

DOCUMENT RESUME

ED 062 552

08

VT 015 248

AUTHOR Neeb, Robert W.; And Others  
TITLE Human Attribute Requirements of Work Elements:  
Further Development of the Occupation Analysis  
Inventory.  
INSTITUTION North Carolina State Univ., Raleigh. Center for  
Occupational Education.  
SPONS AGENCY National Center for Educational Research and  
Development (DHEW/OE), Washington, D.C.  
REPORT NO Cen-Res-Monog-7  
BUREAU NO BR-7-0348  
PUB DATE 71  
GRANT OEG-2-7-070348-2698  
NOTE 200p.; Report Number 4 of the Ergometric Research and  
Development Series

EDRS PRICE MF-\$0.65 HC-\$6.58  
DESCRIPTORS Ability Grouping; \*Ability Identification; Cognitive  
Ability; \*Individual Characteristics; Needs;  
Psychomotor Skills; \*Skill Analysis; \*Vocational  
Interests

IDENTIFIERS ARI; Attribute Requirement Inventory; OAI;  
\*Occupational Analysis Inventory

ABSTRACT

As part of a research framework for a program to improve articulation between the educational and work domains of society, this report describes an attempt to link descriptions of work activities and conditions contained in an Occupation Analysis Inventory (OAI) with certain defined human attributes in the cognitive, affective, and psychomotor domains. The study provides attribute-requirement estimates for the work elements in the OAI, derives basic work dimensions from the attribute-requirement profiles of the OAI work elements, and determines the stability of the resulting OAI dimensions. The application of this research can help to provide counselors with a solid framework for helping students make career decisions. (BH)

HUMAN ATTRIBUTE REQUIREMENTS  
OF WORK ELEMENTS

Further Development of the Occupation Analysis Inventory

Robert W. Neeb, J. W. Cunningham,  
and John J. Pass

Department of Psychology  
North Carolina State University at Raleigh

Report No. 4 of the Ergometric Research and Development Series

Program Director: J. W. Cunningham

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The research reported herein was performed pursuant to a grant with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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Center Research Monograph No. 7

1971

CENTER FOR OCCUPATIONAL EDUCATION

North Carolina State University at Raleigh

Project No. BR 7-0348

Grant No. OEG-2-7-070348-2698

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## PREFACE

One of the problems facing occupational educators today is that of providing an articulation between the work domain of the real world of modern society and the educational domain. Too often, the ideas surrounding what constitutes education for the world of work are based upon intuition or upon traditional methods or curricula whose slow change lags sadly behind the rapidly changing work domain. The Ergometric Research and Development Program presently under way at the Center for Occupational Education has as one of its principle guiding philosophies the notion that progress in education for the world of work will depend heavily upon the ability of research to produce a viable framework through which the educational and work domains may be interrelated.

Although the total program envisions the development of tested products such as curricula and testing devices for general use in the field of occupational education, the first step is the development of a sound empirically supported foundation in research. This report, the fourth in the Ergometric Research and Development Series, presents one aspect of the foundation which is being built. The report describes an attempt to link the descriptions of work activities and conditions contained in the Occupation Analysis Inventory with certain defined human attributes for which standardized tests presently exist. The results of this research move the program a step closer to the ability to determine the human attributes in the cognitive, affective and psychomotor domain that a job, or cluster of jobs requires.

The implications of this research from a developmental standpoint relate primarily to the guidance and placement functions within educational institutions. Potentially, the application of this research can mean that counselors will be provided with a solid framework for helping students make career decisions.

The Center extends its appreciation to the authors of the report and to the graduate students from the Department of Psychology at North Carolina State University who assisted as raters on the project. A special note of thanks goes to Mr. William Ballenger and Mrs. Faye Childers for their assistance in the compilation and processing of the data for the report. Finally, the Center recognizes the assistance of its technical and editorial staff in the preparation of the report for final publication.

John K. Coster  
Director

## SUMMARY

The present report, the fourth in the Ergometric Research and Development Series, describes an attempt to establish linkages between the work elements (descriptions of activities and conditions) in the Occupation Analysis Inventory and a set of defined human attributes in the cognitive, affective, and psychomotor domains.

Specifically, the purpose of this study was threefold: (1) to derive attribute-requirement estimates for the work elements in the Occupation Analysis Inventory (OAI), (2) to derive basic work dimensions (factors) from the attribute-requirement profiles of the OAI work elements, and (3) to determine the stability of the resulting OAI dimensions.

The first phase of the study involved the development of an Attribute Requirement Inventory (ARI), containing definitions of 103 human attributes for which there are identifiable tests. Following construction of the ARI, judges were employed to rate the "Degree of Relevance" of each ARI attribute to each of the work elements (items) in the OAI. Attribute weights were then computed for the OAI elements by averaging judges' ratings for each work element on each of the attributes. An analysis of inter-rater agreement indicated substantial reliabilities for the attribute weights.

Next, six separate groups of OAI work elements were intercorrelated based on attribute-requirement profiles, and each of the six correlation matrices was factor analyzed. The six analyses yielded 77 factors, or work dimensions, all of which were interpreted.

The rating data were then divided into two samples, and six factor analyses were performed on each sample. Evidence of factorial stability was obtained through comparisons across the two samples using Tucker's coefficient of congruence (applied to factor loadings) and the Pearson product-moment correlation (applied to factor scores).

Finally, the 77 first-order factors were subjected to a higher-order factor analysis, which produced 21 interpretable dimensions.

It was noted that the factors derived in this study are subject to a different interpretation than those derived from ratings of occupations on the OAI and that this difference might have some bearing on their application.

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## INTRODUCTION

With the increasing rate of change in our society and work technology, it is imperative that the individual possess capabilities which are transferable across a variety of work situations. The increasing number and variety of jobs renders impracticable the traditional practice of developing a separate educational program for each occupational title (Dillon and Horner, 1968; Face, 1967). Moreover, it would be infeasible to base occupationally related curricula in the early grades (e.g., occupational awareness and exploration curricula) upon individual occupations.

