abilities should clarify the role of environmental factors in the structure and development of abilities (p. 103)."

Perhaps the most comprehensive approach to a methodology for crosscultural studies of factored abilities is a discussion by Irvine (1970) in which he sets up a hypothetical correlational matrix containing three sets of tests: (1)

western tests which try to predict to a socially acceptable criterion of individual cognitive worth; (2) western tests which are concerned with hypothetical parameters of intellect, such as the SI tests; (3) tests designed to measure hypothetical parameters of intellect, but developed within the culture studied (specifically, the Mashona people of Central Africa). Irvine asks the question: with what tests will tests in set number three have the most in common if correlations are computed among all tests in the complete matrix of all three types of tests? He states (1970) that "It is possible to suggest that intelligent behavior as measured by tests in school might be very little related to intelligent behavior in the village, but that the underlying processes of memory, evaluation, discrimination, and cognition that Guilford proposes would be common across all behaviors, irrespective of the mode or product of thinking, for one cultural group (p. 28)." He suggests that "For example, it may be possible to manufacture items based on the statements that have been collected from among the Mashona to find out if they constitute memory, cognition, evaluation or discrimination of behavioral classes, implications, systems and relations, and to isolate different kinds of knowledge by a system like Bloom's taxonomy. Factor analysis in this context would be a useful tool (p. 28)."

It is interesting to speculate as to whether Guilford's model will remain rectangular or will be translated more validly

into a form closer to that suggested by Varela. An answer to this question does not seem possible from the data in the studies so far discussed. Whichever model turns out to be more feasible in the end, the cross cultural schema recommended by Irvine still seems to apply. The further analysis of individual tests to assess their comparative validities across cultures would also be of great value.

Appreciation of the relevance of these studies to the current study requires a recognition that testing of Blacks in the United States may well be regarded as a cross cultural activity.

The alienation of American Negroes and several other minorities from the general American culture, and the insulation of the educational system applied to them, strongly suggests that tests used on these minorities should be carefully analyzed for factor content and comparative validity.

Few instances of factor studies on Blacks or other minority group populations, however, can be found in the United States. In one study, Michael (1949) discovered some variance across factor spaces in an analysis done on West Point Army Cadets and a group of Negro Pilot Trainees. Reasoning and numerical factors came out rather clearly in the White population, but were confounded in the Negro population. Guilford (1967, p. 39) has commented that this might indicate that the range of education in the Negro population was so great that

both mathematical and reasoning scores were probably highly correlated. The educational range of the West Point cadet group was narrower, allowing much more of a chance for factors to be independently established. Relative homogeneity of the group reduces the influence of variance from verbal factors and other variables irrelevant to that being measured. The expectation was that the current study would apply to a population with a narrower range of education than the Black candidates studied by Michael. The SI factors themselves, if found, could become the coordinates for comparison of the SI tests in both populations and for analysis of the more complex civil service tests. Each factor is rather specifically defined in a White population and presents a possible target for analysis on a Black population, in contrast to more vaguely defined factors.

We may be able to illustrate one possible kind of cultural variance by setting up an artificial situation in which an individual item, ostensibly designed to measure one factor, measures two different factors in two different populations. Our example is a mathematics-content item expressed in complicated language and grammatical structure. This item might operate in several stages in its encounter with candidates. First, it might separate those who understand the language and those who don't. Those who don't will fail, but on the basis of verbal capacity rather than on mathematical ability. Then, among those who understand the language, the item will

discriminate on the basis of mathematical capacity. For cultural groups where the norm is a high level of verbal competence, the first problem of understanding the language may be insignificant while the second one, finding the mathematical solution, may be critical in dividing the group. The item, therefore, may discriminate on a mathematical ability factor, for, let's say, 98 per cent of the verbally competent population, while the other 2 per cent will not understand the language and will not be measured on that factor. In a more disadvantaged group, even if the first problem of interpretation precluded something less than half of the examinees from attempting the mathematical portion of the problem, the item would appear to have a high loading on the verbal factor.

Therefore, a disproportionately large percentage of a disadvantaged group would not be measured on the factor for which the item was designed. The item might be thought of as an encounter with four subgroups of the population: (a) those who pass and know both the language and mathematics; the mathematics element of the problem is critical in distinguishing them; (b) those who fail because they do not have the verbal capacity but who might have the needed mathematical ability; (c) those who fail because they do not have the verbal capacity and who do not have the mathematical capacity either; (d) those who have the language facility but not the mathematical facility, and who therefore fail. On its designed

factor of mathematical ability, the item therefore establishes with some certainty category (a) but categories (b), (c), and (d) are lumped together and cannot be distinguished simply. Theoretically an item measuring a particular factor should be able to separate a tested population into two groups who are unambiguously different on that factor. On the basis of the item-person interaction, however, the relative proportion of all four categories described may be drastically different in the two test populations with the result that the item may load on different factors for each group. If this condition prevails for items on a test, then the test scores acquired by the two different samples cannot be reasonably compared. The proportions of subjects in the categories described above will influence both correlations and the factor analysis (Merrifield, 1964).

It was felt that this type of differential loading, described hypothetically, might be better understood through analysis of SI tests given to a Black sample, and by an analysis of Civil Service sub-tests within this SI Matrix.

Specific Hypotheses for this Study

Some of the questions raised above might be clarified, it was thought, by exploring the following specific hypotheses:

1) The prediction of criterion from the Civil Service tests will be different in the White sample than in the Black sample.

2) The addition of information from the SI tests will improve the prediction of criteria appropriate to the Black sample and similarly for the White sample.

3) Some Civil Service sub-tests will correlate positively with the SI scales in Guilford's Structure-of-Intellect Model.

4) In general, the factors emerging in the two groups will be dissimilar.

5) If similar factors are found in both groups, the patterns of loadings of SI tests and Civil Service sub-tests will differ from one group to the other.

CHAPTER III

Procedures

This chapter contains two major discussions. The first deals with the logical analysis of the Civil Service tests, leading to the selection of Structure-of-Intellect factors and tests. The second presents an overview of the data-oriented procedures needed to analyze the data collected.

These procedures consisted of three steps: (1) attempting to elicit the SI factors by giving a battery of 21 SI tests to each group and then factor analyzing the tests for each population; (2) testing each group with the Civil Service sub-tests and determining the relationships of sub-tests to the factors thus elicited; and (3) establishing the relationships, in terms of multiple regression equations and multiple correlations, of combinations of these tests with a performance criterion in each group.

Content Analysis and Selection of Tests

This operation consisted of analyzing the content of the Civil Service sub-tests, hypothesizing constructs that the sub-tests might measure, finding SI factors that might relate to these constructs and then selecting the SI tests to function as markers for the factors.

Civil Service Tests

Among the existing Civil Service sub-tests used in this study were measures of situational judgment, reading comprehension, mathematics, vocabulary, non-verbal figural tests, and verbal analogies. These tests were expected to be complex rather than univocal in terms of SI factors. The selection of tests from the SI Model to be included in the study was governed by a content analysis of the Civil Service sub-tests to estimate upon which factors they were likely to load. Some of the potential value of the study comes from this attempt to "explain" the sub-tests in terms of SI factors; if variance on CS items can be explained by SI factors the reproduction, replacement, and modification of items may be facilitated.

Structure-of-Intellect Tests

The selection of SI tests was made broad enough to account for as much variance as possible and restrictive enough to preclude unnecessary testing. The Civil Service tests and their hypothesized relationships to the selected SI tests are discussed below. Samples of the SI tests may be found in the Appendix.

Civil Service Judgment Test

A judgment item presents a problem situation, often involving human relations, and alternative actions in multiple

choice format. The objective of this type of item is to predict good judgment and rational decision making in handling problems on the job. A simple example of a published item is:

> A patrolman is asked by a citizen the location of a candy store which the patrolman knows is under observation for suspected bookmaking activity. In such a situation the patrolman should
>
> *(A) give the proper directions to the citizen
> (B) give proper directions to the citizen but tell him the store is under observation
> (C) state that he does not know the location of the store
> (D) tell the citizen that he may be arrested if the store is raided.
>
> *-- correct answer

Because the answer is usually implicit in the stem and options of the question, a weighing and comparing process is necessarily involved, and the intellectual operation seems to be one of evaluation of semantic classes, EMC in the SI Model. However, additional SI factors or operations might be anticipated. The level of vocabulary used and other attributes of the item-person interaction, such as personality and attitude, probably influence to a considerable extent the factors measured. Some questions are obviously designed to measure judgment

in social situations, others are logic questions couched in social terms; some seem to measure a sense for setting priorities, others a sense of planning or of proper sequence of actions to accomplish a job.

Two additional abilities likely to be related to this Civil Service test area were therefore thought to be "social intelligence" and "ordering ability." The SI factor NMS (the convergent production of semantic systems) has been referred to as an ordering ability (Petersen, et al., 1963), while SI behavioral tests have been suggested as measures of social intelligence (Hendricks, Guilford, Hoepfner, 1969; O'Sullivan, Guilford, DeMille, 1965). Unfortunately, evaluative behavioral factors have not been experimentally established. Behavioral tests in general, however, might relate closely to the Civil Service Judgment Test, since one purpose of the latter is to predict a type of social intelligence, and since behavioral factors are considered aspects of social intelligence. Inspection of items suggested loadings on several SI behavioral factors, but attention was restricted to only a few on the basis of their previously found stability, relevance to cross-cultural study of tests and factors, and the need to discover whether Civil Service item objectives would be met. Markers for CBS (cognition of behavioral systems) and CBT (cognition of behavioral transformations) seemed to measure traits sought by the Civil Service items. Another consideration, however,

was that tests measuring these factors (CBS and CBT) have content for which there seemed to be a high possibility of irrelevance for a Black population although such content has resulted in the emergence of factors CBS and CBT in a White population. Since the tests Missing Pictures (CBS) and Picture Exchange (CBT) consist of social situation problems presented in a series of realistic photographs of White college students and adults in a milieu somewhat removed from that of the average Negro in the United States, we wondered whether they would in fact contribute to formation of a social intelligence factor in the Black group. These considerations, therefore, reduced selection to the following factors as potential correlates of the Civil Service Judgment tests:

CBT - cognition of behavioral transformations--the ability to reinterpret either a gesture, a facial expression, a statement, or a whole social situation so that its behavioral significance is changed.

The marker tests were :

Picture Exchange

Social Translations

CBS - cognition of behavioral systems--the ability to comprehend a social situation or sequence of social events.

The marker tests were:

Missing Pictures

Missing Cartoons

NMS - the Convergent Production of Semantic Systems.

The marker tests were:

Sentence Order

Temporal Order

EMC- Evaluation of Semantic Classes--the ability to evaluate relations between words or ideas.

The marker tests were:

Best Word Class

Class Name Selection

While the study of Hendricks, Guilford and Hoepfner (1969) demonstrates the possible existence of six divergent behavioral abilities, marker tests for these factors were not used because the judgment test seemed to measure cognition, evaluation, and an ordering ability relative to convergent production.

Civil Service Vocabulary Test

In this test, the examinee is presented with a word and multiple-choice alternatives from which he is to select the one nearest to the meaning of the given word. Sometimes the test word is embedded in a content. The SI Factor directly related to this test seemed to be:

CMU - the Cognition of Semantic Units, an awareness of the meanings of single words (an aspect of verbal comprehension).

The SI marker test was:

Word Completion

It was also planned to use the Guilford Zimmerman Aptitude Survey, Part I, Verbal Comprehension, but the testing time could not be made available. Use of the targeting technique of factor analysis was expected, however, to compensate for this lack of additional marker tests.

Civil Service Reading Comprehension

The format of reading comprehension questions on almost all New York City Civil Service examinations is similar to that typically found in standardized tests. A multiple-choice question presents several statements, one of which may be derived from a given reading passage while others cannot. The factors measured here might range widely over the thirty semantic factors, and might include some symbolic factors. Many abilities

are probably required and a complete factor analysis of the task of reading would be justified in another study. The twelve memory and divergent factors were eliminated but not the convergent factors because reading is an active, ordering, and translation process.

Since the confounding of numerical and reasoning abilities was previously found in a Black population (Michael, 1949) and no subsequent study has clarified this finding, semantic factors found to be significant for mathematical abilities (Petersen, et al., 1963) were included. That study, Petersen, et al., included relatively few minority children. The process of cognition of semantic units, classes, relations, and implications all appeared, a priori, to be so involved in the process of reading that attention was focused more on those which were more doubtful. It was thought that there might be fewer factors found, and higher loadings on CMU (cognition of semantic units), for minority group members since certain vocabulary skills would be essential, and any lack of these skills might prevent the possibility of other skills being brought to bear on the task. At least one previous analysis (Michael, 1949) has shown confounded in a Black group several factors which were rather clearly displayed in a White group.

A multiple-correlation study (Cohn, 1968) has shown reading comprehension to be positively correlated with what was regarded as a field-independence-dependence test, and with verbal and non-verbal intelligence tests. Score on the

Sangren-Woodey Reading Test was predictable from scores on the Lorge-Thorndike Intelligence Test (V and NV) and Jackson's short form of the Embedded Figures Test.

The finding most relevant to this study was that, after partialling out the pairs of sex and verbal I.Q., of sex and non verbal I.Q., and of sex and total I.Q., EFT was correlated at an .05 level of significance (from -.21 to -.24) with total score on reading comprehension. Cohn concluded that these results indicated a positive relationship with Field independence and a negative relationship with Field dependence.

Another implication of these findings, since the embedded figures test is so similar to tests measuring NFT, is simply that the factor NFT (convergent production of figural transformations) is related to reading comprehension, and at least, that transformation is involved.

A factor-analytic technique using relevant marker tests should contribute a great deal to answering the question of what is involved in a reading comprehension task. While it was not possible in this study to explore this question to the depth desirable, Petersen, et al. (1963) discovered that the Iowa Reading Comprehension Test, in a factor analytic study designed primarily to investigate mathematical ability, loaded high on CMU, NMS and EMR, indicating the relevance of ordering and evaluative factors.

The process of successfully comparing and selecting the correct options derived from a reading passage should involve evaluations and, as mentioned previously, the recognition of transformations.

Tests and factors for the reading test in the current study were narrowed down to: NMS, EMC, CMU, CMS, and CMT. The first three factors have already been described in relation to the judgment sub-test. The factors with their marker tests are as follows:

NMS, EMC, CMU--previously discussed.

CMS - Cognition of Semantic Systems (general reasoning); an awareness of interrelatedness among components.

The SI marker tests were:

Necessary Arithmetic Operations

Necessary Facts

CMT - Cognition of Semantic Transformations (penetrations)--awareness of changes, neither immediate nor obvious, in meanings.

The SI marker test was:

Similarities

Civil Service Non-Verbal Figural Tests

Both non-verbal and figural tests are given in Civil

Service tests. Civil Service figural tests seem most related to CFR (Cognition of Figural Relations), and in format are not too different from Figural Analogy tests in the SI model. Since the CS and SI tests are so similar,no SI marker test was included. However, one conjecture was that many sophisticated candidates use semantic or verbal abilities to solve this type of problem. The question then arose as to whether a significant relation of nonverbal testswith semantic factors such as CMS, NMS, and EMC would be found in either group. These factors and their markers were included, as noted previously, because of their relevance to other CS tests. For this test the assumed major SI factor, although not focused on for study, was:

CFR - the cognition of figural relations: the awareness of relationships among figural components. There was no SI marker test for CFR.

Civil Service Verbal Analogies Test

Verbal analogies in the Civil Service test appeared to be similar to those analogies used to measure EMR (Evaluation of Semantics Relations). An important difference, however, was that different relations between pairs of words were used. The following examples demonstrate the difference:

Civil Service sample questions:

1. Whisper is to shout as brook is to D

A) stream, B) pool, C) fish, D) river.

2. Athlete is to stadium as historian is to D

A) seclusion, B) history, C) book, D) library.

Verbal Analogies I sample question:

3. Athlete is to historian as stadium is to D

A) seclusion, B) history, C) book, D) library.

Using the paradigm, A:B as C: ? , for each Civil Service sample, we notice that the A:B relation criterial to solving the problem, is rather easily estimated without inspecting the remainder of the problem. Answering correctly depends 1) on knowledge which permits the detection of the relationship between A and B and the actual detection itself, 2) on then using this relation as a basis for selection of an option that will repeat the relationship, but with C as the first component of the second pair in the analogy.

For the SI Verbal Analogies I test item, the relation between A and B (between Athlete and Historian) in Sample 3 is not so easily established independently of inspection and evaluation of "C" and the available choices. Different abilities might therefore be involved.

The intent, therefore, was to determine whether this difference in item approach would cause the separation of the Civil Service test from SI tests in either or both populations. The factor thought to relate best to the Civil Service verbal analogies sub-test was:

EMR - evaluation of semantic relations (logical evaluation)--deciding on the appropriateness of a relationship on the basis of logical consistency.

The marker test was:

Verbal Analogies I

Civil Service Mathematics Test

The particular Civil Service mathematics items used in this study seemed to involve mainly problem solving abilities, seemed to be classifiable as power rather than speed items, and did not stress computational ability.

Petersen, et al. (1963) found six factors, Memory of Symbolic Implications (MSI), Convergent Production of Semantic Systems (NMS), Evaluation of Symbolic Relations (ESR), Evaluation of Semantic Relations (EMR), Convergent Production of Symbolic Systems (NSS), and Divergent Production of Symbolic Relations (DSR) to be strongly indicated as relevant to general mathematical ability. In their findings, symbolic and semantic factors each seemed important while cognitive abilities did not seem to be as important as hypothesized. Algebraic ability seemed to involve the additional components of Cognition and Convergent production of symbolic relations. Since the Cognition of Symbolic Systems (CSS) appeared to have such a logical validity, the authors were surprised to find no demonstrated relevance for CSS scores. Because of this apparent logical validity it was decided to test again in this study the

relationship of mathematics to the CSS factor by attempting to firmly establish it with several marker tests. Therefore, there were included in this study factors which seemed related generally to mathematical ability: EMR, CMS, and NMS. The factors thought to relate best to the mathematics CS test were:

EMR, CMS, NMS - previously discussed in relation to other sub-test areas.

NSS -the Convergent Production of Symbolic Systems.

CSS -Cognition of Symbolic Systems.

CSC -Cognition of Symbolic Classes.

Civil Service Test of Sociological Knowledge

For want of a better name, this was called a test of sociological knowledge and consisted of questions on community and urban problems. While it was thought that attitudinal tests might correlate highly with this test, the concentration was on SI factors. Factors on which this test might load high were included in the design for studying other tests in this study. They were CMU, CMS, NMS, and EMC. A thought to be explored was the possibility that high scores on this test might be partly a function of intensive previous use of verbal and semantic abilities.