This situation points to the need for a comprehensive taxonomy of human work which could be used to impose some structure and parsimony upon occupational education (Cunningham, 1971; Cunningham, Tuttle, Floyd, and Bates, 1971). One concept which has emerged in response to this need has been termed "occupational clustering"--the grouping of occupations with similar educational requirements. According to the rationale behind the clustering approach, it should prove feasible to develop curricula providing knowledges and skills common to occupations within clusters. This approach could prove applicable at several levels in occupational education, including occupational awareness and exploration curricula, curricula directed toward general vocational capabilities, and curricula at the vocational, technical, and professional levels. The cluster concept raises some troublesome questions, however, concerning the definition and measurement of the variables by which occupations should be described, compared, and grouped for educational purposes (Cunningham, 1969, 1971; Cunningham et al., 1971). To date, little effort has been directed toward answering these questions.

The Occupation Analysis Inventory (OAI) developed at the Center for Occupational Education was conceived as an initial step toward a scheme for describing and classifying occupations for educational purposes (Cunningham et al., 1970, 1971). The items, or work elements, comprising the OAI consist of statements describing various classes of work activities and conditions. These work elements represent an effort to achieve as high a level of descriptive specificity (or content loading) as possible, while retaining applicability to the entire spectrum of occupations. In addition to describing occupations in terms of observable events, however, it was felt that the OAI scheme should also provide occupational descriptions in terms of human attribute requirements--that is, in terms of measurable human characteristics in the cognitive, psychomotor, and affective domains. For this purpose, the OAI work elements were to be linked with certain human dimensions for which there are tests. Such linkages would provide the means for transforming ratings of occupations on the OAI work elements into estimates of the human attribute requirements of the rated occupations. The feasibility of this "synthetic" approach to determining the attribute requirements of jobs and occupations has been demonstrated by the research of E. J. McCormick and his associates at Purdue University

(McCormick, Cunningham, and Thornton, 1967; Mecham and McCormick, 1969a, 1969b).

The present study is concerned with (1) deriving estimated human attribute requirements for the OAI work elements, (2) deriving basic work dimensions (factors) based on the attribute-requirement profiles of the OAI work elements, and (3) determining the stability of the resulting OAI work dimensions. The OAI work dimensions and attribute-requirement estimates might ultimately be applied in such areas as: curriculum development, curriculum evaluation, guidance and placement, test development, and educational planning. The potential applications of the OAI have been discussed in greater detail in a previous paper (Cunningham, Tuttle, Floyd, and Bates, 1971).

RESEARCH INVOLVING INDIRECT VALIDITY AND  
THE DERIVATION OF WORK DIMENSIONS

Ghiselli (1959, 1966) has pointed to the need for a more analytical approach to test validation which would allow empirically established validity to be generalized from one job situation to another. His proposal was based on extensive reviews of the literature reporting validity coefficients of various aptitude tests in predicting job success (Brown and Ghiselli, 1953; Ghiselli, 1966; Ghiselli and Brown, 1951). In these reviews, Ghiselli and Brown found great variations in test validity coefficients within rather narrow job categories, with the greatest variation attributable to the type of criterion used.

The practice of inferring the validity of a test in a given job situation, based on the test's previously demonstrated validity in similar situations, has been termed indirect validity (McCormick, 1959). The concept of indirect validity might, in turn, be subdivided into two more specific approaches: generalized validity and synthetic validity (Lawshe, 1952). Lawshe defines generalized validity as:

. . . an extension of . . . [the classical approach] in that validity statements are assumed to apply to other populations, but only after samples from numerous populations have indicated a somewhat universal validity (p. 32).

He defines synthetic validity as:

. . . the inferring of validity in a specific situation [in a manner] . . . similar to that involved when the time study engineer establishes standard times for new operations, purely on an a priori basis, through the use of "synthetic" times for various elements constituting the operation [p. 32].

Similarly, Balma (1959) defines synthetic validity as:

. . . the inferring of validity in a specific situation from a logical analysis of jobs into their elements, a determination of a test validity for these elements, and a combination of elemental validities into a whole [p. 395].

Thus, generalized validity involves validity inference on the basis of gross, overall job similarities, whereas the synthetic validity approach involves (1) the establishment of test validities for each of a set of work components, (2) the analysis of specific jobs in terms of these basic work components, and (3) based on work-component analysis, the identification of tests which would validly predict success in the jobs analyzed.

Since the concept of synthetic validity underlies the procedure employed in the present study, a review of previous research under this topic is presented in the following sections. Also contained in

this review is a discussion of previous research in which work dimensions were derived based on the attribute-requirement ratings of jobs and work elements.

### Direct Trait-Requirement Ratings of Jobs

One method of estimating trait-requirements of jobs is to identify important traits and then to rate these traits directly on the extent to which they are required by each of a number of jobs. The resulting ratings can subsequently be used to derive (1) trait-requirement profiles for jobs and (2) trait factors and job clusters (or factors) based on the trait-requirement profiles of jobs. The following two sections review studies that used the direct job-rating approach in deriving trait-requirement estimates and work dimensions.

### Indirect Validity Based on Trait-Requirement Ratings of Jobs

The first step in this approach to indirect validity involves defining a set of worker traits which are relevant to job performance. Next, job requirements on these traits are established on the basis of direct ratings assigned to each job for each trait. Finally, tests are selected which measure the traits relevant to a particular job.

Viteles (1932), in attempting to systematically estimate the trait requirements of jobs, developed the "job psychographic method" of job analysis. This method involves the definition of 32 mental traits determined to be relevant to job performance. Jobs are then rated on the extent to which they require each of the defined traits. For a particular job, the ratings are graphically recorded on a form such that traits rated as very important to job success show up as peaks on the form. These peaks, or "'keystone' specific mental abilities" can be readily identified and are considered to be the abilities which must be "tapped" in predicting success for that job.

Another systematic attempt to estimate the human attribute requirements of jobs resulted in the Minnesota Occupational Rating Scales (Paterson, Gerken, and Hahn, 1941). The Minnesota Scales contain a list of 430 jobs rated by 20 vocational psychologists on six human abilities. Both the abilities and a four-level rating scale for each ability were defined. The ratings were averaged and a profile of abilities for each job was obtained. These profiles are offered for use by counselors in matching individual test profiles with the ability-requirement profiles of jobs. The Revised Minnesota Rating Scales (Paterson, Gerken, and Hahn, 1953) are a continuation of the work done on the original Minnesota Scales. The revised scales differ from the original scales by the inclusion of added occupations and ratings on an additional ability. In the revised scales, the levels to be rated were simplified, and D.O.T. numbers were assigned

for cross reference purposes. In addition, a Counseling Record was developed to help a counselor match people to jobs.

Other work involving the ratings of jobs on human trait requirements has been carried out by the United States Employment Service (USES). More than 4,000 jobs from the Dictionary of Occupational Titles has been rated by trained analysts on 48 trait requirements (U. S. Employment Service, undated). The traits include aptitudes, interests, temperaments, and physical capacities. These ratings form attribute-requirement profiles for jobs which can then be used for counseling, selection, and placement purposes. Some evidence for the validity of the USES aptitude-requirement ratings was obtained by Trattner, Fine, and Kubis (1955) from a study in which 10 jobs were rated on 10 aptitudes by two groups of raters. One group of raters used written descriptions of the jobs to be rated as the basis for their ratings, while the other groups performed their ratings on the basis of direct job observation. The resulting aptitude ratings were then correlated with the average GATB test scores (for the 10 aptitudes) of workers in the rated jobs. The results of the study showed (1) a substantial consistency between the ratings based on the two different sources of job information and (2) correlations ranging from .44 to .58 between the ratings and the average GATB test scores of incumbents in the 10 jobs. The investigators interpreted these correlations as indicating a satisfactory degree of consistency with test data.

A series of studies by Primoff (1953, 1955, 1957, 1959) has dealt not only with the estimation of attribute requirements of jobs, but also with a method for estimating test validities, the "J-coefficient." In the derivation of a J-coefficient, qualified judges (usually six to ten) rate, on a three-point scale, the importance of each of a list of human abilities to a particular job. The resulting ratings are averaged to produce an ability-requirement profile for the job. In addition, estimates are obtained (from a table) of the extent to which each of the abilities contributes to performance on each of a specified pool of tests. These latter estimates, or "Beta weights," were originally based on the judgment of a group of psychometrists, but have been revised as actual validity data have been obtained. Finally, a J-coefficient is computed for each test by applying a formula to the ability-requirement estimates for the job and the Beta weights for the test. The resulting J-coefficient is an estimate of the correlation between scores on the test and performance on the job.

One study in which the J-coefficient technique was used was reported by Wherry (1955). In this study, 54 Printer Assistants were administered five tests. J-coefficients were then computed for the five tests and compared with the actual validity coefficients for the same tests. The correlation between J-coefficients and validity coefficients was .55. In the follow-up study, a sample of 135 new workers was used and the correlation was .93. Wherry concluded that these results offer some "empirical evidence" for the J-coefficient method.

### Dimensions Derived from Trait-Requirement Ratings of Jobs

The work reviewed thus far involved establishing the trait requirements of jobs based upon direct job ratings on specified human attributes. Several studies have employed such ratings in deriving basic attribute dimensions, or factors. The rationale for this approach is that the analysis of intercorrelations among the trait ratings of a representative sample of jobs might yield basic trait dimensions for which job requirements could be established. Furthermore, it might be possible to cluster jobs on the basis of their trait-dimension profiles and to establish average trait-requirement profiles for the resultant job clusters. The trait profiles of people could then be compared with the trait-dimension profiles of job clusters.

One of the first attempts to derive dimensions from attribute ratings of jobs involved the rating of 275 occupations on the extent to which they required 20 human traits, one skill, and two job characteristic variables (Jaspen, 1949). The 20 traits were selected from the 45 traits included in the Worker Characteristics Form of the U. S. Employment Service. These ratings were intercorrelated, and the resulting matrix was factor analyzed. Although eight factors were obtained, only six of these were interpreted. These factors were labeled: (1) Strength, (2) Intelligence, (3) Inspection, (4) Physically Unpleasant Working Conditions, (5) Manual Dexterity, and (6) Mechanical Information.

In another study, McCormick, Finn, and Scheips (1957) factor analyzed the USES ratings of 4,000 jobs on 44 human attributes (U. S. Employment Service, undated). Seven factors were identified in this analysis: (1) Mental and Educational Development versus Adaptability to Routine, (2) Adaptability to Precision Operations, (3) Body Agility, (4) Artistic Ability and Aesthetic Appreciation, (5) Manual Art Ability, (6) Personal Contact Ability versus Adaptability to Routine, and (7) Heavy Manual Work versus Clerical Ability. Next, factor scores were derived for each job on each of the seven factors. The factor scores were then divided into "High" and "Low" levels, with the exception of one factor which was divided into "High," "Average," and "Low" levels. From these factor score levels, 192 unique factor score "patterns" (or permutations) were obtained. It was found, however, that 33 patterns accounted for 88 percent of the jobs and that 115 patterns accounted for all of the jobs. The authors interpreted these findings as evidence that jobs can be classified according to a limited number of attribute requirement patterns.

In a study reported by Norris (1956), 159 Air Force enlisted jobs were rated on the level at which each of 170 defined human traits was required in the job. The ratings of 130 of the most reliable and important traits were intercorrelated, and the resulting matrix was factor analyzed. Of the 25 identified factors, only 11 were interpreted: (1) Managerial Ability, (2) Speed, (3) Social-Verbal Facility, (4) Strength, (5) Reasoning, (6) Accuracy, (7) Spatial Visualization, (8) Foot-Hand Coordination, (9) Emotional Control, (10) Mechanical Ability, and (11)

Manual Dexterity. These factors, along with seven traits which had considerable variance not accounted for by the 11 factors, comprised 18 dimensions which the author saw " . . . as a useful framework for describing the requirements of Air Force enlisted jobs" (p. 15).