Data - Analytic Procedures

A principal-axis factor analysis and targeted orthogonal rotation was done on the SI tests involved in order to

determine their factors. The objective of targeted rotation was to maximize possible loadings on the SI factors and to compensate for any insufficiency of marker tests for factors. The hypothesized target matrix of factor loadings had the square roots of the communalities of marker tests as target loadings on the respective hypothesized factors and had zero loadings on all other factors. After the actual factor pattern was obtained from the targeted rotation the Civil Service sub-tests were extended into the factor space determined solely by the SI tests, in order to establish the relationships between the Civil Service tests and the SI Factors obtained (Cliff, 1966).

Orthogonal rotation was employed because the research establishing SI factors has been based on orthogonal rotation. Comparisons or interpretations in light of previous studies would tend to be more intelligible through the use of orthogonal factors.

To decide the significance of a loading on a particular factor, it was recognized that the standard error of a factor loading depends upon the size of the tested group and the number of variables; the rule used was to take the reciprocal of the square root of the quantity resulting from the test group size minus the number of variables minus one, in order to provide a conservative estimate. A factor analysis was also done on scores pooled from both groups, which were first standardized

within each population, in order to base analysis on a larger population. The purpose of standardization of scores was to eliminate covariance attributable to differences in group means. The means were established at 50 and the standard deviations at 10.

The sample was drawn from Black college students employed to supervise Neighborhood Youth Corps Trainees, and from White college work-study students assigned to work with the New York City Government. It was expected that 150 of each would be tested on the selected tests. Selection and composition of groups were affected, however, by the response of cooperating agencies; and the resulting sample of Summer Supervisors upon which the analysis was done was ninety; that of the Urban Corps was fifty-one. Tests were given under field conditions in the sense that, while situations, time and other variables were standardized, the groups and individuals were tested on a "catch-as-catch-can" basis. Recognizing the limitations imposed by the size of the groups, we proceeded with the testing and analysis as described.

The selection of criterion variables for job performance in each group was affected by several factors. The two groups were assigned, as a matter of necessity, to duty complexes which differed, and there were differing ranges of duties within each complex. The existing job-performance rating scales of each work program were used in accord with program requirements since these variables were not subject to

manipulation by the experimenter. Different supervisors rated individuals in each group, since there could be no rotation between or within groups with respect to assignments. Among the existing scale traits considered most predictable were those of problem-solving ability, accuracy and completeness of work, planning and assigning of work, ability to relate to others, and judgment. These ratings were based on a period of two months of summer employment.

To investigate the possible improvement in prediction, the correlations between the criterion scores and three predictor combinations were examined: Civil Service tests alone; Civil Service tests and SI tests; and SI tests alone. The comparisons were made for three groups: the Summer Supervisors, the Urban Corps students, and a combined group of Summer Supervisors and Urban Corps students.

The study, therefore, included several steps from which we thought understanding might come. The targeted rotation would test for each group whether the SI Model is appropriate. The factor extension would permit analysis of the Civil Service tests in a theoretical framework, and the correlations with criteria would explore validity relationships.

CHAPTER IV

Analysis and Interpretation of Data

This chapter is devoted to discussing and interpreting in more depth the data-analytic procedures and results. It centers on three topics: (1) the derivation of the factor structure and factor components of tests; (2) the zero order correlations of tests with criterion; and (3) the degree to which tests combine validly as multiple predictors to criterion.

Factor Analytic Results

First, inter-correlations were computed for each of three populations, e.g., 90 Summer Supervisors, 51 Urban Corps students, and 146 Summer Supervisors and Urban Corps students together in one group. The correlations for each population are shown in Appendix B tables B1, B2, B3.

The scores used in the combined population were standardized within each population, giving each the same mean (50) and standard deviation (10). Next a principal factor analysis was done on 21 SI model tests for each of the populations. This resulted in the unrotated factor profiles shown in Appendix tables B4, B5, and B6.

Inspection of the Eigenvalue profile indicated that a hypothesis for the existence of eleven factors was probably

unsubstantiated. The shape of the curves of the Eigenvalues for the three groups changes abruptly at a point between four and six factors. For inspection purposes, a targeted rotation to a hypothesis of eleven factors was done anyway; the method used was an orthogonal rotation to a target matrix, based on the method described by Cliff (1966). The targets and results are shown in Appendix tables B7 and B8. The fit for each sample was rather good, by inspection, but could not be borne out statistically because the hypothesis of eleven factors could not be supported. Before proceeding to the reduction of the number of factors to be considered, a rotation was done to a random target for the Summer Supervisor population. Random selection of the target loadings on SI factors resulted in a target with completely zero loadings on two factors, or, in effect, a target of nine factors. The target and results are shown in Appendix tables B9 and B10. The fitting of the random target was close enough to indicate that chance variance in the factor analysis could, in itself, produce the close fit that had been found over eleven factors. However, certain tests still seemed to hang together quite well. In a rotation producing the nine clusters shown in Appendix table B10, five tests of the twenty-one tests went off target. Examination of these show that a CSS test (Circle Reasoning) shifted from randomly hypothesized cluster No. 1 to cluster No. 6 in such a way as to turn No. 1 into a CBX cluster and No. 6 into a CSS cluster. Five clusters

can be meaningfully designated in terms of relationship to SI factors as follows:

1. CBX
4. CMU
5. Symbolic factor
6. CSS
8. CMS related factor

The remaining four clusters did not seem to be internally coherent in the SI context.

In the subsequent analysis, several hypotheses regarding factor structure were then examined.

Factor Hypothesis No. 1

First, it was hypothesized that seven orthogonal factors exist, and that these were related to the SI factors in such a way as to be symbolically described as CMS, CMS, EMX,CXS, CBX, NMX, and NSX, expressions in which the X indicates that the factor is undifferentiated with respect to product categories. Thus CMX would be a cognitive semantic factor, EMX an evaluative semantic factor, NMX a convergent semantic factor, NSX a convergent symbolic factor, while CMS would be the SI factor itself, cognition of semantic symbols. With the exception of Systems in CMS, the product dimension of the SI model was, in effect, eliminated; marker tests were hypothesized to relate to factors labeled according to the corresponding operation and content designation of the marker; in the case of cognition semantic factors, the marker tests for CMU and CMT were predicted to fall on CMX while those for CMS would fall on CMS.

Factor Hypothesis No. 2

It was hypothesized that six orthogonal factors exist, described as CMX, EMX, CSX, CBX, NMX, and NSX. In this case the SI model is, in effect, reduced from a cubical shape to a plane. The "product" dimension is eliminated or predicted to be not relevant in this population.

Factor Hypothesis No. 3

Four factors exist: XSS, a symbolic thinking composite; XMX, a semantic thinking composite; CBX, social intelligence; and EMX, an evaluative semantic thinking composite. It was expected that, in general, the symbolic tests would cluster and load on XSS, the semantic and ordering tests on XMX, the behavioral tests on CBX, and the vocabulary and evaluative tests would load on EMX. The tests would load as follows:

XSS

2 - Word Changes (NSS)
3 - Number Series (CSS)
5 - Circle Reasoning (CSS)
8 - Letter Series (CSS)
25 - Letter Triangle (CSS)
28 - Best Number Pairs (CSC)
29 - Operations Sequence (NSS)

XMX

6 - Similarities (CMT)
7 - Temporal Order (NMS)
9 - Necessary Facts (CMS)
26 - Necessary Arithmetic Operations
27 - Problem Solving (CMS)

CBX

10 - Missing Cartoons (CBS)
11 - Missing Pictures (CBS)
12 - Picture Exchange (CBT)
13 - Social Translation (CBT)

EMX

1 - Sentence Order (NMS)
4 - Word Completion (CMU)
23 - Best Word Class (EMC)
30 - Verbal Analogies (EMR)

Targets for Factor Hypothesis 1 are shown in Appendix tables B11, B12, and B13, for Summer Supervisors, Urban Corps and combined group. Targets and results for Factor Hypothesis 2 are shown in Appendix tables B14, B15, and B16. Targets for hypothesis 3 are shown in tables 1, 2, and 3, below.

To examine these factor hypotheses, the principal factor loadings were, for each hypothesis, rotated to the appropriate hypothetical factor patterns, which, for each test, consisted of zero loadings on all factors other than target factors, and of target factor loadings each equal to the square root of the communality of the test designated for that target factor. The objective was to find that factor pattern which maximally approached the target pattern for each hypothesis.

The actual factor patterns, after targeted rotation for each hypothesis in a group, are shown in Appendix tables B 17, B18, and B19, for seven factors; tables B20, B21, and B22, for six factors; and results for four factors are shown in tables 4, 5, and 6.

Discussion of Four Factor Finding and Factor Extension

Of the three possibilities, the "four factor" solution seemed most justified by both the Eigenvalue relationships and the structure of the factor patterns in the separate populations. As shown in table 7, in each group some tests fell off target.

TABLE 1

Target Hypothesis III: Summer Supervisors

SI TESTS	XSS	XMX	CBX	EMX
1-Sentence Order	.0	.0	.0	.52
2-Word Changes	.65	.0	.0	.0
3-Number Series	.78	.0	.0	.0
4-Word Completion	.0	.0	.0	.85
5-Circle Reasoning	.61	.0	.0	.0
6-Similarities	.0	.65	.0	.0
7-Temporal Order	.0	.82	.0	.0
8-Letter Series	.72	.0	.0	.0
9-Necessary Facts	.0	.80	.0	.0
10-Missing Cartoons	.0	.0	.70	.0
11-Missing Pictures	.0	.0	.83	.0
12-Picture Exchange	.0	.0	.71	.0
13-Social Translation	.0	.0	.81	.0
23-Best Word Class	.0	.0	.0	.71
24-Class Name Select.	.0	.0	.0	.70
25-Letter Triangle	.79	.0	.0	.0
26-Nec. Arith. Oper.	.0	.79	.0	.0
27-Problem Solving	.0	.78	.0	.0
28-Best Number Pairs	.74	.0	.0	.0
29-Operations Sequence	.80	.0	.0	.0
30-SI Verbal Analogies	.0	.0	.0	.67

TABLE 2

Target Hypothesis III: Urban Corps

SI TESTS	XSS	XMX	CBX	EMX
1-Sentence Order	.0	.0	.0	.81
2-Word Changes	.74	.0	.0	.0
3-Number Series	.84	.0	.0	.0
4-Word Completion	.0	.0	.0	.74
5-Circle Reasoning	.75	.0	.0	.0
6-Similarities	.0	.66	.0	.0
7-Temporal Order	.0	.73	.0	.0
8-Letter Series	.87	.0	.0	.0
9-Necessary Facts	.0	.74	.0	.0
10-Missing Cartoons	.0	.0	.87	.0
11-Missing Pictures	.0	.0	.77	.0
12-Picture Exchange	.0	.0	.76	.0
13-Social Translation	.0	.0	.72	.0
23-Best Word Class	.0	.0	.0	.73
24-Class Name Select.	.0	.0	.0	.79
25-Letter Triangle	.80	.0	.0	.0
26-Nec. Arith. Oper.	.0	.84	.0	.0
27-Problem Solving	.0	.89	.0	.0
28-Best Number Pairs	.78	.0	.0	.0
29-Operations Sequence	.83	.0	.0	.0
30-SI Verbal Analogies	.0	.0	.0	.79

TABLE 3

Target Hypothesis III: Combined Group

SI TESTS	XSS	XMX	CBX	EMX
1-Sentence Order	.0	.0	.0	.57
2-Word Changes	.58	.0	.0	.0
3-Number Series	.74	.0	.0	.0
4-Word Completion	.0	.0	.0	.77
5-Circle Reasoning	.55	.0	.0	.0
6-Similarities	.0	.63	.0	.0
7-Temporal Order	.0	.76	.0	.0
8-Letter Series	.73	.0	.0	.0
9-Necessary Facts	.0	.71	.0	.0
10-Missing Cartoons	.0	.0	.73	.0
11-Missing Pictures	.0	.0	.74	.0
12-Picture Exchange	.0	.0	.59	.0
13-Social Translation	.0	.0	.73	.0
23-Best Word Class	.0	.0	.0	.63
24-Class Name Select.	.0	.0	.0	.60
25-Letter Triangle	.75	.0	.0	.0
26-Nec.Arith. Oper.	.0	.76	.0	.0
27-Problem Solving	.0	.78	.0	.0
28-Best Number Pairs	.66	.0	.0	.0
29-Operations Sequence	.76	.0	.0	.0
30-SI Verbal Analogies	.0	.0	.0	.70

TABLE 4

Factor Loadings
Hypothesis III: Summer Supervisors

SI TESTS	XSS	XMX	CBX	EMX
1-Sentence Order	.26	.15	.09	.14
2-Word Changes	.27	.32	.06	.12
3-Number Series	.48	.44	.11	.02
4-Word Completion	.04	.43	.22	.53
5-Circle Reasoning	.38	.10	.09	.17
6-Similarities	.04	.46	.13	.16
7-Temporal Order	.14	.67	.27	.21
8-Letter Series	.42	.34	.28	.19
9-Necessary Facts	.21	.63	.03	.25
10-Missing Cartoons	.14	.35	.48	.13
11-Missing Pictures	.26	.08	.71	.17
12-Picture Exchange	.28	.05	.48	.03
13-Social Translation	.26	.16	.63	.26
23-Best Word Class	.26	.11	.03	.38
24-Class Name Select.	.28	.11	.10	.50
25-Letter Triangle	.66	.25	.00	.15
26-Nec. Arith. Oper.	.45	.30	.05	.19
27-Problem Solving	.56	.23	.20	.18
28-Best Number Pairs	.55	.01	.22	.07
29-Operations Sequence	.58	.16	.21	.20
30-SI Verbal Analogies	.18	.25	.21	.40

TABLE 5

Factor Loadings
Hypothesis III: Urban Corps

SI TESTS	XSS	XMX	CBX	EMX
1-Sentence Order	.29	.13	.30	.66
2-Word Changes	.49	.17	.20	.26
3-Number Series	.54	.57	.16	.19
4-Word Completion	.26	.25	.00	.62
5-Circle Reasoning	.40	.32	.34	.03
6-Similarities	.13	.31	.12	.35
7-Temporal Order	.49	.35	.14	.31
8-Letter Series	.66	.30	.37	.18
9-Necessary Facts	.62	.32	.04	.10
10-Missing Cartoons	.39	.05	.68	.35
11-Missing Pictures	.08	.12	.66	.22
12-Picture Exchange	.06	.51	.44	.23
13-Social Translation	.27	.21	.40	.30
23-Best Word Class	.10	.04	.18	.58
24-Class Name Select.	.06	.38	.19	.46
25-Letter Triangle	.70	.33	.17	.01
26-Nec. Arith. Oper.	.52	.58	.13	.23
27-Problem Solving	.53	.63	.20	.04
28-Best Number Pairs	.68	.18	.05	.30
29-Operations Sequence	.66	.37	.05	.08
30-SI Verbal Analogies	.38	.18	.43	.52

TABLE 6

Factor Loadings
Hypothesis III: Combined Group

SI TESTS	XSS	XMX	CBX	EMX
1-Sentence Order	.20	.28	.24	.31
2-Word Changes	.17	.47	.20	.17
3-Number Series	.53	.41	.01	.12
4-Word Completion	.14	.39	.14	.52
5-Circle Reasoning	.34	.07	.21	.19
6-Similarities	.05	.50	.00	.28
7-Temporal Order	.26	.59	.23	.24
8-Letter Series	.44	.41	.35	.20
9-Necessary Facts	.34	.54	.02	.20
10-Missing Cartoons	.23	.29	.54	.24
11-Missing Pictures	.18	.01	.69	.16
12-Picture Exchange	.32	.09	.36	.08
13-Social Translation	.29	.11	.51	.38
23-Best Word Class	.27	.03	.04	.50
24-Class Name Select.	.28	.24	.18	.37
25-Letter Triangle	.63	.33	.06	.10
26-Nec. Arith. Oper.	.57	.29	.07	.24
27-Problem Solving	.67	.22	.14	.13
28-Best Number Pairs	.60	.05	.10	.16
29-Operations Sequence	.66	.22	.13	.08
30-SI Verbal Analogies	.23	.30	.34	.41

TABLE 7

Tests Falling Off Target in Summer Supervisor and Urban Corps Groups

	Summer Supervisors[1]		Urban Corps[1]		
	Loading on Target Factor	Other[a] Factor Loading	Loading on Target Factor	Other[a] Factor Loading	Off Target For:
1. Sentence Order (NMS)(EMX)	.14 (EMX)	.26 (XSS)	.66 (EMX)	.29 (XSS)	Summer Supervisors
2. Word Changes (NSS)(XSS)	.27 (XSS)	.32 (XMX)	.49 (XSS)	.17 (XMX)	Summer Supervisors
26. Necessary Arithmetic Operations (CMS)	.30 (XMX)	.45 (XSS)	.58 (XMX)	.52 (XSS)	Summer Supervisors
27. Problem Solving (CMS)(XMX)	.23 (XMX)	.56 (XSS)	.63 (XMX)	.53 (XSS)	Summer Supervisors
3. Number Series (CSS)(XSS)	.48 (XSS)	.44 (XMX)	.54 (XSS)	.57 (XMX)	Urban Corps
6. Similartties (CMT)(XMX)	.46 (XMX)	.16 (EMX)	.31 (XMX)	.35 (EMX)	Urban Corps
7. Temporal Order (NMS)(XMX)	.67 (XMX)	.21 (XSS)	.35 (XMX)	.49 (XSS)	Urban Corps
9. Necessary Facts (CMS)(XMX)	.63 (XMX)	.21 (XSS)	.32 (XMX)	.62 (XSS)	Urban Corps
12. Picture Exchange (CBX)(CBX)	.48 (CBX)	.05 (XMX)	.44 (CBX)	.51 (XMX)	Urban Corps

1. See Table 4 for Summer Supervisors, Table 5 for Urban Corps.

a. In the upper right and lower left quadrants the highest loadings shown are on the targeted factors; loading on the other factor are for comparison.

The overall structure, however, seemed reasonable in each group considered separately.

Some differences between the groups are implied in that different tests fell off target. Table 7 and tables 4 and 5 facilitate comparison of the off-target tests. Here we see that in the Summer Supervisor group, Necessary Arithmetic Operations and Problem Solving (CMS markers) deviated from the expected XMX and loaded highest on XSS. In the Urban Corps group, the same two tests loaded highest on the target XMX and also projected high on XSS. The tentative implication is that Summer Supervisors are differentiated mainly on symbolic systemic thinking while Urban Corps students are differentiated mainly on a semantic composite thinking with less emphasis on XSS. Still, for both populations, the main common variance consists of factors XSS and XMX. In the Urban Corps group, two tests, Temporal Order (7) and Necessary Facts (9), targeted for XMX, fell instead on XSS, keeping some variance on XMX; while in the Summer Supervisor group the tests hit the targets. Word Changes (2), targeted for XSS fell on XMX in the Summer Supervisor population while hitting its target in the Urban Corps data. Word Changes did, however, have its next highest loading on XSS in the Summer Supervisor population. For Summer Supervisors, the Guttman communality of Word Changes is much less in this factor analysis than in that of Urban Corps subjects. For Summer Supervisors, the Guttman communality of

Word Changes (2) is .36, while for Urban Corps the Guttman Communality is .52.

Those Summer Supervisors who do well are differentiated from those who do poorly on Word Changes by the factor XMX, while the Urban Corps people are differentiated on the same test by factors XSS. Sentence Order (1), which is hypothesized as an NMS marker test in the SI model and which was directed toward an EMX target in the four factor rotation, shows distinct differences for the two groups. It loads .66 on the target EMX in the Urban Corps population, but misses the target and loads only .14 on EMX in the Summer Supervisor group, consistent with the great contrast of communalities of Sentence Order in the Summer Supervisors and Urban Corps groups: .16 in the Summer Supervisors; .62 in the Urban Corps. Picture Exchange (12) also operates uniquely in one group since it loads highest on XMX in the Urban Corps group, maintaining, however, a significant loading on CBX. Similarities (6) is univocal in the Summer Supervisor group on XMX but has two main components in the Urban Corps group, loading on two semantic factors in that group, EMX and XMX.

In general, there seems to be a differential response in the two groups in the capacities used to solve the tasks in tests hypothesized to be markers for XMX and XSS. In the Urban Corps groups two tests targeted for XMX fell instead on XSS, while one targeted for the XSS fell on XMX. In the Summer Supervisor group three tests completely different than those in

the Urban Corps group exchanged factors in a similar way. Two tests targeted for XMX slipped over instead to XSS, and one test targeted for XSS went to XMX. Of the twenty-one tests in the battery, a total of five went off target in the Urban Corps group, while a total of four, which were distinctly different from those in the Urban Corps group, went off target in the Summer Supervisor group. Therefore, four similar factors are reasonably demonstrated to exist in each group on the basis of a large number of tests falling on target, but the nine tests which did not go on target shown in table 7, cannot with assurance be said to measure the same things in the two groups.

The targeted rotation of the factor analysis of the merged samples (based on standard scores) resulted in a rather close fit, with only three tests off target. Two CMS marker tests, Necessary Arithmetic Operations (26) and Problem Solving (27) shift from XMX target to XSS. Word Changes, in contrast, leaves its XSS target for a loading of .47 on XMX which differs greatly with its loading of .32 on XMX in the Summer Supervisor group and with loadings of .17 on XMX and .49 on XSS in the Urban Corps group. Sentence Order (1), while having its highest loading (.31) on EMX, spreads its variance rather evenly over all four factors.

The four factor description of the battery of SI tests as a whole functioned better to explain the test behavior of

Urban Corps students; in that 56 per cent of total variance was accounted for by the analysis, in contrast to 42 per cent of variance for Summer Supervisors. The degree to which each factor contributed to the total sum of common factor variance is shown in table 8. Each entry is equivalent to the ratio of the sum of squared loadings on each factor to the total sum of squared factor loadings on all four factors. The rows sum to unity.

Examining the four factors found in our analysis leads to some discoveries which suggest careful investigation of the implications of Varela's torus model. As previously described under definitions, the torus shape is based on the hypotheses that the operations and products dimensions of SI abilities each have dependent categories while categories in the content dimension are largely independent. The first finding is that the marker tests establish a smaller number of independent factors than the number of SI factors hypothesized in the battery, implying a closer relationship among some of the hypothesized factors. Next, the clustering of the tests in EMX, CBX, XMX, and XSS are somewhat along the lines of the relationship described and discussed by Varela. The clusters, with the exception of XMX, are distinguished clearly on the content dimension (behavioral, semantic, and symbolic) which is the only dimension in Varela's torus which is not closed. The CBS and CBT tests making up CBX hypothesize transformation and system abilities which are adjacent in the torus. In the EMX cluster,

TABLE 8

Proportions of Variance

	Factor 1 XSS	Factor 2 XMX	Factor 3 CBX	Factor 4 EMX	All Factors
Summer					
Supervisors	.34	.26	.11	.16	1.00
Urban Corps	.37	.22	.18	.22	1.00
Combined					
Population	.37	.25	.19	.18	1.00

the unit, class, and relations categories are the ones called continuous by Varela while evaluation and cognition are adjacent sectors. The fact that a CSC test, Best Number Pairs, loads on XSS may not contradict this pattern of separation of system and transformation from units, classes and relations since Best Number Pairs (CSC) may differentiate in this sample according to a system instead of a class ability. As an example, in the Summer Supervisor group, Best Number Pairs (CSC) has its highest correlation with CSS test (Letter Triangle, .44) and an NSS test (Operations Sequence, .43). In XMX, the product categories also relate in that transformation and system are adjacent in the torus, while cognition and semantic abilities combine logically in determining that composite factor. We might hypothesize that a force differentiating EMX and XMX is that the XMX composite exemplifies (in addition to the prevalence of cognition as an operation or process) transformation and system products while units, classes, and relations products predominate in the marker tests of EMX. The patterning of tests in relationship to these four factors, therefore, seems consistent with the torus model suggested by Varela.

Relations of Civil Service Tests to the Four Factors

It was decided that the four factors in each population could reasonably be used as a basis for a factor extension of the Civil Service tests in order to examine the relationship

between those tests and the factors. The method used was a factor extension technique first described by Dwyer (1937).

In the factor extension method, the factors determined by the target rotation become coordinates to which the Civil Service tests can be related. Geometrically, the process involves fixing the location of the tests as points in a previously stabilized four-dimensional space, derived from the factor analysis of the SI tests and the subsequent, targeted rotation of factors. This is possible since the correlations of the Civil Service tests to the SI tests are known and the relationships of the SI tests to the four factors are also known. The resulting outputs of matrices of factor loadings, each entitled Extended Matrix, in tables B23, B24, and B25 in the Appendix indicate the loadings of the Civil Service tests on each of the four factors in each group.

The relationships of each of the Civil Service tests to the factors, and, when relevant, to the correlational findings are discussed below.

Vocabulary. For Summer Supervisors, the vocabulary test is univocal, but for the Urban Corps students, it loads on two factors, XMX and EMX. The Summer Supervisors loading seems consistent with the fact that sentence completion (CMU) is a part of the cluster establishing EMX. This implies that the vocabulary test given to Urban Corps measures both cognitive and evaluative semantic abilities related to the more traditional concepts of intelligence, while a vocabulary test given

to the Summer Supervisor group seems restricted to measuring mainly the evaluative semantic composite, EMX.

In the merged population, vocabulary test performance is accounted for by a combination of the evaluative semantic thinking composite (.54), and the symbolic system composite (.30).

Figural Analogies. It was expected that the Civil Service Non-Verbal Figural Analogies Test would show a more marked relationship in the Summer Supervisor group to semantic factors than in the Urban Corps sample. The rationale was that some verbal and semantic abilities operate like facilitating components in figural tasks and that a greater heterogeneity in the Summer Supervisor group might cause differentiation related to such abilities. The findings were consistent with this expectation since the loadings of the Figural Analogies test in the Summer Supervisor sample are, as to be expected, highest (.41) on XSS, but also significantly high (.31) on EMX. For the Urban Corps population the Figural tests loaded approximately zero (-0.04) on EMX, highest (.59) on CBX, and high on XSS (.45). In the combined population the Figural tests loaded very much as might be predicted in a general population, almost univocally on XSS (.47).

Sociological Knowledge. It was hypothesized that high scores on this test would be partly a function of intensive previous use of verbal and semantic abilities. In the merged populations, the Sociological test vector does have its highest

loading on (.33) EMX, the evaluative semantic composite, and its next highest loading on (.23) XMX, the semantic composite. Its lowest loading is on CBX, the "social intelligence" composite.

The test functions differently for the Summer Supervisors and the Urban Corps. The highest loading for the Urban Corps (.49) is on XMX, the next highest on EMX, with no significant loadings on CBX and XSS. It is a multi-vocal test for Urban Corps, measuring mainly, as predicted, semantic abilities. On the other hand, the test is univocal for Summer Supervisors, measuring mainly an Evaluative Semantic Ability.

Mathematics. It was predicted that the Mathematics test could be explained by CSS, NSS,EMS, NMS and EMR. Mathematics did appear to follow this pattern partly in both the Summer Supervisor and Urban Corps groups by dividing its variance mainly between XSS and XMX, since CSS and NSS tests are included in the clusters determining XSS and XMX. In the combined group, XSS was clearly the primary factor (.51) while XMX (.19) was secondary, with zero loadings on the other two factors.

The hypothesis that certain kinds of semantic and symbolic abilities are important to performance on this kind of mathematics test seems to be supported.

Reading Comprehension. It was expected that, in both samples, variance on the reading comprehension test would be

explained by CMS, CMU, NMS, EMC and CMT. For findings to be consistent with this hypothesis in terms of the composites discovered, the reading comprehension test should load primarily on XMX and EMX. In the Summer Supervisor sample, there were major loadings on EMX (.37) and XMX (.32), but reading comprehension in the Urban Corps group loaded .58 on the symbolic composite (XSS) and .43 on CBX, while it loaded insignificantly (.32) on XMX. Examination of highest correlations with reading ability in all three groups shows Reading Comprehension to be highly correlated with many tests and to have a high average correlation with CSS markers in the Urban Corps group. In the combined populations, Reading Comprehension showed up as a complex task consisting of all four factor components but loaded highest on EMX (.36) and XMX (.29).

Verbal Analogies. The expectation that Verbal Analogies would load highest on a factor similar to EMR was not fulfilled in either the Summer Supervisor or Urban Corps groups. The second highest factor loading was on EMX in each case. Loadings on CBX and EMX were significant at the .01 level for Summer Supervisors but no loadings were significant, even at the .05 level, for Urban Corps. In the combined population, however, the highest relationship was with EMX, the expected factor, as the table shows; and all loadings except that on XSS were significant at the .01 level of significance.

As described previously, comparison of items in the Civil Service Verbal Analogies with those in the SI Verbal

Analogies test creates a first impression that the tests are identical or alternate forms. We had proposed, however, that a difference in the structure of the analogy items in the two tests might result in findings that they measure different things.

The hypothesis was based on the fact that the first two components of the CS analogy showed a clear and easily distinguished relationship to each other while the corresponding first couple of elements in the SI analogy item did not reveal such a relationship.

Examining the matrix of correlations for each group shows the relationship between the Civil Service Verbal Analogies and the SI Verbal Analogies and tends to support this supposition. The correlations between Verbal Analogies (SI) and Verbal Analogies (CS) were: -0.02 in the Summer Supervisor group, .48 in the Urban Corps, and .20 in the combined sample. While the correlations are significant at the .01 level in the latter two groups, they clearly are not high enough to indicate that the tests are identical or highly similar.

Judgment Test. The highest loading for the Judgment test was on CBX (.23) in the Summer Supervisor sample, and on XSS (.23) in the Urban Corps sample, hardly explaining its variance, but suggesting some relationship to a behavioral factor in the Summer Supervisor group. The loadings of the Judgment test in the total sample suggest that the Evaluation

Semantic Composite (.28) contributes something to performance in this area. Judgment test variance seems explained by something internal to the Battery of Civil Service tests, since the higher correlations in all groups are with Civil Service tests, as an inspection of the correlations tabled in the Appendix reveals.

The pattern throughout the samples is alike in that performance on Civil Service Judgment tests is related to performance on tests of Civil Service Verbal Analogies, Reading Comprehension, and Sociological Knowledge, rather than to SI Cognition tests.

Zero Order Correlations with Criterion

The zero order correlations for the Urban Corps group were much higher than those for the other two groups.

Zero Order Correlations in the Urban Corps Group

In examining the capacities of the tests to predict job performance criterion in an Urban Corps group of thirty-three for whom criterion measurements could be obtained, the following correlations, all of which are higher than r = .40 (significant at the one per cent level for N = 33), with the criterion were found:

Civil Service	r
16 - Figural Analogies	.42
XSS	
5 - Circle Reasoning	.42
8 - Letter Series	.47
25 - Letter Triangle	.51

	r
XMX	
7 - Temporal Order	.40
26 - Necessary Arithmetic Operations	.57
27 - Problem Solving	.60
CBX	
12 - Picture Exchange	.46
EMX	
24 - Class Name Selection	.47

Eight SI tests related to performance at the one per cent level of significance. One Civil Service test related to performance at that significance level.

Zero Order Correlations in the Summer Supervisor Group

In the case of the Summer Supervisors (population 90), the correlations with the performance criterion were very low. Only Circle Reasoning was significantly different ($p < .05$) from zero at -.22. A correlation of .20 would be significant at the 5 per cent level.

While, as seen above, the XSS and XMX tests were together a major part of the tests found to have predictive capacity in the Urban Corps group, only one test in the Summer Supervisor Group, Circle Reasoning (XSS), played a part approaching importance, and that test correlated negatively with the criterion. Considering the tests as single predictors then, it can be concluded that a number of tests have rather high criterion-related validity in the Urban Corps group but not in the Summer Supervisor group.

Zero Order Correlations in the Combined Group

Examining the tests as single predictors in the combined population (123) reveals that among Civil Service tests the highest coefficient is that with Reading Comprehension (.10). Since this correlation is not significant at the 5 per cent level, no relationship of Civil Service tests with performance is indicated. Among Structure-of-Intellect tests, the highest criterion-related tests were Word Changes (NSS-XSS) (.220) and Operations Sequence (NSS-XSS) (.175). These indicated little relationship of the individual SI tests to the performance in a mixed group.

The Tests as Multiple Predictors to a Criterion

In each of the three groups, three combinations of variables were investigated as bases for prediction to a performance criterion: (1) all Civil Service tests; (2) all SI tests; (3) both Civil Service and SI tests. These are summarized in table 9.

Multiple Prediction for the Urban Corps Group

There were only 33 cases in which Urban Corps individuals took all SI tests, all Civil Service tests, and at the same time were rated on performance.

Civil Service tests. As a result of using a stepwise multiple regression program, the maximum significant multiple R found is shown in table 10 where the subscripts to the B's refer to the test variables listed in the key. The values for B and

TABLE 9

Summary Table of Multiple Correlation Coefficients
Indicating Increase in Multiple-R with Each Step

Structure of Intellect Tests

Summer Supervisors		Urban Corps		Combined Group	
Circle Reasoning	.22	Problem Solving	.60	*Word Changes (.05)	.22
*Word Changes (.05)	.30	Best Number Pairs	.67	Picture Exchange (.05)	.26
Sentence Order	.34	*Verbal Analogies (.001)	.73	Circle Reasoning (.01)	.30
Picture Exchange	.37	Letter Triangle	.76	Operations Sequence	.32
Best Word Class	.38	Similarities	.78	Best No. Pairs	.37
Letter Series	.41	Class Names		Missing Pictures	.39
Operations Sequence	.42	Selection	.80	Best Word Class	.41

Civil Service Tests

Summer Supervisors		Urban Corps		Combined Group	
**Mathematics	.19	*Figural Analogies (.05)	.42	**Sociological Knowledge	.10
Reading Comprehension	.23	Reading Comprehension	.43	Mathematics	.16
Figural Analogies	.26	**Vocabulary	.45		
Sociological Knowledge	.28	Verbal Analogies	.46		
		Sociological Knowledge	.46		
		Police Judgment	.47		

Civil Service & SI Tests

Summer Supervisors		Urban Corps		Combined Group	
Circle Reasoning	.22	Problem Solving	.60	*Word Changes (.05)	.22
*Word Changes (.05)	.30	Best No. Pairs	.67	Picture Exchange	.26
Mathematics	.35	*Verbal Analogies (.001)	.73	Mathematics	.31
Sentence Order	.39	Letter Triangle	.76	Necessary Arithmetic	.34
Operations Sequence	.42	Similarities	.78	Operations	.37
Picture Exchange	.44	Vocabulary	.80	Circle Reasoning	.39
Sociological Knowledge	.46	Arithmetic Operations	.81	Sociological Knowledge	.41
Letter Series	.48				

*Variable beyond which no addition of a variable produces a significant increment of R (at .05 level). The number in parenthesis indicates the level of significance. Unless there is further indication on the list, each variable added beyond the asterisked one continues a significant Multiple R.

**The level of significance for Multiple R is above .05.

for the constant are the coefficients and constant value in the multiple regression equations. Multiple correlation coefficients at each step are shown in table 10 with the subscripts keyed as shown.

In terms of raw scores, the multiple regression equation which is the most efficient predictor is:

$$X_{22} = .86X_{16} - 0.16X_{18} + 14.61$$

where X_{22} indicates the score on criterion 22. To indicate the relative weight of contribution of the tests, the equation is also given in Z-score form in which the coefficients are the partial correlation coefficients (Beta weights) giving the relationship, in each case, between the respective test variable and the criterion, with all other variables in the equation partialled out or held constant.

$$Z_{22} = .49Z_{16} - .11Z_{18}$$

The multiple correlation of the criterion with these two variables is .43, which is significant at the .05 level. This weighted combination of scores on Civil Service Figural Analogies and Reading Comprehension produces the best predictor score.

Structure of Intellect Tests. Applying the same program to the SI tests resulted in a much higher multiple correlation. Multiple correlation coefficients at each step are shown in table 11 with the subscripts keyed as shown.

TABLE 10

Multiple R's, CS Tests, Urban Corps

Step	Multiple R	B_{16}	B_{18}	Constant
1	.42	.75		14.4
2	.43	.86	-.16	14.61

Key:

16 - Figural Analogies

18 - Reading Comprehension

TABLE 11

Multiple R, Urban Corps, SI Tests

Variable Added	Multiple R	B 27	B 28	B 30	B 25	B 6	Constant
27	.60	1.25					14.11
28	.67	1.50	.33				19.04
30	.73	1.37	.53	.30			18.70
25	.76	.97	.59	.23	.62		19.33
6	.78	.98	.63	.27	.75	.19	22.60

Key:

27 - Problem Solving

28 - Best Number Pairs

30 - Verbal Analogies (SI)

25 - Letter Triangle

6 - Similarities

The criterion variable (22) has a multiple correlation of .73 with the best combination of three tests, significant at a level beyond .001. Adding tests does not increase the multiple correlation significantly. The raw score multiple regression equation expressing the relationship of these three variables with the criterion variable is:

$$X_{22} = 1.38X_{27} - .53X_{28} + .31X_{30} + 18.7$$

The relative weight of contribution of the tests to the criterion is shown in the Z-score form of the multiple regression equation:

$$Z_{22} = .66Z_{27} - .53Z_{28} + .36Z_{30}$$

This is a weighted combination of scores on Problem Solving (27), Best Number Pairs (28), and Verbal Analogies (30). Therefore, these three tests combined and weighted according to the coefficients shown would correlate .73 with the criterion, indicating a substantial validity for these SI tests.