Another investigation employing the USES trait ratings has been reported by Orr (1960). In this study, "Distance (D) Measures" based on nine aptitude ratings were computed for pairs of jobs, such that a large D-score represented a large difference in the aptitude profiles of the jobs in a pair. Two independent samples of 140 jobs were selected from the 4,000 jobs which had been rated on the USES traits, and D scores were computed among the jobs within each sample. These D-scores were then subjected to cluster analysis within each of the two samples, yielding six job clusters for each sample. The resulting clusters were paired across samples. Next, each of 28 jobs from a third sample was assigned to that cluster in both original samples for which the job's D-score from the cluster centroid was the smallest. Using this method, Orr found that 75 percent of the jobs in the third sample fell into matched clusters. He interpreted this result as support for the use of the clustering procedure. The six clusters seemed to represent different levels of three broad job areas: (1) intellectual-supervisory, (2) mechanical-manual, and (3) clerical.

#### Trait-Requirement Ratings of Work Elements

In the previously cited studies, trait-requirement estimates were derived from direct trait-requirement ratings of jobs. Another approach to this problem is to develop a comprehensive inventory of "work elements" that define various aspects of work, and then establish the trait requirements of these individual work elements. The trait-requirement profiles of the work elements can then be factor analyzed to obtain basic work dimensions, or these profiles can be combined with ratings of jobs on the work elements to obtain trait-requirement estimates of jobs. In the following sections, studies involving trait-requirement ratings of work elements are reviewed.

#### Indirect Validity Based on Trait-Requirement Ratings of Work Elements

As mentioned earlier, the synthetic-validity approach involves: (1) defining a set of basic work elements (activities and conditions), (2) rating the work elements on trait requirements, (3) rating jobs on the work elements, and (4) combining information from the preceding steps to derive attribute-requirement estimates for jobs. In describing work elements, McCormick (1959) distinguished between "job-oriented" and "worker-oriented" elements. He defined a job-oriented element as a statement describing what is accomplished in the job, and a worker-oriented element as a statement describing what the worker actually does. According to McCormick, worker-oriented statements are more

suitable for describing a wide variety of jobs, since these variables, as contrasted with job-oriented statements, are independent of the specific technological aspects of jobs.

A study using job-oriented elements to describe jobs is reported by Lawshe and Steinberg (1955). In this study supervisors identified the five most important activities in the Job Description Checklist of Clerical Operations (a 139-item job-analysis inventory) for each of 262 clerical positions in 12 companies. In addition, the workers in these positions were administered the Purdue Clerical Adaptability Test. Prior to this study, the 139 items in the checklist had been rated by 15 judges on the extent to which each work element required various aptitudes represented in the Purdue Clerical Adaptability Test (*i.e.*, spelling, memory for oral instructions, arithmetic computation, checking, vocabulary, accuracy of copying, and arithmetic reasoning). An expectancy chart was then prepared for each aptitude, relating the number of activities for which the specified aptitude was rated critical to a position, with the percentage of incumbents in the position who scored above the median on the subtest for that aptitude. Chi-square values were computed for each of the seven subtests to determine if the percentage of workers scoring above the median for that subtest was significantly related to the number of activities (in their positions) for which that aptitude was critical. The results showed significant differences for the aptitudes of spelling, arithmetic computation, vocabulary, and arithmetic reasoning. The investigators concluded that these results support attempts to "synthetically" determine the test requirements of jobs.

In contrast to job-analysis inventories using job-oriented variables are those using worker-oriented variables. In two series of studies, McCormick and his associates have used worker-oriented inventories to derive trait requirements of jobs. In the first series (Cunningham and McCormick, 1964a, 1964b; Gordon and McCormick, 1963; McCormick, Cunningham, and Gordon, 1967; McCormick, Cunningham, and Thornton, 1967; Thornton and McCormick, 1964), a checklist of worker-oriented elements, the Worker Activity Profile (WAP), was developed which follows the basic conceptual approach taken in the development of an earlier checklist by Palmer and McCormick (1961). Two samples, one involving 400 jobs and the other 371 jobs, were rated on the WAP. For both samples, 119 reliable items were factor analyzed. When the resulting factors were compared across the two samples, 22 of 28 factor pairs were found to be congruent, or similar, thus indicating a stable structure of work dimensions (Cunningham and McCormick, 1964a; Gordon and McCormick, 1963; McCormick, Cunningham, and Gordon, 1967).

The next phase in the WAP research series involved the derivation of attribute-requirement estimates for jobs, based upon WAP ratings (Cunningham and McCormick, 1964b). Forty-two attributes were selected, with some modification, from the list of traits defined by the U. S. Employment Service (1956). These included aptitudes, motor abilities, temperaments, interests, and physical capacities. Each WAP work element was rated (by three to five judges) on the extent to which it required

each of the specified human attributes. The median rating of each work element on a given attribute was then multiplied by the rating of a job on the same work element. An attribute-requirement estimate for a particular job was obtained by summing the products of attribute weights and job ratings across all work elements. Attribute-requirement estimates were thus obtained for a sample of 401 jobs selected from the list of 4,000 for which USES trait ratings were available. The WAP attribute-requirement scores for the 401 jobs on 37 of the 42 attributes were then correlated with corresponding USES trait ratings for the same jobs. All but five of these correlations were significant in the expected direction. Although the correlations were generally highest for aptitudes (average correlation .56) and motor abilities (average correlation .42), there were also some substantial correlations in the other groups of attributes.