The implications for the SI tests, however, are far beyond this, since this best combination of three leaves out many tests which are themselves individually high predictors to the criterion. The stepwise multiple R computation method tends to select tests that correlate highly with the criterion and low with each other. Since the orthogonal factors are each represented by several tests, other alternative configurations of tests may produce multiple correlation coefficients

which are almost as high as those reported here.

Structure of Intellect and Civil Service Tests combined. Analysis of the entire battery of both SI tests and Civil Service tests reveals a best combination in the Urban Corps which contains exactly the same three tests and relationships found when the SI tests alone are analyzed. A combination of Problem Solving (27), Best Number Pairs (28), and Verbal Analogies (30) results in a multiple R of .73 beyond which adding tests produces no significant increase in relationship. In addition, not only do the first three, but the next two SI tests coincide, so that the best combination of five tests emerges as the same tests found previously in the analysis of the SI tests alone. The sixth test (vocabulary, shown in table 12) is the first Civil Service test to emerge; that is, at a point beyond that where additional tests increase the significance of multiple R. After SI tests have been used as predictors, Civil Service tests add nothing significant.

Multiple Predictors in the Summer Supervisor Group

Civil Service Tests. When the stepwise multiple regression technique is applied to the Civil Service tests taken by 90 Summer Supervisors, no multiple correlation significant at the .05 level is found at the first step. If this is disregarded purely for comparison of a best combination of four, a multiple R of .28 is found in the Summer Supervisor

TABLE 12

Multiple R, Urban Corps, Combined SI and Civil Service Tests

Variables Added	Mult. R	B 27	B 28	B 30	B 25	B 6	B 14	B 26	Constant
14	.80	.78	-.73	.32	.88	-.29	.39		20.57
26	.81	.52	-.71	.28	.80	-.32	.30	.22	20.23

Key:

14 - Vocabulary

26 - Necessary Arithmetic Operations

group, a rate which does not even slightly approach that in the Urban Corps group. The four tests are Mathematics, Reading Comprehension, Figural Analogies and Sociological Knowledge, while the corresponding best four in the Urban Corps group are Vocabulary, Figural Analogies, Reading Comprehension and Verbal Analogies, whose combination results in a multiple R of .46 . Thus, Figural Analogies and Reading Comprehension are the only tests common to the two batteries.

While it must be noted that the multiple correlations are insignificant, table 13 shows the development of the multiple regression formula, step by step.

The Civil Service tests, therefore, do not, under these circumstances, combine to produce a useful predictor battery for the Summer Supervisor group as they do for the Urban Corps students.

Structure-of-Intellect Tests. While the entries in table 14 of multiple correlation coefficients for each predictor variable indicate the finding at each step from a stepwise multiple regression computation method, no increase in correlation beyond the second step reaches statistical significance at the .05 level. The multiple correlation coefficient of .30 between the criterion and the combination of Circle Reasoning (5) and Word Changes (2) is significant at the .05 level. The raw score regression equation is:

TABLE 13

Multiple R, Summer Supervisors,
Civil Service Tests

Variables Added	Multiple R	B 17	B 18	B 16	B 15	Constant
17	.19	.11				24.77
18	.23	-.13	.06			23.07
16	.26	-.11	.07	.05		24.63
15	.28	-.12	.05	.06	.04	24.04

Key:

17 - Mathematics

18 - Reading Comprehension

16 - Figural Analogies

15 - Sociological Knowledge

TABLE 14

Multiple R, Summer Supervisors, SI Tests

Variables Added	Multiple R	B 5	B 2	B 1	B 12	Constant
5	.22	-.66				26.11
2	.30	-.78	.16			19.88
1	.34	-.80	.20	-.14		21.79
12	.37	-.89	.21	-.16	.44	18.69

Key:

5 - Circle Reasoning (CSS)

2 - Word Changes (NSS)

1 - Sentence Order (NMS)

12 - Picture Exchange (CBT)

$$X_{22} = .16X_{2} - .78X_{5} + 19.9$$

The regression equation in Z-score form is:

$$Z_{22} = .05Z_{2} - 1.0Z_{5}$$

This finding indicates that an appropriately weighted combination of at least two SI tests might be valid for selecting Summer Supervisors from a Black population of college students, since a significant multiple R results from combining these two tests in a battery.

Civil Service and Structure-of-Intellect Tests combined. Table 15 shows the development of the best combination of four tests derived from application of a multiple regression stepwise technique to both Civil Service and SI test scores in the Summer Supervisor group. While any addition of predictors beyond the first two is statistically insignificant, a multiple R of .39 results which is slightly higher than that (.37) found for the best four SI tests. Substituting Mathematics for Picture Exchange results in this increase in relationship to the criterion. The tests are otherwise the same. The SI tests and Civil Service tests are those indicated in the key below. The first two tests are, however, the only combination which is significant as a predictor combination, and they, with the associated multiple R, correspond exactly with those selected by the stepwise multiple regression method from among the SI tests alone.

TABLE 15

Multiple R, Summer Supervisors, SI and Civil Service Tests

Variables Added	Multiple R	B 5	B 2	B 17	B 1	Constant
5	.22	-.66				26.11
2	.30	-.78	.16			19.88
17	.35	-.68	.18	-.11		21.56
1	.39	-.70	.22	-.11	-.14	23.58

Key:

5 - Circle Reasoning

2 - Word Changes

17 - Mathematics

1 - Sentence Order

These are Circle Reasoning and Word Changes.

Multiple Regression Prediction in a Combined Summer Supervisors and Urban Corps Group

Exploring the relationship of tests to criterion in a combined population of 123 Summer Supervisors and Urban Corps students presented a difficult problem since performance rating scales used by the agencies employing the two groups were different. In order to provide a consistent basis for pooling the scores, criterion ratings were converted to standard scores within each group and the groups combined into one large group. Multiple correlations and multiple regression equations involving these criterion scores were then derived for the standard test scores which had been previously computed on all tests for both groups and combined into one population of 123 test scores.

Civil Service Tests. No significant multiple correlations of Civil Service test scores to criterion were found. The results, however, of computation of equations for the best combination of two tests are shown in table 16, consisting of multiple correlations, B coefficients and constants. B and Beta coefficients coincide here since the equations represent the relationships among standard scores with equal means and standard deviation.

After two tests are combined to produce a multiple correlation of .16, a third test added produces no increase.

TABLE 16

Multiple R, Combined Group, Civil Service Tests

Variables Added	Multiple R	B 15	B 17	Constant
15	.10	.10		44.67
-17	.16	.14	-.13	49.24

Key:

15 - Sociological Knowledge

17 - Mathematics (CS)

The indication is that little value exists in these particular tests for a general integrated population where a large majority is Black. This finding comes after variance attributable to group means has been eliminated by standardizing both tests and the criterion. It seems to be consistent with the fact that little basis for validity was found in the multiple regression analysis of the Summer Supervisor Group and that the finding in the Urban Corps group would be obscured by its lack of weight in a combined group.

Structure-of-Intellect Tests. The same method applied to Structure-of-Intellect tests results in a relationship to the criterion. Although only one test, Word Changes, can be shown to significantly relate at the .05 level, the coefficients of the resulting equations are shown in the table. The best combination of four tests has a multiple correlation of .32 as seen in table 17. There seems to be some usefulness in the SI tests for predicting to this criterion, in a combined group, when variance attributable to difference in means is eliminated and scores are expressed in terms of relative standing within each group for both tests and criteria.

Structure-of-Intellect Tests combined with Civil Service Tests. When Civil Service tests are added to SI tests, the stepwise multiple regression application results in the findings shown in table 18.

TABLE 17

Multiple R, Combined Group, SI Tests

Variable Added	Multiple R	B 2	B 12	B 5	B 29	Constant
2	.22	.22				28.83
12	.26	.20	.16			31.90
5	.30	.24	.18	-.15		36.19
29	.32	.22	.16	-.17	.12	32.82

Key:

2 - Word Changes

12 - Picture Exchange

5 - Circle Reasoning

29 - Operations Sequence

TABLE 18

Multiple R, Combined Group, SI Tests
and Civil Service Tests

Variable Added	Multiple R	B 2	B 12	B 17	B 26	Constant
2	.22	.22				38.84
12	.26	.20	.15			31.90
17	.31	.23	.18	-.16		37.27
26	.34	.20	.16	-.20	.15	33.03

Key:

2 - Word Changes

12 - Picture Exchange

17 - Mathematics (CS)

26 - Necessary Arithmetic Operations

Again, the only significant predictor is Word Changes. Observations may be made, however, of the results of the train of computations, and implicit comparisons made. A best combination of four tests results in a multiple R of .34. Only one Civil Service test is found in a battery of four, but the addition of the Civil Service mathematics test raises the multiple R to a value higher than that found for SI tests alone. It may only be speculated that a weighted combination of Civil Service and SI tests given under appropriate conditions might predict with some degree of validity the ratings on this criterion.

CHAPTER V

Findings and Conclusions

This chapter contains three main divisions: (1) a summary description of the problem, hypotheses, and rationale for the study; (2) a discussion of the findings and conclusions; and (3) an examination of the further implications of the study.

Summary

Problem

Two groups, one Black, one White, were compared on the manner in which a series of relations emerged among 29 variables applying to each group. Twenty-one of the variables were Structure-of-Intellect tests, seven were Civil Service sub-tests, and one was a job performance criterion. The relationships determined were: the factor structure of the 21 Structure-of-Intellect tests in each group; the relations of the Civil Service sub-tests to the factors found; and the relations of Structure-of-Intellect tests, Civil Service tests, and combinations of both, to criterion.

Hypothesis

It was hypothesized that, for the two groups, the relations with the criterion would be different, the addition

of information from the SI model would improve prediction, the factor structures would be different, some CS tests would relate differently to factors in each group, and some CS tests would correlate positively with SI factors.

Rationale and Need for the Study

Most research studies in the United States which compare races and groups in level of performance on psychological tests do not deal adequately with the necessity to establish comparative validity, in the sense advocated by Irvine (1969), of the tests used to measure possible differences. This current study examines the concepts of factor validity and comparative validity and their bearing on the problem of test results in different ethnic groups. The study is, in addition, directed toward meeting the needs for: devising job selection tests that will not discriminate unfairly against minority groups; gaining greater understanding of the growth and development of intellectual abilities; investigating the possible role of behavioral and "social intelligence" tests as job selection techniques; and developing a rationale for development of valid tests in Civil Service and other settings.

Conclusions

Factor Structures in the Two Groups

1. The question as to whether the same factors previously established on an American White population would emerge

in the Summer Supervisor population could not be answered definitely. In neither the Summer Supervisor nor Urban Corps samples did the traditional SI factors emerge in pure form, nor did they in the combined population. Instead, what appeared were four factors which seemed to be composites of the qualities attributed to the hypothesized SI factors. These four factors appeared in all three samples, including the combined sample of 146 candidates. The Eigenvalue profiles in the principal axis Factor Analysis for each population were similar. The factors were labeled XSS (a symbolic systems composite), XMX (a semantic composite), CBX (a cognitive behavioral composite), and EMX (an evaluative semantic composite). The finding of these composites does not undercut SI intellect factors as mental operations, but does imply that some SI mental operations are not completely statistically independent. The configuration of the SI marker tests loading on these factors suggests that further investigation of the torus SI model proposed by Varela might be profitably investigated as an alternative to the cubical model now hypothesized by Guilford.

While the four factors emerged as discernible and rather distinct in each of the groups analyzed, the construct validity of SI tests varied between the two groups. As pointed out in the analysis of findings, at least nine of the twenty-one tests did not measure the same things in both groups in this study, and therefore cannot be used as

instruments for comparing the two groups.

Difference in Prediction for Groups

2. The hypothesis that prediction of criteria from the Civil Service tests would be different in the Urban Corps population than the Summer Supervisor population tended to be supported by the findings in several respects. In the Urban Corps group, when each test was considered singly, three XSS tests, three XMX tests, one CBX test, one EMX test, and one Civil Service test were found to correlate above .42 (.33 is significant at the one per cent level) with the performance rating criterion in this group; one test, Problem Solving, correlated .60. When each test was considered singly in the Summer Supervisor group, no test correlated above .16 (.21 would be significant at the .05 level), four tests had negative non-significant correlations, and several tests which correlated positively with the criterion in the Urban Corps group correlated negatively with the criterion in the Summer Supervisor group. The tests which correlated most highly with the criterion in the Urban Corps group were not the same as those correlating most highly in the Summer Supervisor group. In both groups, however, SI tests tended to correlate with the criterion more than did the Civil Service tests.

When multiple correlations of tests were compared for the two groups, further differences were discovered. As seen in summary table 9, which compares for each population the best combinations of SI tests alone, Civil Service tests alone, and SI tests together with Civil Service tests, the highest correlation for all combinations were in the Urban Corps group. The best combination of a specific number of tests, in each case, was that one set which, when compared with all possible sets of that number, contributed most significantly to the best multiple R. The best combination of five SI tests, for example, produced in the Urban Corps a multiple correlation of .78 as contrasted to one of .37 in the Summer Supervisor group. For Urban Corps, there is justification for combining the three SI tests in a battery since they produced a statistically significant multiple R of .73, while, in the Summer Supervisors, there is justification for combining only two tests, since they produced a much lower multiple R of .30.

These conclusions, however, must be qualified because of the criterion conditions in the two groups. For both groups the criteria for job performance were supervisory ratings, and there were no strictly objective measures of performance. Urban Corps students were rated according to an eight-factor, five-point scale used in their supervising agency. Three of these eight factors, for which instructions were confusing,

were eliminated from consideration in scoring. The mean performance rating was 20.6 with an S.D. of 5.9. Ratings for Summer Supervisors were done according to a seventeen-factor, three-point scale, and the mean performance was 21.5 with an S.D. of 8.4. The criterion score was a summation of scores on these factors. The five rating factors used for the Urban Corps students had counterparts in the scale for Summer Supervisors; in addition, Summer Supervisors were also rated on personal appearance, safety, and care of property and materials. Samples of these rating forms are shown in Appendix C. Both Summer Supervisors and Urban Corps students were assigned to different supervisors in agencies dispersed throughout the city. The sources of variance in the criteria were therefore not under neat control.

Effect of Adding Information from SI Tests to Civil Service Tests

3. It was hypothesized that the addition of information from the SI tests would improve the prediction of criteria appropriate to the Summer Supervisor population, and similarly for the Urban Corps population.

This hypothesis was supported by the

data, in that more SI tests in each group contributed to the maximized multiple correlation even though the tests which comprised the combinations differed considerably. Examination of table 9 shows that no combination of Civil Service tests produces a significant multiple R in the Summer Supervisor group, while a best two combination of SI tests results in the multiple R of .30. The significant multiple R (.43) is produced by a best combination of two Civil Service tests in the Urban Corps group while three SI tests contribute to a significant multiple R of .73.

This pattern also holds for the combined population of Summer Supervisors and Urban Corps students. In this case, only SI tests show promise in prediction of the criterion, while the Civil Service tests are not significant. In general, when all Civil Service tsts and SI tests were included in the same battery in each sample and subjected to a stepwise multiple regression procedure, the result in each case was an improvement in comparison to the multiple R computed on Civil Service tests alone. The best predictive battery consisted of an overwhelming proportion of SI tests. Therefore, the hypothesis that prediction would be improved for both populations by the addition of information from SI tests is supported. The implication for test construction is that criterion prediction might be improved if Civil Service tests were to be modeled after the SI tests listed in summary table 9 for each group respectively.

Relations of Civil Service Tests to Structure-of Intellect Tests

4. The question of how Civil Service tests related to or could be explained in terms of SI factors was transformed into one of possible explanation in terms of the four related SI composites which had developed from the principal axis and targeted factor analysis. The relationships were found through a factor extension method which involved finding how each Civil Service test loaded on the factors independently established by the prior factor analysis.

These findings have been discussed in detail for each test in the chapter on analysis and interpretation of data. In general, however, it may be stated that the Civil Service tests did not show comparative factor validity for the two groups. For example: Vocabulary was univocal on EMX for Summer Supervisor, but loaded significantly on two factors in the Urban Corps group, EMX and XMX; Figural Analogies loaded significantly on two factors in each group but only on one in common; sociological knowledge was univocal on EMX for Summer Supervisors but loaded significantly in the Urban Corps group on two factors, EMX and XMX; Reading Comprehension loaded on two completely different factors in each of the two samples; Civil Service Verbal Analogies loaded on two factors for Summer Supervisors but had no significant loading on any factor for Urban Corps; Police Judgment had no significant loading in either population although it was univocal in the

combined population with a low but significant loading on EMX. The mathematics test was the only test on which loadings might be comparable in that it loaded significantly in both populations on the same two factors.

Behavioral Measures, or "Social Intelligence"

5. One question was how the "social intelligence scales" in Guilford's model would relate to the situation judgment Civil Service tests. Perhaps the best indication of variance on the judgment test is the fact that its highest loading (.28) is on the composite factor, EMX, in the combined population, while its highest correlations in both groups are with Civil Service Verbal Analogies. The conclusion is that the judgment test tends, in general, to measure verbal capacity rather than "social intelligence," and abilities other than those measured by tests loading on CBX. We had expected the CBX tests to act differently in the two groups, that behavioral factors might emerge in the Urban Corps and not in the Summer Supervisors. The CBX factor or composite did, however, show up in both groups; and the judgment test did not load significantly on CBX in either group.

Implications of the Study

There were several limitations to the results of this study. The size of the samples was too small and they were too broadly defined to validly extrapolate the difference in factor pattern to groups in the larger society. While approximately 50 per cent of the Black subjects attended southern colleges, they had spent their childhood in segregated areas of New York City and attended de facto segregated schools. Over 80 per cent of the White students came from New York City and attended colleges in the New York City metropolitan area. Decisions as to racial identity were in some cases subject to unreliability since they were made on the basis of visual observation. The multiple-correlation coefficients found were significant but were related to criterion measures whose stability could not be confirmed by retest or repetition of ratings. A decision to select the Summer Supervisors without regard to high or low marks on the selection interview and the inclusion of seventeen factors in the job performance rating measure probably contributed to reliability by producing greater dispersion than otherwise in criterion scores. The scales used for Urban Corps students were less incisive. Ratings by different supervisors in different locations also inevitably added to error variance.

There are, however, a number of implications affecting further research and practice in testing.

That a test cannot be used to compare two groups, unless the test is demonstrated to have the same factor components when applied to the two groups, seems exemplified. The findings suggest that the concept of "comparative validity" of tests, proposed by Irvine (1969), should be emphasized much more strongly, not only in making studies across cultures but across populations which differ in other respects. Irvine maintains that tests have comparative validity when their factor loadings and their measured sources of variance for different cultures and subcultures agree in kind and amount.

Comparative validity seems, in general, to be an asset of neither the Civil Service tests nor the SI tests for the two samples in this study. A further interesting finding, however, is the relative stability, within the study, of the four factors themselves, XSS, CMX, EMX, and CBX, in the three different groups. They appear, although in different degree. This stability contrasts with the greater variability of relationship of tests with the factors. It would be interesting to know whether these same factors, in number and kind, would emerge on much larger

samples. An additional implication of the findings is that most research, and speculation based on research, which attempts to suggest or prove genetic racial inferiority by citing results of psychological tests can be disregarded, since so few of these involve any established comparative validity of tests.

The findings of this study reinforce the need for further study of the SI Model on Black populations in America, and on other groups. There is a vast potential area for research, not from the point of view of a narrow obsession with demonstrating inferiority or superiority of intelligence in different groups, but with the objective of discovering how particular intellectual abilities evolve, and how they are affected by values and practices within the cultures and societies studied. The findings suggest that programs of the type developed by Jacobs and Vandeventer (1968) for "teaching intelligence" should be expanded. By concentrating on one Structure-of-Intellect factor, Cognition of Figural Relations (CFR), Jacobs and Vandeventer extracted from the universe of items and operations requiring this ability a generic set of tasks to be used as training exercises for developing a CFR capacity extending to new material. Such an approach clearly specifies the relations

between operations used for measuring abilities and those used for training. Applied to other S.I. factors, it should contribute both to psychological theory and to educational methodology.

There are implications for construction of tests as selective instruments to be used by Civil Service and other agencies. The greater predictive efficiency of the S.I. tests in this study indicates that the S.I. tests and item types are adaptable to, and may better meet, objectives in Civil Service test construction, since there is a particular need for "a priori validity operations" and construct validity in tests which must be produced rapidly and in massive numbers for many different kinds of jobs, tests which are the primary basis, often required by law and the merit system, for very important decisions in personnel selection. We suggest the term "a priori validity operations" to define a definite set of proposed practices to be carried out in the construction of a test. These practices should be directed toward maximizing the probability of criterion-related validity. They would partly consist of the standard task analysis and efforts to relate test content to skills and capacities needed to do the

job for which the test is to be given. Both task analysis and item type, however, would be related to known factors established through research done on the SI model, with the proviso that necessary standardization and modification of the SI model take place to meet the requirements of comparative validity for different cultural groups and to adjust to the implications of this and further research. A valuable asset of the SI model is the very closely reasoned basis it provides for the construction of items to measure specific kinds of mental operations. Such a basis is needed for carrying out the steps suggested for "a priori validity operations."

The procedure suggested is:

a) Establish a set of coordinates of abilities. This is done on the basis of SI-type research, but is not affected by the possibility that the torus model may be found to be more descriptive of SI abilities than the cubical model.

b) Determine and weight as criterion scales the coordinates that are relevant to the job or occupation to be tested for. For example, CMU and CSS might be important for the capacity to do one kind of job, while CBS and MFU might be important for another. This determination might be made through carefully analyzing the operations involved, testing individuals doing the job, and interviewing supervisors to establish the validity of the criterion elements and scales. A job may be mapped in gross terms directly into the SI model; then, after the transposition of each relevant cell into a coordinate, the "job" or, synonymously, differential abilities required to do the job, could be related to the coordinates. Such a mapping process could be applied to many classes of jobs.

c) Construct the tests by selecting and weighting individual SI tests or item types which relate to this application of the model; or, if necessary, uniquely construct such tests and items to conform to SI model items.

The entire process might be summarized as an effort to map the job and the test onto the SI model. After these steps, the pilot studies and the determination of the statistical correlations between test performance and criteria performance should be carried out. Since statistical assessments of results indicate adjustments to be made, the test constructor continues to work under the guidance of a rational theory. He can be expected to come closer to his target with each repetition of the procedure.

The need today in Civil Service testing agencies for such a validation model is critical because they are usually required by law to use competitive tests for selection purposes for most jobs under their jurisdiction. A private industrial concern, since it is not mandated to test, can easily abandon the use of standardized or other tests, can use them with great flexibility, or can attempt to compensate otherwise for inadequate representation of minorities among employees. Civil Service jurisdictions are the employers now under pressure to increase budgets for test validation and to develop newer and better techniques for selection. Civil Service testing agencies, while sincerely engaged in efforts to maximize objectivity of selection, are those which may be subject to accusations that, by mass producing and exposing to the public tests that have no demonstrated validity, they are inadvertently destroying whatever public acceptance exists of scientific approaches to test construction and research efforts. Law suits against local Civil Service agencies on matters of

possible test inequity are increasing disproportionately, initiated not only by minority group organizations but by experienced civil servants.

On the other hand, the continued thrust by Black and Hispanic groups toward reducing the general de facto discrimination in Civil Service selection and employment has met with so little success that many now question the merits of the "merit system" and have become unwitting allies and convenient scapegoats for those interests which prefer to see Civil Service personnel administration become completely politically responsive in personnel selection.

Civil Service jurisdictions can respond to these pressures in several ways. They can validate their methods of selection, and improve their methods of recruiting, training, and promoting employees so that minority groups are fairly represented and all employees benefit by the better approaches; or they can abandon worthwhile practices of the merit system which have been judged by many to benefit both Civil Service employees and the government administrations employing them. The first alternative seems much the better, and research similar to this study contributes to that end.

This study indicates several directions for further research. First, factor analyses might be done on much larger populations to discover whether the four factors which emerged will repeat themselves, to further investigate the degree to which comparative validity exists or can be incorporated into

the tests used. Next, investigations should be directed specifically at determining the reasonableness of Varela's torus model. To do this, basic studies are needed of Guilford's SI abilities to see whether they are statistically independent along each dimension of the model. The results of this study warrant the enunciation and further empirical examination of such hypotheses. The influence of the homogeneity of tests and population samples on factor emergence and on factor loadings should be further assessed, since the abilities in the SI model may be discrete abilities in a functional sense which show up as independent factors in a homogeneous group, but as correlated factors in a heterogeneous group. In this case, the factors might be thought of as like the ribs of a collapsible paper fan. In a heterogeneous population they are like the collapsed fan, contracted, and correlated, and tending to show up as "g". In a homogeneous population, the factors are like ribs of the extended fan and show up as orthogonal factors. For this purpose homogeneity might be described as meaning relatively small variances and sufficiently high means on facilitating components as defined by Merrifield (1964). A very pertinent statement is made by Irvine (1969) in a discussion of factor analysis done in Africa:

> The point of the analysis is that when item types and populations are relatively homogeneous, it is possible to witness the disintegration of the general factor (given a varimax rotation), even in Africa, and more variance becomes associated with item types. Students of factor analysis will not regard this experience as

> unique to Africa. The earlier, possibly continuing, controversies over the nature of theoretical frames for cognitive structure, polarized by Spearman and Thorndike, reconciled by Burt, Thomson, and Vernon, have largely arisen out of the nature of the tests used and the populations to which they have been administered. African results tend to underline the relativity of human experience, and absolute theoretical constructs may require modification if psychological advances are to be made (p. 37).

The above considerations bear particularly on the design of research that might be done on the Varela hypothesis. One inference from his torus model is that the abilities in the SI model are oblique on a product dimension and are orthogonal on a content dimension, e.g., that CFU will be oblique in relation to CFC but will be orthogonal to CMU. But the implication from the observations of both Irvine and Merrifield is that the population should be homogeneous on relevant facilitating factors.

A final observation is that the social intelligence test, Picture Exchange, had a significant validity coefficient of .47 in the Urban Corps group. This fact suggests further experimentation with adapting the test to Civil Service selection. The first problem to be solved is that of validating and adapting it for a Black population, but this should be possible with sufficient work. The emergence of a social intelligence factor in the Summer Supervisor group, despite the hypothesized lack of situational relevance for a Black population, creates a basis for further research.

In conclusion, it is suggested that this study presents a model which should be adopted and used again for

analysis and understanding of the components of existing tests, of tests in the process of construction, and of tests applied to different cultural groups.

APPENDIX A

EXAMPLES OF STRUCTURE OF INTELLECT

TEST ITEMS DISCUSSED IN STUDY

ALPHABETICAL LOCATOR FOR TESTS DESCRIBED IN APPENDIX A

Tests are Grouped by Factors

Tests for Factor NMS: (convergent production of semantic systems)

Sentence order

Gives three sentences in scrambled order, each of which is a natural step in some series of events. Subject indicates correct order by numbering sentences.

Example:

2 She bought some food at the market.

3 She returned home and cooked some of the food she had bought.

1 She went to the market.

Answer:

The numbers, as inserted correctly by the candidate, indicate the correct sequence.

Temporal ordering

Presents a problem requiring a number of steps in a logical practical order to accomplish solution. The steps are given in scrambled order and labelled alphabetically. The subject answers such questions as:

The first two steps, in order, should be _____
The step before the last one should be _____

Tests for Factor NSS (convergent production of symbolic systems)

Word changes

There is a column with a word at the top, a word at the bottom, and three blank spaces between. The subject is presented with three additional words which if arranged correctly, will fit spaces in such a way that only one letter will differ from word to word. The subject must order words to meet this condition.

Example:

Bell

2	1. Bail
1	2. Ball
3	3. Mail

Main

Answer: The numbers labelling the words, as inserted correctly by the candidate, indicate the sequence that will meet the condition set.

Operations sequence

The subject is asked to state the necessary order for a given set of arithmetic operations in starting from a given number and arriving at another given number in three steps.

Example:

Start with 6, get 18. (A) +3 (B) ÷2 (C) x3

Answer: B A C

Tests for Factor CSS (cognition of symbolic systems)

Letter series

What letters are needed in the blank spaces in order to extend the series after CR?

Example:

A R B R C R

Answer: D R

Letter triangle

Letters can be arranged in a triangle according to a rule. Look at this sample item:

```
        a
      b   b
    c   c   c
  d   d   d   d
  _   _   ?   _   _
```

Possible answers

A. b
B. c
C. d
D. e
E. f

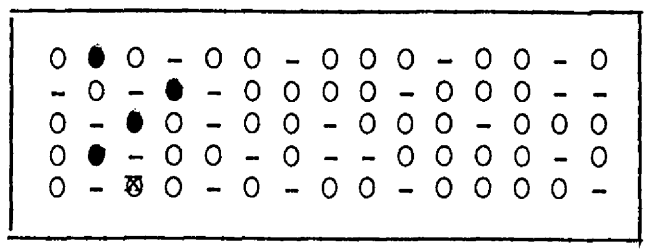
What letter should go in the blank where the question mark is? For this sample item the answer is "e," which is listed as answer D in the list of possible answers. You would mark D on your answer sheet.

Circle reasoning

Below are five rows of circles and dashes. One of the circles in each of the first four rows is black. The circle is blackened according to a rule. The problem is to find the rule and then mark the circle that should be black in the last row.

Example:

Sample Item I



The rule is: The second circle from the left in each row should be black. Therefore, the second circle in the last row is marked to indicate that it is the one that should be black.

Number series

S is asked to state the nature of the principle involved in the item.

Series: 24 48 12 24 6

Response: x2, ÷ 4.

Tests for Factor CMU (Cognition of Semantic units)

Word completion

Write a word or short phrase to define each of the following words:

1. execute _____
2. deter _____

Guilford Zimmerman Aptitude survey (verbal comprehension section). Vocabulary items are in multiple choice format. (Note that this test was not used in study)

Example:

To reap

A. To flatter
B. To harvest
C. To refer
D. To release
E. To repose

Answer: B. To harvest.

Tests for Factor CMS (cognition of semantic systems)

Necessary arithmetic operations

The subject must select the sequence of necessary operations.

Example:

A city lot 48 feet wide and 149 feet deep costs $79,432. What is the cost per square foot?

A. Add and multiply
B. Multiply and divide
C. Subtract and divide
D. Add and subtract
E. Divide and add

Answer: B.

Problem Solving

Example:

A car travelled a certain distance in 45 minutes, three quarters of the time it took to travel the same distance on a previous trip. How many minutes did the first trip take?

A. 50
B. 55
C. 60
D. 65
E. 70

Answer: C.

Necessary facts:

The subject is asked to tell what additional facts are necessary to enable solution of the problem.

Example: A rectangular tank is being built to hold water. It is to be 5 feet high and 9 feet long. How many cubic feet of water will it hold?

Answer: The width of the tank.

Tests for Factor CMT (cognition of semantic transformations)

Similarities

In this test the subjects are to think of ways in which different objects are alike. Each item names two objects. The subject is to write as many as six ways in which the objects are alike.

Example:

Apple and orange are alike:

A. sweet, B. round, C. have seeds, D. fruit, E. have skins, F. grow on trees

Tests for Factor CSC (cognition of symbolic classes)

Best number pairs

Example:

Choose one of the three pairs of numbers that makes the best class (where "best class" is defined by the rank order: perfect square, multiples in common, odd or even numbers, and no common properties):

A. 6-4 B. 4-9 C. 9-6

Answer: B (perfect square).

Tests for Factor CBT (cognition of behavioral transformations)

Picture exchange

A test item consists of a row of four pictures which "tell a story," and three additional pictures only one of which can replace the third picture in the row and make a changed but meaningful story. The subject is asked to recognize a possibility of making a transformation in meaning of a sequence of actions presented in scenes in four photographs.

Social translations

The problem for S is to decide in which other person-to-person relations the same statements would change materially in significance, three alternative pairs being supplied for his choice.

Example:

Boss to secretary
"Please"

1. Beggar to stranger
2. Father to son
3. Chauffeur to boss

Answer:

1.

Tests for Factor CBS (cognition of behavioral systems)

Missing pictures

Items in this test utilize a sequence of events as the kind of system that is to be cognized. Each item is designed to tell a little story in four successive scenes, with one of the four scenes left blank. S's task is to fill it with the one scene, selected from three alternatives, which will make the sequence of pictures tell a meaningful story. The pictures in the scenes are photographs of people (students) who engaged in action. The episodes often involve boy-girl problems, with one, two, or three persons appearing each scene.

Missing Cartoons

Missing cartoons is like missing pictures, but has instead successive scenes in cartoon drawings as the basis for each item, one scene blank. S must choose the scene that tells the story.

Tests for Factors EMR (evaluation of semantic relations)

Verbal analogies

Cloth is to dye as House is to _____

A. shade B. paint C. brush D. wood

Answer:

B. paint

Tests for Factor EMC (evaluation of semantic classes)

Class name selection

S is to say which of three class names best fits a class represented by four given members. The criterion has to do with whether the class name is too restrictive or is not restrictive enough.

Example:

Class members	Class names
CAT	A. farm animals
COW	B. four-legged animals
MULE	C. domestic animals
MARE	

Answer:

C. domestic animals

Best Word Class

Example:

Of the four given classes, the subject must select the one to which the given object best belongs.

Example:

Palm is in the class of:

A. plant
B. tree
C. flower
D. lead

Answer: B

APPENDIX B

TABLES B 1 TO B 25

KEY TO TESTS IN APPENDIX B

Tests in the tables and throughout the text, when referred to by numbers, are numbered as follows:

1 - Sentence Order

2 - Word Changes

3 - Number Series

4 - Word Completion

5 - Circle Reasoning

6 - Similarities

7 - Temporal Order

8 - Letter Series

9 - Necessary Facts

10 - Missing Cartoons

11 - Missing Pictures

12 - Picture Exchange

13 - Social Translation

14 - Vocabulary (CS)

15 - Sociological Knowledge (CS)

16 - Figural Analogies (CS)

17 - Mathematics (CS)

18 - Reading Comprehension (CS)

19 - Verbal Analogies (CS)

20 - Judgment (CS)

22 - Performance Rating

23 - Best Word Class

24 - Class Name Selection

25 - Letter Triangle

26 - Necessary Arithmetical Operations

27 - Problem Solving

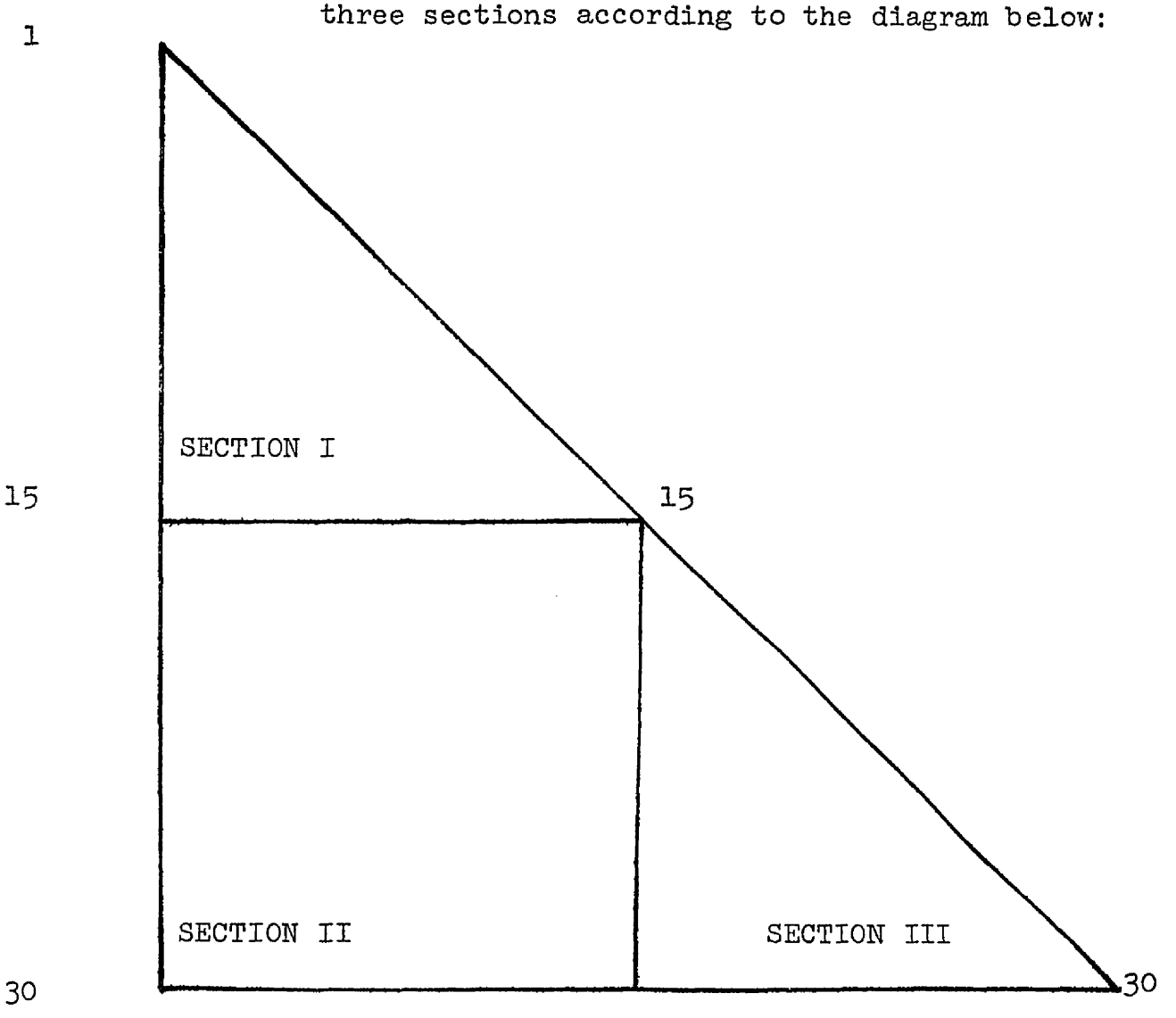
28 - Best Number Pairs

29 - Operations Sequence

30 - SI Verbal Analogies

Arrangement of Tables B 1, B 2, and B 3

Tables B 1, B 2, and B 3 are triangular correlational tables, each presented in three sections according to the diagram below:



SECTION I -- Correlations of Variables 1-15 with variables 1-15

SECTION II -- Correlations of Variables 16-30 with variables 1-15

SECTION III -- Correlations of Variables 16-30 with variables 16-30

TABLE B-1

Inter Correlations Among Tests Given To Summer Supervisors

Section I

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.00														
2	.27	1.00													
3	.27	.28	1.00												
4	.18	.37	.31	1.00											
5	.01	.19	.09	.05	1.00										
6	.03	.14	.09	.22	.06	1.00									
7	.12	.32	.22	.45	.07	.36	1.00								
8	.22	.27	.40	.21	.29	.16	.46	1.00							
9	.14	.34	.46	.55	.04	.31	.54	.25	1.00						
10	.14	.13	.25	.18	.07	.14	.43	.40	.15	1.00					
11	.12	.10	.16	.28	.21	-.20	.21	.25	.13	.36	1.00				
12	.15	.01	.25	.16	.19	.05	.21	.28	.04	.28	.31	1.00			
13	.18	.29	.29	.41	.15	-.01	.34	.37	.31	.38	.60	.32	1.00		
14	.02	.22	.25	.43	.04	.02	.21	.29	.38	.19	.22	.21	.37	1.00	
15	.11	.04	-.03	.25	.13	.13	.22	.10	.16	.14	.06	.00	.11	.05	1.00

TABLE B-I

Inter Correlations Among Tests Given To Summer Supervisors

Section II

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	.16	.15	.26	.20	.24	-.00	.16	.31	.22	.16	.20	.00	.14	.16	.47
17	.01	.15	.23	.21	.19	.07	.31	.12	.32	.03	.10	.13	.21	.18	.23
18	.16	.18	.08	.39	.03	.16	.35	.17	.33	.23	.09	.10	.30	.19	.47
19	.18	.15	.04	.38	.01	.05	.25	.23	.26	.24	.19	.12	.37	.28	.44
20	.17	.04	.03	.21	-.12	.05	.21	.12	.11	.21	.00	.16	.26	.16	.42
22	-.09	.16	-.00	.10	-.22	.06	.10	-.09	.03	.02	.05	.06	.04	-.01	.06
23	.05	-.04	.15	.12	.11	.03	.18	.29	.12	.14	.04	-.10	.27	.24	.09
24	.19	.08	.19	.31	.21	.14	.18	.35	.21	.25	.14	.23	.19	.34	.15
25	.25	.19	.43	.14	.20	.19	.27	.32	.33	.22	.16	.26	.19	.21	.05
26	.31	.16	.44	.06	.07	.03	.27	.34	.23	.35	.18	.03	.24	.18	.05
27	.22	.27	.51	.37	.30	-.03	.25	.36	.31	.30	.21	.32	.35	.30	.25
28	.11	.07	.18	-.04	.11	-.06	.21	.25	.07	.20	.27	.27	.35	.20	-.02
29	.16	.16	.30	.33	.16	-.03	.32	.34	.34	.19	.44	.21	.33	.33	.25
30	.13	.17	.08	.37	.23	.28	.43	.29	.27	.21	.30	.11	.27	.22	.13

TABLE B-1

Inter Correlations Among Tests Given To Summer Supervisors

Section III

Test	16	17	18	19	20	22	23	24	25	26	27	28	29	30
16	1.00													
17	.29	1.00												
18	.31	.23	1.00											
19	.25	.19	.59	1.00										
20	.22	.15	.54	.58	1.00									
22	-.13	-.19	.08	.04	.08	1.00								
23	.19	.12	.22	.08	.06	.04	1.00							
24	.33	.08	.21	.24	.18	-.04	.26	1.00						
25	.20	.21	.12	.01	-.05	-.02	.21	.38	1.00					
26	.35	.20	.15	.10	.08	.02	.39	.35	.45	1.00				
27	.33	.37	.17	.21	.11	-.03	.19	.26	.36	.36	1.00			
28	.25	.25	.01	.00	.02	-.03	.31	.24	.44	.30	.36	1.00		
29	.33	.21	.24	.12	.09	.10	.27	.16	.51	.33	.43	.44	1.00	
30	.15	.12	.14	.02	.02	-.11	.21	.24	.24	.10	.23	.18	.34	1.00

TABLE B-2

Inter Correlations Among Tests Given To Urban Corps Students

Section I

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.00														
2	.41	1.00													
3	.31	.43	1.00												
4	.48	.30	.41	1.00											
5	.22	.29	.25	.25	1.00										
6	.36	.35	.28	.38	.17	1.00									
7	.45	.44	.51	.38	.31	.34	1.00								
8	.50	.52	.55	.35	.43	.27	.56	1.00							
9	.22	.42	.50	.30	.37	.18	.37	.55	1.00						
10	.59	.50	.19	.31	.44	.31	.42	.57	.29	1.00					
11	.31	.24	-.05	.10	.05	.15	.12	.33	.08	.55	1.00				
12	.32	.26	.29	.22	.40	.25	.31	.35	.28	.44	.27	1.00			
13	.41	.19	.21	.41	.41	.27	.40	.46	.27	.43	.32	.28	1.00		
14	.53	.24	.51	.59	.33	.35	.39	.46	.26	.42	.05	.50	.28	1.00	
15	.53	.39	.42	.38	.32	.31	.45	.46	.30	.42	.23	.48	.31	.48	1.00

TABLE B-2

Inter Correlations Among Tests Given To Urban Corps Students

Section II

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	.30	.28	.22	.12	.44	.08	.36	.50	.34	.59	.36	.44	.40	.25	.51
17	.16	.17	.43	.10	.37	-.04	.38	.34	.37	.17	.00	.39	.22	.04	.39
18	.56	.43	.45	.31	.43	.17	.41	.66	.50	.60	.37	.42	.50	.43	.59
19	.51	.19	.32	.45	.43	.24	.34	.57	.33	.39	.20	.26	.48	.52	.43
20	.33	.04	.25	.35	.21	.14	.24	.46	.29	.27	.14	.05	.36	.35	.37
23	.42	.12	.10	.47	.28	.19	.22	.17	.10	.41	.14	.28	.36	.45	.26
24	.50	.40	.34	.33	.05	.39	.33	.34	.25	.33	.34	.42	.13	.52	.50
25	.30	.39	.51	.26	.48	.31	.47	.56	.43	.44	.13	.28	.27	.24	.50
26	.37	.34	.58	.28	.36	.30	.60	.66	.53	.35	.08	.43	.45	.43	.59
27	.32	.39	.65	.31	.54	.19	.42	.54	.61	.43	.08	.51	.34	.42	.54
28	.33	.43	.45	.36	.37	.21	.44	.44	.58	.34	.03	.20	.29	.43	.38
29	.36	.25	.66	.35	.34	.12	.49	.60	.51	.22	.02	.21	.27	.28	.40
30	.59	.40	.34	.49	.42	.25	.48	.53	.36	.61	.39	.51	.40	.50	.56

TABLE B-2

Inter Correlations Among Tests Given To Urban Corps Students

Section III

Test	16	17	18	19	20	23	24	25	26	27	28	29	30
16	1.00												
17	.49	1.00											
18	.56	.42	1.00										
19	.28	.26	.44	1.00									
20	.19	.03	.36	.71	1.00								
23	.29	-.03	.23	.22	.15	1.00							
24	.23	-.03	.42	.23	.25	.13	1.00						
25	.61	.61	.57	.32	.21	.15	.16	1.00					
26	.46	.47	.62	.44	.36	.27	.37	.59	1.00				
27	.64	.65	.64	.35	.19	.19	.30	.64	.66	1.00			
28	.42	.39	.55	.23	-.00	.35	.25	.59	.55	.49	1.00		
29	.34	.58	.54	.44	.36	.09	.18	.59	.57	.57	.47	1.00	
30	.41	.33	.51	.48	.26	.42	.30	.42	.52	.41	.44	.31	1.00

TABLE B-3

Intercorrelations Among Tests Given To Combined Groups

Section I

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.00														
2	.36	1.00													
3	.29	.34	1.00												
4	.30	.36	.35	1.00											
5	.12	.25	.17	.14	1.00										
6	.18	.23	.17	.28	.13	1.00									
7	.26	.37	.33	.43	.17	.38	1.00								
8	.35	.38	.45	.28	.35	.22	.51	1.00							
9	.20	.37	.47	.46	.17	.28	.49	.38	1.00						
10	.34	.28	.25	.24	.23	.24	.45	.48	.23	1.00					
11	.23	.20	.11	.23	.19	.02	.22	.32	.15	.46	1.00				
12	.20	.09	.25	.17	.25	.12	.25	.30	.13	.32	.29	1.00			
13	.30	.28	.28	.42	.27	.12	.37	.42	.31	.42	.52	.28	1.00		
14	.22	.24	.36	.50	.16	.15	.28	.36	.34	.29	.18	.30	.36	1.00	
15	.28	.18	.15	.30	.22	.22	.32	.24	.23	.28	.16	.15	.23	.23	1.00

TABLE B-3

Intercorrelations Among Tests Given To Combined Groups

Section II

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	.21	.18	.24	.15	.31	.05	.24	.37	.27	.32	.26	.17	.24	.19	.48
17	.05	.13	.29	.15	.24	.02	.32	.19	.33	.07	.05	.22	.20	.13	.27
18	.32	.27	.23	.35	.20	.02	.39	.34	.39	.38	.22	.20	.40	.29	.54
19	.30	.18	.15	.41	.17	.20	.29	.35	.29	.30	.21	.17	.41	.37	.43
20	.25	.06	.09	.27	.02	.13	.24	.25	.19	.26	.05	.11	.33	.25	.43
23	.21	.05	.15	.26	.20	.11	.20	.26	.12	.25	.11	.03	.33	.22	.28
24	.33	.22	.26	.33	.18	.26	.26	.37	.25	.32	.25	.29	.20	.42	.30
25	.30	.28	.45	.19	.31	.26	.36	.43	.39	.32	.19	.27	.23	.22	.35
26	.35	.23	.50	.19	.19	.15	.41	.47	.35	.37	.17	.18	.33	.29	.39
27	.25	.31	.55	.34	.37	.05	.32	.42	.42	.34	.17	.40	.32	.32	.43
28	.18	.18	.29	.11	.20	.04	.29	.31	.26	.25	.18	.23	.33	.30	.31
29	.24	.21	.43	.35	.22	.02	.39	.44	.40	.21	.30	.21	.30	.31	.31
30	.32	.28	.20	.42	.32	.30	.47	.40	.32	.45	.37	.25	.34	.33	.25

TABLE B-3

Intercorrelations Among Tests Given To Combined Groups

Section III

Test	16	17	18	19	20	23	24	25	26	27	28	29	30
16	1.00												
17	.36	1.00											
18	.40	.28	1.00										
19	.26	.21	.53	1.00									
20	.21	.10	.49	.63	1.00								
23	.21	.05	.32	.30	.25	1.00							
24	.30	.03	.31	.25	.23	.23	1.00						
25	.35	.34	.28	.12	.05	.20	.32	1.00					
26	.39	.29	.32	.23	.20	.35	.37	.50	1.00				
27	.43	.46	.31	.26	.13	.17	.27	.45	.47	1.00			
28	.31	.30	.21	.09	.03	.32	.25	.48	.39	.39	1.00		
29	.31	.33	.31	.24	.19	.20	.17	.53	.42	.49	.44	1.00	
30	.25	.17	.29	.20	.13	.30	.29	.33	.27	.30	.26	.33	1.00

TABLE B 4

Summer Supervisors
*Loadings On First 12 Factors Of Principal Axis Analysis

	1	2	3	4	5	6	7	8	9	10	11	12
1	.34	-.01	-.10	-.19	.07	-.13	.01	-.00	.25	-.09	-.09	-.07
2	.40	.28	.01	-.24	.04	-.04	.08	.28	.14	-.16	-.04	.02
3	.58	.01	-.23	-.39	.06	-.11	-.05	-.02	-.12	.09	.10	.00
4	.55	.47	.22	-.14	-.14	.07	.18	-.22	-.01	-.01	-.08	-.03
5	.29	-.11	.06	.06	.24	.19	.31	.22	-.00	.06	.09	.05
6	.20	.47	-.19	.27	.19	.07	-.08	-.01	-.00	-.04	.07	.04
7	.62	.37	.05	.25	-.02	-.06	-.23	.10	-.06	-.01	-.06	-.03
8	.63	-.03	-.05	.13	.17	-.14	.07	.17	-.07	.03	.06	-.16
9	.56	.46	-.09	-.15	-.17	.07	-.09	-.05	-.06	.01	.11	.04
10	.51	-.04	.12	.20	.15	-.31	-.12	-.01	-.00	.12	-.09	.07
11	.49	-.26	.55	-.02	-.11	-.05	-.02	-.02	.16	.11	.10	.02
12	.39	-.18	.24	-.05	.42	.08	-.14	-.16	-.09	-.04	.00	-.05
13	.62	-.09	.39	-.03	-.13	-.19	.04	-.00	-.06	-.19	.10	.04
23	.35	-.18	-.25	.28	-.33	-.07	.21	-.01	-.14	-.04	.03	-.03
24	.47	-.05	-.17	.16	.17	.00	.26	-.30	.10	-.05	.00	-.00
25	.60	-.15	-.33	-.01	.07	.24	-.14	-.04	.15	-.01	.08	.03
26	.54	-.22	-.40	-.01	-.12	-.27	-.01	-.01	.12	.08	-.01	.04
27	.63	-.13	-.05	-.26	.08	.08	.12	.04	-.20	.05	-.18	.06
28	.46	-.44	-.06	.12	-.07	.16	-.15	.02	-.07	-.22	-.06	.04
29	.62	-.19	.04	-.04	-.26	.31	-.12	.04	.05	.11	-.03	-.09
30	.49	.17	.14	.31	-.03	.15	.07	.05	.10	.08	-.08	.03

*Civil Service tests and criterion are not included in this Analysis.

TABLE B 5

Urban Corps
First 12 Factor Loadings Of Principal Axis Analysis

	1	2	3	4	5	6	7	8	9	10	11	12
1	.64	-.38	.16	-.17	-.10	.03	.08	.18	-.04	-.02	-.16	-.03
2	.59	-.06	.23	.16	-.09	-.30	-.05	-.02	-.09	.14	-.00	.04
3	.66	.41	.27	-.08	.06	.06	.01	.09	-.11	.02	.10	.09
4	.56	-.14	.07	-.44	-.00	.00	.01	-.03	-.15	-.03	.12	-.01
5	.55	.06	-.44	.06	.13	-.09	-.14	.03	-.14	.05	-.04	-.09
6	.43	-.18	.25	-.13	.06	-.12	-.34	-.04	.00	-.06	.06	-.04
7	.68	.05	.11	-.09	-.12	.07	-.12	.04	.11	.15	-.03	.03
8	.79	.05	.03	.20	-.23	.16	-.01	-.04	-.05	.10	-.04	-.01
9	.63	.31	.00	.10	-.00	-.11	.16	-.27	-.11	.01	-.00	-.04
10	.67	-.44	-.16	.23	-.09	-.11	-.01	.10	-.02	-.02	-.05	.07
11	.31	-.55	.03	.37	-.13	.12	.08	-.10	.01	-.14	.12	.01
12	.54	-.18	-.05	.15	.45	.09	.02	.03	.04	.06	.01	-.03
13	.54	-.21	-.25	-.12	-.10	.23	-.17	-.21	-.07	-.04	-.02	.01
23	.40	-.33	-.26	-.40	.07	-.07	.10	.00	.03	-.06	-.02	.07
24	.48	-.25	.51	.05	.22	-.00	.04	-.06	.04	-.09	-.07	-.05
25	.59	.27	-.13	.13	-.11	-.14	-.14	.16	.16	-.16	.07	-.03
26	.78	.23	.00	-.06	.08	.19	-.04	-.12	.26	.03	-.03	.03
27	.75	.31	-.11	.16	.28	.01	.03	.04	-.10	-.11	-.03	.09
28	.65	.22	-.08	-.14	-.10	-.30	.14	-.12	.15	-.06	-.03	-.01
29	.64	.42	.03	.02	-.17	.22	.10	.14	-.06	-.10	-.00	-.07
30	.72	-.30	-.14	-.04	.02	.00	.18	.08	.09	.18	.15	-.05

TABLE B 6

Combined Group (Summer Supervisors and Urban Corps)
Loadings on First 12 Factors of
Principal Axis Analysis

	1	2	3	4	5	6	7	8	9	10	11	12
1	.49	-.11	.03	.09	-.01	.24	-.00	-.00	-.18	.02	.07	-.02
2	.49	-.07	.23	-.10	-.11	.07	-.06	-.22	-.16	-.05	.05	-.02
3	.60	.32	.14	-.10	-.08	.19	-.01	-.01	.06	.00	-.02	.02
4	.55	-.20	.32	-.25	.15	.06	.21	.09	-.01	.02	.00	-.00
5	.41	-.02	-.14	.03	-.15	-.19	.21	-.24	-.03	.00	-.05	-.01
6	.33	-.17	.40	.25	-.08	-.11	.02	.04	.02	-.08	-.03	.02
7	.65	-.11	.24	.02	.05	-.16	-.19	.04	.14	.02	.03	-.04
8	.71	-.01	-.03	.06	-.08	.00	-.13	-.12	.03	.09	-.10	-.06
9	.59	.11	.32	-.18	.04	-.05	-.04	.01	.04	-.06	-.03	.02
10	.60	-.30	-.14	.13	-.11	.02	-.14	-.01	.09	.04	.06	.04
11	.44	-.38	-.36	-.21	-.01	.03	-.12	.08	-.09	-.01	-.05	.03
12	.42	-.06	-.20	-.02	-.32	-.03	.12	.17	.10	-.03	.01	-.03
13	.59	-.27	-.20	-.18	.16	.08	.00	-.09	.10	-.15	-.02	-.00
23	.38	-.05	-.11	.22	.37	.03	.18	-.08	.06	.03	-.00	.00
24	.49	-.09	.02	.21	-.09	.17	.14	.17	-.07	-.01	-.06	-.02
25	.64	.30	-.04	.15	-.05	-.13	-.04	.05	-.15	-.08	-.01	.04
26	.64	.25	-.06	.22	.11	.18	-.10	-.00	.07	.03	-.01	.03
27	.65	.30	-.09	-.16	-.16	.01	.16	-.04	.10	.05	.07	.01
28	.51	.23	-.24	.09	.15	-.10	.00	.03	-.02	-.14	.07	-.04
29	.61	.29	-.11	-.21	.15	-.14	-.07	.11	-.11	.09	-.03	-.11
30	.59	-.28	.02	.06	.06	-.20	.07	.02	-.07	.11	.04	.02