In attempting to establish the validity of the WAP attribute-requirement estimates, Thornton and McCormick (1964) carried out a study using a sample of 43 Naval job specialties for which test validity coefficients had been determined. Validity coefficients were available for four tests: General Classification (Intelligence), Clerical, Arithmetic (including two subtests), and Mechanical (including three subtests). Attribute scores were derived for each specialty in the manner described above. Attribute scores were also obtained for the specialties by deriving attribute weights for each of the aforementioned WAP factors (based on the weights of individual items comprising the factors), and then summing the cross-products of attribute weights for the various factors by the factor scores of the job in question. These attribute scores were then correlated with (1) 125 validity coefficients for corresponding tests (four tests and five subtests) obtained from 125 separate validity studies of the 43 Navy specialties, and (2) 43 average validity coefficients for each test and subtest within each Navy specialty. These analyses yielded all significant correlations for attribute scores derived through the use of WAP factors. Correlations for attribute scores derived from individual WAP items were significant in eight out of nine cases using the 125 individual validity coefficients and in six out of nine cases using validity coefficients averaged within the 43 Navy specialties.

In a subsequent series of studies, McCormick, Jeanneret, and Mecham (1969a, 1969b) developed a new 189-item job-analysis inventory, the Position Analysis Questionnaire (PAQ), which they considered a marked improvement over the WAP. In the first study involving this instrument (Mecham and McCormick, 1969a), 178 PAQ work elements were rated by 8 to 18 judges on 68 human attributes (of either an "aptitudinal" or "situational" nature), in terms of the "relevance" of each attribute to each work element. The inter-rater reliability coefficients of the mean attribute ratings averaged .91, with only six of the 68 reliability coefficients falling below .80. Median values were also derived for each of 67 attributes on every item of the PAQ. These medians provided an attribute-requirement profile for each work element.

In a second study (Jeanneret and McCormick, 1969), 536 jobs were rated on the PAQ through direct observation by job analysts. These ratings were then used in several factor analyses of the PAQ work elements. An overall factor analysis of the PAQ items yielded five dimensions, and separate analyses of the six major PAQ sections produced 27 additional dimensions. Similar factor analyses were also performed using the aforementioned attribute profiles on the PAQ work elements as the basis for intercorrelating these elements. This part of the study yielded 21 factors, several of which are similar to those obtained in the factor analyses of job ratings.

In the last PAQ study (Mecham and McCormick, 1969b), two analyses were carried out to determine the "validity" of synthetically estimated attribute-requirement estimates for jobs. For these analyses, 179 positions were selected from the 900 that had been rated on the PAQ. These positions, in turn, corresponded to 90 D.O.T. (Dictionary of Occupational Titles) job titles for which General Aptitude Test data were available (through the U. S. Employment Service) in the form of both mean test scores of incumbents and validity coefficients. These data served as criterion variables for the analyses which are described next.

In the first analysis, scores were obtained for the 179 positions on two sets of PAQ work dimensions: (1) the 27 factors derived from job ratings on the PAQ work elements, and (2) the 21 factors derived from attribute profiles of PAQ work elements. A multiple correlation analysis was then carried out relating work-dimension (factor) scores for the 179 positions to both sets of criterion variables mentioned above. For each test, a set of work dimensions was selected consisting of the factors having the highest bivariate correlations with the criterion variable; a multiple correlation was then computed between the selected set of factors and the criterion. The results were as follows: (1) against the test-score criteria, dimensions based on job data yielded multiple correlations with a median of .71, and those based on attribute profiles yielded multiple correlations with a median of .70; (2) against the criteria of validity coefficients, job-data dimensions yielded multiple correlations with a median of .47, and attribute dimensions yielded multiple correlations with a median of .44. These results indicate a significant predictability of GATB test scores and validities by combinations of PAQ factors.

The second analysis involved correlating PAQ attribute-requirement estimates for the 179 positions with the two sets of criterion variables; nine sets of PAQ attribute-requirement estimates were correlated with the mean scores and validity coefficients of the nine corresponding GATB tests. The attribute profiles for jobs were obtained through a series of three steps. First, a profile on the 67 attributes were derived for each of the 21 work dimensions that had been identified through factor analyses of the attribute profiles of work elements. An attribute-requirement profile for a particular work dimension was based on the attribute-requirement profiles of the work elements (items) comprising that dimension. Next, a factor score was derived for each of the 179 positions on each of the same 21 dimensions. (A factor score was the sum of the cross-

products of weights of the work elements on a dimension, times the ratings of a position on the elements.) Finally, each attribute-requirement estimate for a position was obtained by taking the sum of the cross-products of the position's score on each work dimension times the weight for that dimension on the attribute in question. The correlations between attribute-requirement estimates for positions and the average scores of incumbents on corresponding tests was substantial for cognitive abilities (with a range of .31 to .70 and a median of .60), but negligible for perceptual and psychomotor abilities (with a range of -.24 to .16 and a median of .03). The correlations between attribute estimates and corresponding validity coefficients were, for the most part, negligible.

Based on their findings, Mehan and McCormick concluded that the ". . . results of the study support quite strongly the basic notion that . . . job attribute requirements can be derived synthetically on the basis of reasonably objective job analysis data, specifically quantitative data that reflect job characteristics and/or job dimensions of a worker-oriented or behavioral nature [1969b, p. 14]."

#### Dimensions Derived from Trait-Requirement Ratings of Work Elements

A study in which dimensions were derived from trait-requirement ratings of work elements has been reported by Thorndike *et al.* (1957). In this study, a follow-up of the previously cited study by Norris (1956), a Job Activities Blank was constructed containing 7 to 20 activity statements for each of 14 of Norris' 18 trait dimensions. A sample of 963 men in 25 Air Force jobs rated each activity in terms of frequency of performance. Trait-dimension scores were obtained for each of the 963 positions by summing the ratings for the activity items representing the dimension; dimension scores were obtained for each of the 25 jobs by averaging the dimension scores of the positions corresponding to the job. A factor analysis of the 14 oblique trait dimensions, using the 25 jobs as cases, yielded 8 orthogonal trait dimensions. The two sets of dimensions (oblique and orthogonal) were then used as a basis for computing "distance" (D) scores for all pairs among the 25 jobs, and each set of D-scores was subjected to a cluster analysis. The correlation between the two sets of D-scores was .91, indicating good correspondence between the two methods of measuring job similarity. However, only two general clusters were identified: a mechanical cluster and a non-mechanical cluster. The investigators concluded that the substantial correlations among the original trait dimensions had reduced their effectiveness in describing job requirements and clustering jobs.