TABLE B 7

Eleven Factor Target: Summer Supervisors

	NMS	NSS	CSS	CMI	CMT	CMS	CBS	CBT	EMC	CSC	EMR
1	.52	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2	.0	.65	.0	.0	.0	.0	.0	.0	.0	.0	.0
3	.0	.0	.78	.0	.0	.0	.0	.0	.0	.0	.0
4	.0	.0	.0	.85	.0	.0	.0	.0	.0	.0	.0
5	.0	.0	.61	.0	.0	.0	.0	.0	.0	.0	.0
6	.0	.0	.0	.0	.65	.0	.0	.0	.0	.0	.0
7	.82	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8	.0	.0	.72	.0	.0	.0	.0	.0	.0	.0	.0
9	.0	.0	.0	.0	.0	.80	.0	.0	.0	.0	.0
10	.0	.0	.0	.0	.0	.0	.70	.0	.0	.0	.0
11	.0	.0	.0	.0	.0	.0	.83	.0	.0	.0	.0
12	.0	.0	.0	.0	.0	.0	.0	.71	.0	.0	.0
13	.0	.0	.0	.0	.0	.0	.0	.81	.0	.0	.0
23	.0	.0	.0	.0	.0	.0	.0	.0	.71	.0	.0
24	.0	.0	.0	.0	.0	.0	.0	.0	.70	.0	.0
25	.0	.0	.79	.0	.0	.0	.0	.0	.0	.0	.0
26	.0	.0	.0	.0	.0	.79	.0	.0	.0	.0	.0
27	.0	.0	.0	.0	.0	.78	.0	.0	.0	.0	.0
28	.0	.0	.0	.0	.0	.0	.0	.0	.0	.74	.0
29	.0	.80	.0	.0	.0	.0	.0	.0	.0	.0	.0
30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.67

TABLE B 8

Targeted Rotation, 11 Factors
Summer Supervisors

	NMS	NSS	CSS	CMU	CMT	CMS	CBS	CBT	EMC	CSC	EMR
1	.28	.11	.26	.13	-.15	.13	.09	.00	.07	.01	-.20
2	.36	.36	.25	.15	-.06	.15	-.08	.13	-.07	-.21	-.00
3	.06	.08	.46	.09	-.00	.57	.05	.14	-.04	-.04	-.17
4	.18	.22	.06	.64	.10	.33	.09	.22	.08	-.15	.16
5	-.09	.14	.45	.00	-.08	-.12	.01	.14	.11	-.08	.27
6	.32	-.06	.17	.14	.47	.03	-.13	-.06	.05	-.07	.16
7	.48	.15	.13	.10	.35	.33	.19	.18	.03	.03	.31
8	.24	.07	.46	-.09	.05	.25	.18	.24	.20	-.05	.19
9	.19	.29	.16	.34	.35	.49	-.01	.08	.00	-.09	.03
10	.34	-.13	.22	-.03	.02	.22	.43	.21	.09	.03	.15
11	-.05	.30	.11	.12	-.12	.03	.64	.36	.03	.07	.06
12	.04	-.14	.28	.13	.01	-.02	.22	.42	-.14	.25	.02
13	.14	.28	.08	.10	-.05	.22	.36	.57	.20	.00	.02
23	-.02	.11	.04	-.15	.01	.32	.03	.02	.57	.10	.16
24	.11	-.11	.39	.26	.04	.08	.10	.06	.45	.11	.02
25	.10	.22	.55	.05	.15	.25	.08	-.05	.15	.37	-.07
26	.20	.07	.34	-.15	-.09	.47	.22	-.11	.34	.10	-.16
27	.03	.11	.45	.16	-.25	.44	.02	.24	.02	.13	.17
28	.05	.20	.23	-.17	-.06	.16	.10	.24	.21	.54	.05
29	-.06	.45	.26	.11	.00	.34	.27	.05	.06	.36	.18
30	.22	.21	.17	.21	.16	.05	.24	.05	.18	.05	.41

TABLE B 9

Random Target: Summer Supervisors

	* 1 ** NMS	2 NSS	3 CSS	4 CMT	5 CMS	6 CBS	7 CBT	8 CSC	9 EMR
1	.0	.0	.52	.0	.0	.0	.0	.0	.0
2	.0	.0	.0	.0	.0	.0	.0	.0	.65
3	.0	.0	.0	.0	.0	.0	.78	.0	.0
4	.0	.0	.0	.85	.0	.0	.0	.0	.0
5	.61	.0	.0	.0	.0	.0	.0	.0	.0
6	.0	.0	.0	.0	.65	.0	.0	.0	.0
7	.0	.82	.0	.0	.0	.0	.0	.0	.0
8	.0	.0	.0	.0	.0	.72	.0	.0	.0
9	.0	.0	.0	.0	.0	.0	.0	.80	.0
10	.0	.0	.70	.0	.0	.0	.0	.0	.0
11	.83	.0	.0	.0	.0	.0	.0	.0	.0
12	.71	.0	.0	.0	.0	.0	.0	.0	.0
13	.0	.0	.0	.0	.0	.0	.81	.0	.0
23	.0	.0	.0	.0	.0	.0	.71	.0	.0
24	.0	.0	.0	.0	.0	.0	.0	.0	.70
25	.0	.79	.0	.0	.0	.0	.0	.0	.0
26	.0	.0	.0	.0	.0	.0	.79	.0	.0
27	.0	.0	.78	.0	.0	.0	.0	.0	.0
28	.0	.0	.0	.0	.74	.0	.0	.0	.0
29	.0	.0	.0	.0	.80	.0	.0	.0	.0
30	.0	.67	.0	.0	.0	.0	.0	.0	.0

*Numeric designation of factor axes.
**

TABLE B 10

Rotation to Random Target
Summer Supervisors

	1*	2	3	4*	5*	6*	7	8*	9
1	.04	.11	.28	-.03	-.00	-.13	.22	.06	.31
2	.04	.14	.22	.14	.02	.13	.11	.29	.33
3	.07	.03	.40	-.02	.11	.07	.44	.44	.15
4	.13	.26	.15	.67	.04	-.02	.16	.31	.20
5	.32	.04	.05	-.01	.15	.34	.01	-.05	.25
6	-.17	.46	-.04	.07	.00	.21	-.13	.11	.19
7	.03	.64	.19	.23	.13	.23	.17	.21	-.03
8	.21	.32	.25	-.02	.10	.37	.35	.04	.16
9	-.05	.34	.09	.33	.15	.04	.26	.54	.12
10	.23	.42	.35	.02	-.08	.15	.29	-.09	-.06
11	.68	.18	.09	.16	.04	-.12	.31	-.06	-.11
12	.50	.08	.33	-.03	.17	.06	-.01	.05	.06
13	.46	.13	.11	.28	.09	.10	.48	.04	.03
23	-.14	.13	-.10	.10	.25	.20	.53	-.21	.02
24	.11	.23	.12	.11	.12	.05	.28	-.14	.41
25	.11	.31	.19	-.20	.46	-.06	.29	.17	.28
26	-.09	.24	.28	-.18	.10	-.03	.63	-.02	.15
27	.19	-.01	.50	.17	.33	.19	.30	.13	.14
28	.19	.11	.14	-.12	.56	.02	.32	-.16	.01
29	.27	.26	.15	.11	.52	-.10	.32	.12	-.05
30	.18	.51	.04	.28	.17	.14	.07	-.06	.09

*Factor-designations in text discussion, pages 43-44:
1 - CBX, 4 - CMU, 5 - Symbolic Factor, 6 - CSS, 8 - CMS Related Factor

TABLE B 11

Target Hypothesis I: Summer Supervisors

	CMX	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.0	.0	.0	.0	.0	.43	.0
2-Word Changes	.0	.0	.0	.0	.0	.0	.56
3-Number Series	.0	.0	.0	.76	.0	.0	.0
4-Word Completion	.32	.0	.0	.0	.0	.0	.0
5-Circle Reasoning	.0	.0	.0	.55	.0	.0	.0
6-Similarities	.65	.0	.0	.0	.0	.0	.0
7-Temporal Order	.0	.0	.0	.0	.0	.81	.0
8-Letter Series	.0	.0	.0	.69	.0	.0	.0
9-Necessary Facts	.0	.78	.0	.0	.0	.0	.0
10-Missing Cartoons	.0	.0	.0	.0	.68	.0	.0
11-Missing Pictures	.0	.0	.0	.0	.80	.0	.0
12-Picture Exchange	.0	.0	.0	.0	.68	.0	.0
13-Social Translation	.0	.0	.0	.0	.78	.0	.0
23-Best Word Class	.0	.0	.69	.0	.0	.0	.0
24-Class Name Select.	.0	.0	.62	.0	.0	.0	.0
25-Letter Triangle	.0	.0	.0	.76	.0	.0	.0
26-Nec. Arith. Oper.	.0	.77	.0	.0	.0	.0	.0
27-Problem Solving	.0	.72	.0	.0	.0	.0	.0
28-Best Number Pairs	.0	.0	.0	.70	.0	.0	.0
29-Operations Sequence	.0	.0	.0	.0	.0	.0	.78
30-SI Verbal Analogies	.0	.0	.65	.0	.0	.0	.0

TABLE B 12

Target Hypothesis I: Urban Corps

	CMX	CMS	LMX	CSX	CBX	NMX	NSX
1-Sentence Order	.0	.0	.0	.0	.0	.81	.0
2-Word Changes	.0	.0	.0	.0	.0	.0	.74
3-Number Series	.0	.0	.0	.84	.0	.0	.0
4-Word Completion	.74	.0	.0	.0	.0	.0	.0
5-Circle Reasoning	.0	.0	.0	.75	.0	.0	.0
6-Similarities	.66	.0	.0	.0	.0	.0	.0
7-Temporal Order	.0	.0	.0	.0	.0	.73	.0
8-Letter Series	.0	.0	.0	.87	.0	.0	.0
9-Necessary Facts	.0	.74	.0	.0	.0	.0	.0
10-Missing Cartoons	.0	.0	.0	.0	.87	.0	.0
11-Missing Pictures	.0	.0	.0	.0	.77	.0	.0
12-Picture Exchange	.0	.0	.0	.0	.76	.0	.0
13-Social Translation	.0	.0	.0	.0	.72	.0	.0
23-Best Word Class	.0	.0	.73	.0	.0	.0	.0
24-Class Name Select.	.0	.0	.79	.0	.0	.0	.0
25-Letter Triangle	.0	.0	.0	.80	.0	.0	.0
26-Nec. Arith. Oper.	.0	.84	.0	.0	.0	.0	.0
27-Problem Solving	.0	.89	.0	.0	.0	.0	.0
28-Best Number Pairs	.0	.0	.0	.80	.0	.0	.0
29-Operations Sequence	.0	.0	.0	.0	.0	.0	.83
30-SI Verbal Analogies	.0	.0	.81	.0	.0	.0	.0

TABLE 13

Target Hypothesis I: Combined Group

	CMX	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.0	.0	.0	.0	.0	.57	.0
2-Word Changes	.0	.0	.0	.0	.0	.0	.58
3-Number Series	.0	.0	.0	.74	.0	.0	.0
4-Word Completion	.77	.0	.0	.0	.0	.0	.0
5-Circle Reasoning	.0	.0	.0	.55	.0	.0	.0
6-Similarities	.63	.0	.0	.0	.0	.0	.0
7-Temporal Order	.0	.0	.0	.0	.0	.76	.0
8-Letter Series	.0	.0	.0	.73	.0	.0	.0
9-Necessary Facts	.0	.71	.0	.0	.0	.0	.0
10-Missing Cartoons	.0	.0	.0	.0	.73	.0	.0
11-Missing Pictures	.0	.0	.0	.0	.74	.0	.0
12-Picture Exchange	.0	.0	.0	.0	.59	.0	.0
13-Social Translation	.0	.0	.0	.0	.73	.0	.0
23-Best Word Class	.0	.0	.63	.0	.0	.0	.0
24-Class Name Select.	.0	.0	.60	.0	.0	.0	.0
25-Letter Triangle	.0	.0	.0	.75	.0	.0	.0
26-Nec. Arith. Oper.	.0	.76	.0	.0	.0	.0	.0
27-Problem Solving	.0	.78	.0	.0	.0	.0	.0
28-Best Number Pairs	.0	.0	.0	.66	.0	.0	.0
29-Operations Sequence	.0	.0	.0	.0	.0	.0	.76
30-SI Verbal Analogies	.0	.0	.70	.0	.0	.0	.0

TABLE B 14

Target Hypothesis II: Summer Supervisors

	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.0	.0	.0	.0	.43	.0
2-Word Changes	.0	.0	.0	.0	.0	.55
3-Number Series	.0	.0	.75	.0	.0	.0
4-Word Completion	.79	.0	.0	.0	.0	.0
5-Circle Reasoning	.0	.0	.45	.0	.0	.0
6-Similarities	.64	.0	.0	.0	.0	.0
7-Temporal Order	.0	.0	.0	.0	.78	.0
8-Letter Series	.0	.0	.69	.0	.0	.0
9-Necessary Facts	.78	.0	.0	.0	.0	.0
10-Missing Cartoons	.0	.0	.0	.67	.0	.0
11-Missing Pictures	.0	.0	.0	.80	.0	.0
12-Picture Exchange	.0	.0	.0	.66	.0	.0
13-Social Translation	.0	.0	.0	.78	.0	.0
23-Best Word Class	.0	.65	.0	.0	.0	.0
24-Class Name Select.	.0	.56	.0	.0	.0	.0
25-Letter Triangle	.0	.0	.75	.0	.0	.0
26-Nec. Arith. Oper.	.77	.0	.0	.0	.0	.0
27-Problem Solving	.71	.0	.0	.0	.0	.0
28-Best Number Pairs	.0	.0	.68	.0	.0	.0
29-Operations Sequence	.0	.0	.0	.0	.0	.78
30-SI Verbal Analogies	.0	.67	.0	.0	.0	.0

TABLE B 15

Target Hypothesis II: Urban Corps

	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.0	.0	.0	.0	.80	.0
2-Word Changes	.0	.0	.0	.0	.0	.74
3-Number Series	.0	.0	.84	.0	.0	.0
4-Word Completion	.74	.0	.0	.0	.0	.0
5-Circle Reasoning	.0	.0	.75	.0	.0	.0
6-Similarities	.57	.0	.0	.0	.0	.0
7-Temporal Order	.0	.0	.0	.0	.71	.0
8-Letter Series	.0	.0	.87	.0	.0	.0
9-Necessary Facts	.72	.0	.0	.0	.0	.0
10-Missing Cartoons	.0	.0	.0	.87	.0	.0
11-Missing Pictures	.0	.0	.0	.76	.0	.0
12-Picture Exchange	.0	.0	.0	.76	.0	.0
13-Social Translation	.0	.0	.0	.70	.0	.0
23-Best Word Class	.0	.73	.0	.0	.0	.0
24-Class Name Select.	.0	.79	.0	.0	.0	.0
25-Letter Triangle	.0	.0	.79	.0	.0	.0
26-Nec. Arith. Oper.	.84	.0	.0	.0	.0	.0
27-Problem Solving	.89	.0	.0	.0	.0	.0
28-Best Number Pairs	.0	.0	.78	.0	.0	.0
29-Operations Sequence	.0	.0	.0	.0	.0	.83
30-SI Verbal Analogies	.0	.79	.0	.0	.0	.0

TABLE B 16

Target Hypothesis II: Combined Group

	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.0	.0	.0	.0	.57	.0
2-Word Changes	.0	.0	.0	.0	.0	.58
3-Number Series	.0	.0	.74	.0	.0	.0
4-Word Completion	.74	.0	.0	.0	.0	.0
5-Circle Reasoning	.0	.0	.50	.0	.0	.0
6-Similarities	.53	.0	.0	.0	.0	.0
7-Temporal Order	.0	.0	.0	.0	.73	.0
8-Letter Series	.0	.0	.72	.0	.0	.0
9-Necessary Facts	.71	.0	.0	.0	.0	.0
10-Missing Cartoons	.0	.0	.0	.72	.0	.0
11-Missing Pictures	.0	.0	.0	.73	.0	.0
12-Picture Exchange	.0	.0	.0	.58	.0	.0
13-Social Translation	.0	.0	.0	.73	.0	.0
23-Best Word Class	.0	.60	.0	.0	.0	.0
24-Class Name Select.	.0	.59	.0	.0	.0	.0
25-Letter Triangle	.0	.0	.74	.0	.0	.0
26-Nec. Arith. Oper.	.76	.0	.0	.0	.0	.0
27-Problem Solving	.77	.0	.0	.0	.0	.0
28-Best Number Pairs	.0	.0	.66	.0	.0	.0
29-Operations Sequence	.0	.0	.0	.0	.0	.76
30-SI Verbal Analogies	.0	.70	.0	.0	.0	.0

TABLE B 17

Factor Loadings
Hypothesis I: Summer Supervisors

	CMX	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.06	.35	-.04	.24	.13	.02	-.04
2-Word Changes	.37	.35	-.05	.13	.14	.03	.08
3-Number Series	.11	.58	-.13	.43	.14	.07	.07
4-Word Completion	.60	.35	.13	-.01	.26	.07	.30
5-Circle Reasoning	.21	-.08	.21	.35	.17	-.24	-.00
6-Similarities	.43	-.02	.13	.15	-.16	.40	-.10
7-Temporal Order	.36	.19	.22	.17	.26	.58	.13
8-Letter Series	.15	.24	.27	.42	.33	.16	-.09
9-Necessary Facts	.44	.44	.05	.13	.03	.31	.32
10-Missing Cartoons	.04	.15	.17	.23	.48	.33	-.16
11-Missing Pictures	-.04	.05	.10	.07	.73	-.03	.29
12-Picture Exchange	.09	-.12	-.16	.45	.45	.04	-.00
13-Social Translation	.07	.28	.18	.08	.67	.06	.19
23-Best Word Class	-.17	.27	.59	.13	.00	.05	.09
24-Class Name Select.	.16	.16	.36	.42	.11	-.02	-.11
25-Letter Triangle	-.01	.21	.13	.66	.00	.18	.24
26-Nec. Arith. Oper.	-.23	.54	.26	.38	.08	.17	-.05
27-Problem Solving	.14	.36	.05	.50	.27	-.12	.19
28-Best Number Pairs	.30	.04	.22	.47	.23	.10	.28
29-Operations Sequence	-.04	.19	.19	.38	.25	.09	.57
30-SI Verbal Analogies	.32	.02	.39	.17	.25	.21	.19