Work dimensions were also derived from the trait-requirement ratings of the PAQ work elements. In the previously cited study by Jeanneret and McCormick (1969), three different multivariate procedures were used to derive dimensions based on the attribute-requirement profiles of the PAQ work elements (items). Principal components

analyses of the six major sections of the PAQ yielded 21 dimensions, a number of which were similar to dimensions obtained from the factor analyses based on ratings of jobs on the PAQ elements. In fact, the dimensions based on the attribute-requirement profiles of the PAQ items accounted for more of the total variance and were easier to interpret than the dimensions derived from job ratings. Two clustering procedures were also applied to the attribute profiles of the PAQ elements. The first clustering procedure, employing item intercorrelations (Lorr and Radhakrishnam, 1967), was applied to profiles comprised of 17 aptitude-requirement estimates for the various PAQ work elements. This analysis produced six dimensions (or clusters) of PAQ elements, five of which were interpreted. The second clustering procedure, a hierarchical grouping analysis (Ward, 1961; Ward and Hook, 1963), was applied both to the aptitude profiles and to profiles based on the entire list of 67 human attributes. The analysis of the aptitude profiles yielded 18 item groups, several of which were uninterpretable; however, the analysis of complete attribute profiles produced 22 interpretable item groups out of a total of 23. Seven of these latter groups were given titles identical to dimensions derived through factor analysis. In discussing their results, Jeanneret and McCormick concluded that, despite the different procedures used, there were ". . . several similarities, indicating that there appears to be a common 'core' of attribute requirements underlying various job activities and work situations [p. 103]."

#### Implications

The studies cited in the preceding review demonstrate that (1) it is feasible to derive human attribute-requirement estimates for jobs through systematic job-analysis procedures and (2) that stable work dimensions can be derived from attribute ratings of jobs and work elements. The present study deals with the application of quantitative job-analysis procedures, particularly those developed by E. J. McCormick, to the development of a system that might ultimately find use in the field of occupational education.

## PURPOSE

This study is part of a series designed to develop and test a quantitative system for describing and classifying occupations for educational purposes. The first phase of this series involved the development of a comprehensive job-rating instrument, the Occupation Analysis Inventory (Cunningham et al., 1970, 1971). As noted previously, the OAI was designed to achieve as high a level of descriptive specificity (or content loading) as possible, while retaining its applicability to the general population of jobs and occupations. The purposes of the present study are described below.

### Deriving Attribute Requirements for the OAI Work Elements

One way of estimating the human attribute requirements of jobs involves: (1) establishing attribute requirements for each of a set of individual work elements, (2) rating jobs on these work elements, and (3) combining the job ratings and attribute weights to obtain attribute-requirement estimates for the jobs. Evidence for the feasibility of this method can be found in the research of E. J. McCormick and his associates (McCormick, Cunningham, and Thornton, 1967; Mecham and McCormick, 1969a, b). One purpose of the present study was to derive attribute-requirement profiles for the OAI work elements.

### Factor Analyses of the OAI Work Elements

A comprehensive set of work dimensions by which jobs and occupations could be described, compared, and classified would have relevance to a number of educational problems (see p. 1 of present paper, and Cunningham et al., 1971). Accordingly, the second purpose of this study was to derive a set of basic work dimensions through factor analyses of the OAI work elements, using the attribute-requirement profiles of the work elements. The final purpose of the study was to determine the stability (or replicability) of the derived work dimensions.

## PROCEDURE

Two instruments, the Occupation Analysis Inventory (OAI) and the Attribute Requirement Inventory (ARI), were used in this study. Descriptions of these two instruments and the data gathering and analysis procedures are presented below.

### The Occupation Analysis Inventory (OAI)

The Occupation Analysis Inventory (OAI) is a rating device designed for the systematic description of jobs and occupations (Cunningham *et al.*, 1971). The items, or work elements, in the OAI consist of written descriptions of classes of work activities or conditions, along with specific examples for each class. The Inventory contains 622 work elements grouped under the following major headings:

1. Information Received (125 elements)
2. Mental Activities (41 elements)
3. Work Behavior (267 elements)
4. Work Goals (112 elements)
5. Work Context (77 elements)

These five categories correspond to the five components of the information processing model shown in Figure 1.

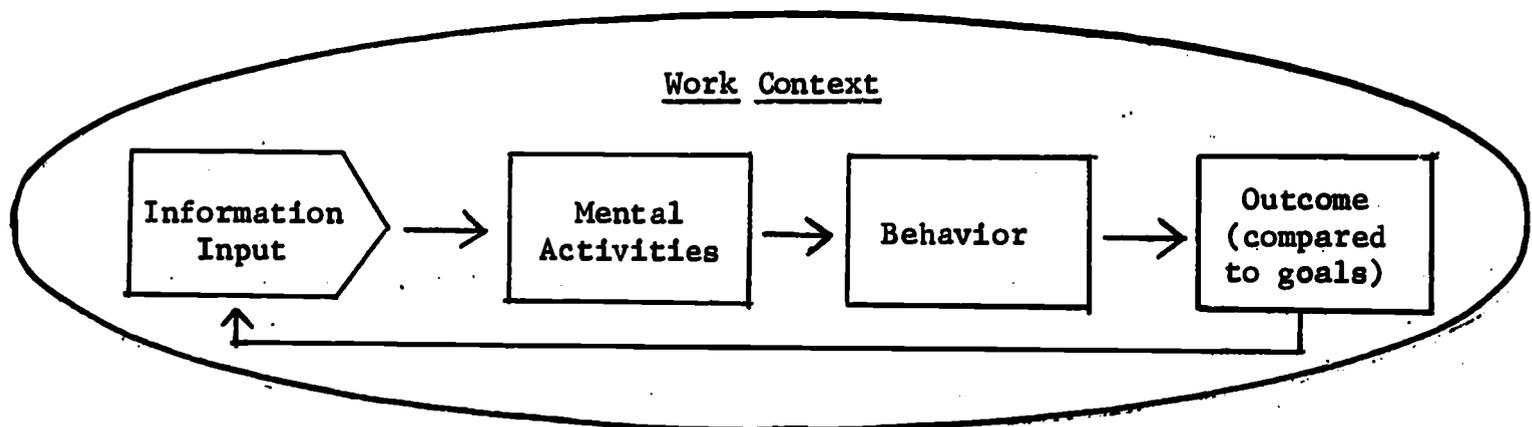


Figure 1. Paradigm for the Occupation Analysis Inventory (OAI)

The work elements of the OAI are generally rated on three standard scales. Two of these scales, Significance to the Job and Extent of Occurrence, are six-point scales (0-5), while the third scale, Applicability, is dichotomous. In addition, certain OAI items have special scales which are contained in, and apply specifically to, the work element in question. The points on the OAI scales are defined by written descriptions, some

consisting of definitions only and others consisting of definitions plus examples.

### The Attribute Requirement Inventory (ARI)

The Attribute Requirement Inventory (shown in Appendix B) contains 103 definitions of human attributes that have been identified as potentially useful in describing the human requirements of jobs. These attributes fall into the following six categories:

1. General Vocational Capabilities (24 attributes)
2. Cognitive Abilities (20 attributes)
3. Psychomotor Abilities (12 attributes)
4. Sensory Capacities (6 attributes)
5. Interests (24 attributes)
6. Needs (17 attributes)

The General Vocational Capabilities were selected from those defined by Altman (1966). These attributes represent knowledges and skills relevant to a wide variety of occupations but which are more occupationally specific than basic aptitudes and academic abilities. In identifying these general vocational capabilities, Altman first drew a sample of 31 occupations which were thought to have major employment opportunities for the coming decade. Task descriptions were then developed for each occupation, and a sample of task behaviors was selected from each occupational description and translated into multiple-choice test items. Tests were formed by having psychologists sort the items into 24 rationally defined capability categories. The resulting 24 tests were ordered along a hardware-to-people continuum divided into the following six areas: (1) Mechanical, (2) Electrical, (3) Spatial (including structures and layout and visualization), (4) Chemical-Biological, (5) Symbolic (including numerical operations and verbal communication), and (6) People. Intercorrelations among the tests were generally consistent with the hypothesized hardware-to-people continuum: tests close together on this continuum were more highly correlated than tests further apart.

The Cognitive Abilities were adapted, for the most part, from those described by French, Ekstrom, and Price (1963). The abilities measured by the General Aptitude Test Battery of the U. S. Employment Service and the Differential Aptitude Test Battery (Bennett, Seashore, and Wesman, 1966) are also represented in the ARI. (Most of the GATB and DAT tests can be matched with factors identified by French *et al.*) The factors presented by French, Ekstrom, and Price were selected from the many cognitive factors identified by various researchers. All of these factors (24 in number) were identified in at least two, and in most cases several, studies. The authors, along with the help of many collaborators, supplied definitions for each factor along with a description of the factor, its relationship to other factors, and evidence for the factor's existence. They also selected three tests to

measure each factor and presented descriptions of these tests in their discussion of the factor. The factors selected for inclusion in the ARI consisted of those thought to be (1) relevant to work analysis and (2) defined concretely enough to be potentially ratable.

The Psychomotor Abilities were adapted from the factors identified in a series of studies by Fleishman (1967). The psychomotor factors included in the ARI were selected on the same bases as the cognitive abilities.

The Interests defined in the ARI were adapted from the Ohio Vocational Interest Survey (1969). The conceptual approach used in the development of the Ohio Vocational Interest Survey (OVIS) was borrowed from the Data-People-Things scheme employed by the U. S. Employment Service. In the derivation of the OVIS scales, the 114 worker-trait groups identified in the Dictionary of Occupational Titles were plotted in three-dimensional space using the dimensions of Data, People, and Things. When plotted, these 114 groups fell into 24 clusters, each of which was used to form a scale of the OVIS. The interest scales were comprehensively defined, and questionnaire items were written for each scale. These items represented job activities from the worker-trait groups included in the scale definition. The instrument consisting of the original items has been refined by reducing scale intercorrelations, increasing scale homogeneity, and improving reliabilities.

The Needs were adapted from the Minnesota Importance Questionnaire (MIQ), which was one of a number of instruments developed in accordance with the Theory of Work Adjustment (Weiss et al., 1966). The 20 scales of the instrument were derived from studies of need-fulfillment carried out by many researchers. These 20 scales were designed to comprehensively cover the most important, identifiable human needs. Of the 20 scales represented in the MIQ, 17 were chosen to be included in the ARI.

The attributes included in the ARI were selected for several reasons. First, those attributes selected were considered to be most representative of the attributes consistently identified in each area (i.e., Cognitive Abilities, Interests, Needs, etc.). Second, only attributes considered suitable for job-analysis purposes were included. Third, in the case of General Vocational Capabilities, Cognitive Abilities, Interests, and Needs, attributes were selected for which there were easily administered tests. This last point is important since, to establish the validity of synthetically derived estimates of attribute requirements of jobs, direct measures of the attributes are needed. A list of the tests that measure each of these attributes is presented in Appendix A.

Prior to the construction of the ARI items, the available definitions and other information concerning the selected attributes were reviewed. Based on this information, a comprehensive description was written for each attribute. In addition, job or work activity examples were supplied (for all categories of the ARI except Needs) to aid in understanding the attribute definition. These examples represented jobs

or work activities requiring a substantial amount of the attribute in question. The ARI attribute definitions are presented in Appendix B.