TABLE B 18

Factor Loadings
Hypothesis I: Urban Corps

	CMX	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.22	.04	.46	.22	.35	.42	.19
2-Word Changes	.22	.04	.22	.40	.26	-.01	.47
3-Number Series	.20	.55	.09	.42	-.11	.23	.35
4-Word Completion	.33	.13	.42	.30	.05	.39	-.03
5-Circle Reasoning	.07	.27	.08	.56	.33	-.11	-.21
6-Similarities	.55	.05	.13	.17	.21	.11	.18
7-Temporal Order	.25	.25	.10	.44	.19	.34	.21
8-Letter Series	-.00	.30	.03	.52	.40	.36	.34
9-Necessary Facts	-.06	.38	.18	.54	.04	.03	.28
10-Missing Cartoons	.06	-.02	.31	.39	.69	.09	.14
11-Missing Pictures	-.12	-.11	.17	-.05	.67	.16	.23
12-Picture Exchange	.14	.49	.31	.09	.47	-.07	-.00
13-Social Translation	.15	.13	.08	.35	.42	.38	-.20
23-Best Word Class	.16	-.02	.51	.26	.18	.21	-.32
24-Class Name Select.	.33	.27	.38	-.09	.26	.13	.46
25-Letter Triangle	.09	.28	-.02	.70	.19	.03	.20
26-Nec. Arith. Oper.	.17	.56	.11	.48	.17	.30	.12
27-Problem Solving	.04	.66	.14	.53	.21	-.06	.12
28-Best Number Pairs	.05	.16	.33	.68	-.05	.07	.17
29-Operations Sequence	-.08	.46	-.02	.52	-.04	.38	.23
30-SI Verbal Analogies	.03	.18	.48	.38	.44	.24	.03

TABLE B 19

Factor Loadings
Hypothesis I: Combined Group

	CMX	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.12	.32	.20	.16	.28	.24	-.07
2-Word Changes	.32	.27	-.01	.20	.22	.26	.10
3-Number Series	.14	.58	-.03	.39	.08	.13	.13
4-Word Completion	.53	.35	.25	.02	.23	.10	.28
5-Circle Reasoning	.16	.02	.15	.41	.25	-.13	.03
6-Similarities	.43	-.02	.18	.22	-.03	.34	-.09
7-Temporal Order	.30	.12	.17	.35	.20	.45	.28
8-Letter Series	.10	.26	.14	.46	.35	.30	.11
9-Necessary Facts	.35	.35	.04	.30	.05	.24	.34
10-Missing Cartoons	.07	.07	.21	.32	.53	.32	-.02
11-Missing Pictures	-.04	.03	.11	.07	.70	.08	.17
12-Picture Exchange	.12	.09	-.01	.39	.40	-.09	-.08
13-Social Translation	.08	.22	.29	.10	.56	.10	.26
23-Best Word Class	-.03	.15	.58	.13	.09	.05	.09
24-Class Name Select.	.18	.27	.27	.28	.23	.15	-.19
25-Letter Triangle	.00	.26	.15	.65	.07	.15	.15
26-Nec. Arith. Oper.	-.13	.46	.28	.44	.10	.27	.06
27-Problem Solving	.13	.46	.02	.54	.23	-.13	.16
28-Best Number Pairs	-.17	.21	.28	.46	.13	.01	.23
29-Operations Sequence	-.03	.33	.10	.44	.16	.03	.49
30-SI Verbal Analogies	.30	-.01	.35	.31	.35	.18	.18

TABLE B 20

Factor Loadings
Hypothesis II: Summer Supervisors

	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.30	-.07	.27	.14	-.03	-.05
2-Word Changes	.47	-.14	.11	.14	.15	.10
3-Number Series	.55	-.15	.47	.14	-.08	.03
4-Word Completion	.61	-.00	-.08	.25	.28	.34
5-Circle Reasoning	-.06	.02	.32	.16	.23	.14
6-Similarities	.28	.17	.02	-.19	.51	-.08
7-Temporal Order	.50	.34	.07	.25	.41	.06
8-Letter Series	.30	.22	.41	.33	.21	-.08
9-Necessary Facts	.70	.07	.07	.02	.20	.26
10-Missing Cartoons	.22	.23	.22	.47	.19	-.20
11-Missing Pictures	.04	.10	.08	.73	-.05	.28
12-Picture Exchange	-.07	-.15	.39	.42	.27	.08
13-Social Translation	.30	.15	.11	.68	-.02	.16
23-Best Word Class	.19	.56	.21	.04	-.19	.01
24-Class Name Select.	.18	.23	.42	.12	.20	-.04
25-Letter Triangle	.25	.20	.64	-.01	.07	.22
26-Nec. Arith. Oper.	.40	.30	.49	.11	-.25	-.17
27-Problem Solving	.33	-.05	.52	.27	.00	.23
28-Best Number Pairs	-.04	.33	.49	.23	-.12	.22
29-Operations Sequence	.24	.27	.36	.25	-.08	.52
30-SI Verbal Analogies	.21	.36	.08	.23	.37	.22

TABLE B 21

Factor Loadings
Hypothesis II, Urban Corps

	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	.23	.45	.18	.34	.46	.16
2-Word Changes	.13	.35	.38	.20	.05	.47
3-Number Series	.63	.03	.39	-.10	.17	.36
4-Word Completion	.36	.43	.23	.03	.43	-.05
5-Circle Reasoning	.28	.12	.55	.31	-.12	-.19
6-Similarities	.23	.41	.09	.10	.18	.22
7-Temporal Order	.38	.15	.39	.16	.34	.22
8-Letter Series	.33	-.03	.52	.41	.32	.34
9-Necessary Facts	.38	.05	.55	.07	-.02	.26
10-Missing Cartoons	.04	.37	.39	.66	.13	.13
11-Missing Pictures	-.12	.14	-.03	.69	.16	.22
12-Picture Exchange	.51	.25	.08	.48	-.14	.01
13-Social Translation	.24	.11	.30	.40	.37	-.18
23-Best Word Class	.16	.47	.21	.18	.25	-.36
24-Class Name Select.	.39	.41	-.13	.24	.12	.46
25-Letter Triangle	.30	.04	.69	.16	.02	.21
26-Nec. Arith. Oper.	.64	.03	.45	.18	.22	.13
27-Problem Solving	.64	.04	.53	.24	-.16	.13
28-Best Number Pairs	.26	.28	.67	-.05	.10	.13
29-Operations Sequence	.49	-.20	.52	.02	.29	.22
30-SI Verbal Analogies	.29	.37	.37	.47	.24	-.01

TABLE B 22

Factor Loadings
Hypothesis II, Combined Group

	CMS	EMX	CSX	CBX	NMX	NSX
1-Sentence Order	0.39	0.21	0.18	0.28	0.06	-0.12
2-Word Changes	0.47	0.00	0.13	0.21	0.13	0.06
3-Number Series	0.59	-0.06	0.44	0.08	-0.04	0.10
4-Word Completion	0.59	0.16	-0.07	0.24	0.20	0.27
5-Circle Reasoning	0.04	0.05	0.35	0.26	0.21	0.12
6-Similarities	0.30	0.20	0.06	-0.04	0.50	-0.10
7-Temporal Order	0.43	0.26	0.23	0.17	0.40	0.22
8-Letter Series	0.37	0.19	0.44	0.33	0.19	0.07
9-Necessary Facts	0.56	0.04	0.22	0.04	0.22	0.30
10-Missing Cartoons	0.20	0.27	0.28	0.51	0.25	-0.06
11-Missing Pictures	0.06	0.14	0.08	0.69	0.02	0.16
12-Picture Exchange	0.08	-0.09	0.36	0.41	0.17	-0.01
13-Social Translation	0.28	0.28	0.12	0.56	-0.00	0.23
23-Best Word Class	0.14	0.53	0.18	0.11	-0.06	0.08
24-Class Name Select.	0.33	0.22	0.28	0.24	0.14	-0.19
25-Letter Triangle	0.27	0.15	0.64	0.06	0.14	0.14
26-Nec. Arith. Oper.	0.41	0.31	0.54	0.10	-0.10	-0.02
27-Problem Solving	0.39	-0.10	0.57	0.24	-0.00	0.21
28-Best Number Pairs	0.11	0.27	0.52	0.12	-0.07	0.23
29-Operations Sequence	0.31	0.10	0.47	0.15	-0.06	0.47
30-SI Verbal Analogies	0.22	0.34	0.19	0.34	0.37	0.20

TABLE B 23

Factor Extension: Summer Supervisors

	Extended Matrix			
	XSS	XMX	CBX	EMX
	1	2	3	4
14-Vocabulary	0.20	0.18	0.21	0.41
15-Sociological Knowledge	0.02	0.12	0.05	0.33
16-CS Figural Analogies	0.41	0.05	0.00	0.31
17-Mathematics	0.30	0.23	0.05	0.06
18-Reading Comprehension	-0.01	0.32	0.15	0.27
19-Verbal Analogies	-0.08	0.22	0.32	0.21
20-Judgment	-0.10	0.18	0.23	0.17
	Squared Elements			
	1	2	3	4
14-Vocabulary	0.04	0.03	0.04	0.17
15-Sociological Knowledge	0.00	0.01	0.00	0.11
16-CS Figural Analogies	0.17	0.00	0.00	0.10
17-Mathematics	0.09	0.05	0.00	0.00
18-Reading Comprehension	0.00	0.10	0.02	0.13
19-Verbal Analogies	0.00	0.04	0.10	0.09
20-Judgment	0.01	0.03	0.05	0.03
	Communalities			
	1			
14-Vocabulary	0.29			
15-Sociological Knowledge	0.13			
16-CS Figural Analogies	0.27			
17-Mathematics	0.15			
18-Reading Comprehension	0.26			
19-Verbal Analogies	0.25			
20-Judgment	0.12			

TABLE B 24

Factor Extension: Urban Corps

	Extended Matrix			
	XSS	XMX	CBX	EMX
	1	2	3	4
14-Vocabulary	0.11	0.51	0.06	0.65
15-Sociological Knowledge	0.28	0.49	0.27	0.37
16-CS Figural Analogies	0.45	0.27	0.59	-0.04
17-Mathematics	0.52	0.46	0.13	-0.27
18-Reading Comprehension	0.58	0.32	0.43	0.19
19-Verbal Analogies	0.35	0.23	0.27	0.31
20-Judgment	0.23	0.17	0.14	0.22

	Squared Elements			
	1	2	3	4
14-Vocabulary	0.01	0.26	0.00	0.42
15-Sociological Knowledge	0.08	0.24	0.07	0.14
16-CS Figural Analogies	0.20	0.07	0.34	0.00
17-Mathematics	0.27	0.22	0.01	0.07
18-Reading Comprehension	0.33	0.10	0.18	0.03
19-Verbal Analogies	0.12	0.05	0.07	0.09
20-Judgment	0.05	0.03	0.02	0.05

	Communalities
	1
14-Vocabulary	0.71
15-Sociological Knowledge	0.54
16-CS Figural Analogies	0.63
17-Mathematics	0.58
18-Reading Comprehension	0.66
19-Verbal Analogies	0.35
20-Judgment	0.15

TABLE B 25

Factor Extension: Combined Group

	Extended Matrix			
	XSS	XMX	CBX	EMX
	1	2	3	4
14-Vocabulary	0.30	0.16	0.09	0.54
15-Sociological Knowledge	0.19	0.23	0.13	0.33
16-CS Figural Analogies	0.47	0.07	0.18	0.17
17-Mathematics	0.51	0.19	-0.01	-0.08
18-Reading Comprehension	0.23	0.29	0.22	0.36
19-Verbal Analogies	0.12	0.22	0.26	0.33
20-Judgment	0.04	0.17	0.17	0.27

	Squared Elements			
	1	2	3	4
14-Vocabulary	0.09	0.02	0.01	0.29
15-Sociological Knowledge	0.03	0.05	0.01	0.11
16-CS Figural Analogies	0.22	0.00	0.03	0.03
17-Mathematics	0.26	0.03	0.00	0.00
18-Reading Comprehension	0.05	0.08	0.04	0.12
19-Verbal Analogies	0.01	0.04	0.07	0.11
20-Judgment	0.00	0.03	0.02	0.07

	Communalities
	1
14-Vocabulary	0.42
15-Sociological Knowledge	0.22
16-CS Figural Analogies	0.29
17-Mathematics	0.30
18-Reading Comprehension	0.32
19-Verbal Analogies	0.24
20-Judgment	0.14

APPENDIX C

Rating Scale Used with Summer Supervisors

Trait Evaluations: For each trait listed, please place a check mark in the appropriate place to the right.

TRAIT	EXCEL-LENT	SATISFAC-TORY	UNSATIS-FACTORY
Attitude toward the department.....			
Attitude toward the job.....			
Attitude toward the supervisor.....			
Personal appearance.....			
Accuracy and completeness of work.....			
Willingness to learn.....			
Tact and courtesy.....			
Judgment.....			
Discipline, control and leadership of enrollees.			
Interest in welfare of enrollees.....			
Problem solving ability.....			
Care of property and materials.....			
Planning and assigning of work.....			
Relationship with his supervisor.....			
Safety consciousness.....			
Keeping supervisor informed of work problems and progress.....			
Creativity, adaptability and resourcefulness....			

Score is sum of ratings on 17 scales: excellent = 2; satisfactory = 1; unsatisfactory = 0.

For N = 90, the mean score was 21.5, the standard deviation 8.4.

Rating Scale Used with Urban Corps

Please circle the number next to each question below which most closely represents your opinion. Numbers range from 1 to 5. Thus, the number 1 indicates the HIGHEST level of effectiveness, while 5 indicates the LOWEST. Similarly, 1 indicates the LEAST amount of training required, while 5 indicates the MOST, etc.

1. How effective was the student in performing his/her work? 1 2 3 4 5

5. How well did the student respond to instruction or training? 1 2 3 4 5

6. Did the intern demonstrate an eagerness to work? 1 2 3 4 5

7. How much imagination or initiative did he/she exhibit? 1 2 3 4 5

8. Did he/she establish a good working relationship with fellow workers? 1 2 3 4 5

Only these 5 of the 9 scales were used in scoring for this study.

Score is 30 minus the sum of the numbers circled.

For N = 33, the mean was 20.6, the standard deviation 5.9.

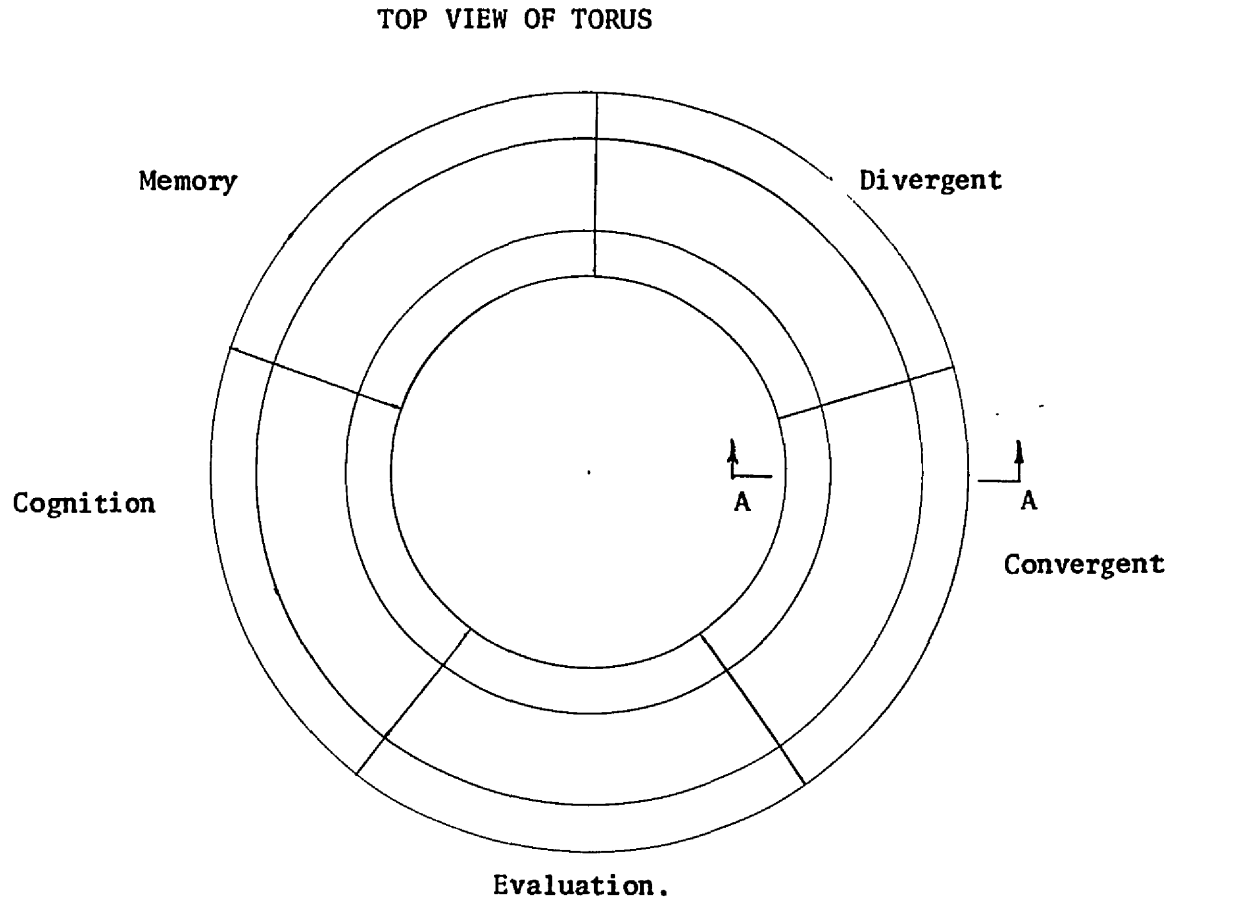
Unused items are shown below:

Unused scales

2. How much responsibility was the student given in his/her assignment? 1 2 3 4 5

3. How easily did the student assume responsibility? 1 2 3 4 5

4. How much training or instruction was required to prepare the student for his/her duties? 1 2 3 4 5



A torus representation of the Guilford SI Model
(adapted from varela, 1969)

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