### Raters

The raters in this study were recruited from the Department of Psychology, North Carolina State University at Raleigh. All of the raters were required to have some measurement background. All of the 13 raters recruited were graduate students, seven of whom had received their Master of Science degree.

### Rating Procedure

Each rater was given a copy of the OAI, a copy of the ARI, a set of answer sheets, and a set of instructions. The raters were assigned a number of attributes to rate based on the time they had available. By this method, each ARI attribute was assigned to nine to ten raters.

All raters were instructed to rate each OAI item (using a 0-5 scale) on the "Degree of Relevance" of the ARI attribute in question to the work element described in that OAI item. Since two categories of attributes defined in the ARI appeared inherently different, "Degree of Relevance" was defined for the General Vocational Capabilities, Cognitive Abilities, Psychomotor Abilities, and Sensory Capacities as the "amount" or "level" of the attribute in question required of the incumbent to deal effectively with the OAI work element. For Interests and Needs, however, "Degree of Relevance" was defined as the extent to which the attribute in question is "compatible" with the OAI work element. When rating each OAI work element, the raters assumed that element to be a very significant part of a hypothetical job. The items in the Mental Activities category of the OAI were excluded from the ARI ratings, since they represent basic cognitive factors which did not seem suitable for this purpose. (However, the investigators later assigned weights to the Mental Activities items on selected cognitive abilities in the ARI.) A complete set of rating instructions is presented in Appendix B.

When the rating forms were returned, they were checked for completeness and coded as to rater, attribute, and OAI section. The ratings were then key-punched into data processing cards.

### Analyses

After all data had been collected, the following analyses were carried out. All of the statistical calculations were performed on either an IBM 360-75 or an IBM 370-165 computer.

### Method of Deriving Attribute-Requirement Estimates of OAI Work Elements

In order to derive attribute-requirement estimates for OAI work elements, a mean rating was computed on each attribute for each OAI work element which had been rated on the attribute. This procedure yielded a profile of 103 attribute means for each of the 581 OAI items. (As mentioned earlier, the 41 Mental Activities items did not receive attribute ratings.) The mean was selected as the measure of central tendency because it is easier to deal with statistically than other measures of central tendency. Furthermore, it was shown in a previous study that mean attribute-requirement estimates of work elements correlated .97 with median attribute-requirement estimates of those same work elements (Mecham and McCormick, 1969a).

### Method of Estimating Inter-rater Reliability

An analysis-of-variance procedure (Winer, 1962) was used to compute reliability coefficients for each of the 103 ARI attributes; observations consisted of attribute ratings for the 581 OAI work elements. Four coefficients of reliability were computed for each attribute. The first two coefficients were computed from unadjusted data. One, the intraclass correlation coefficient, represents the reliability for a single hypothetical rater and is approximately equal to the mean intercorrelation between all possible pairs of raters for a particular attribute. The second coefficient represents the reliability of the mean ratings across all raters for the attribute in question. This latter reliability coefficient can be interpreted as the approximate correlation which would be obtained if the mean ratings of this study were correlated with the mean ratings obtained in another study using a new sample of raters (*i.e.*, a sample of the same size drawn randomly from the same population). The last two reliability coefficients were adjusted for differences in the raters' frames of reference. Although these coefficients correspond to the first two coefficients, they are usually higher, since they contain no error due to systematic differences in rating tendencies.

### Factor Analyses of Work Elements Within Six Sections of the OAI

A factor-analytic procedure was applied to the attribute profiles of the OAI work elements in order to derive a set of basic work dimensions. Since the selected factor-analysis program would not handle the large number of variables in this study, the work elements were divided into six separate a priori groups corresponding to the following OAI sections: (1) Information Received (115 elements); (2) Physical Work Behavior (191 elements); (3) Representational Work Behavior (39 elements); (4) Interpersonal Work Behavior (32 elements); (5) Work Goals

(112 elements); and (6) Work Context (60 elements). Three groups of OAI items were excluded from the factor analyses. It was felt that the Sensory Channel and Incentives items (17 and 10 items, respectively) should be omitted, because they represent basic psychological dimensions which might not combine meaningfully with the more specific work elements. The Mental Activities category of the OAI (41 items) was also excluded from factor analysis, since, as mentioned earlier, its elements were not rated on the ARI attributes. In addition, five elements of an open-ended nature (19t, 40t, 46t, 66t, and 95t) were omitted from the second analysis (Physical Work Behavior). Thus, of the original 622 OAI items, a total of 549 were included in the sectional factor analyses.

In all six factor analyses, a principal components solution was employed with 1.0's entered in the main diagonal of the correlation matrix. Eigenvalues were computed for the resulting factors and then plotted for each section. The Scree Test (Cattell, 1966a) was then applied to these plots to determine the number of factors to rotate in each analysis. Next, these factors were rotated obliquely for simple loadings (Gennrich and Sampson, 1966). Kaiser normalization was used for rotation. In accordance with Cattell's (1966b) arguments, the main reasons for the use of oblique rotations in this study were: (1) there was no reason to eliminate the possibility of correlated factors; (2) an oblique rotation permits an orthogonal solution, while the reverse is not true; and (3) an oblique rotation, in many cases, leads to more interpretable factors. After rotation, factor scores were computed for each attribute on all of the factors.

#### Methods of Estimating Factorial Stability

There is some danger in accepting a factorial structure without first testing its replicability, since, as demonstrated by Armstrong and Soelberg (1968), it is possible to obtain interpretable factors from randomly generated data. For this reason, analyses were performed to determine the invariance of the factors obtained in the present study. These analyses involved the following three steps: (1) the attribute ratings were randomly divided into two samples; (2) the previously described factor analyses were performed separately on each sample; and (3) the resulting factors were compared across samples. The details of these steps are described below.

In the first step, the 13 raters were divided into the following three categories: (1) raters who had rated the OAI items on all 103 ARI attributes and who were permanently employed on the research project; (2) temporary (hourly paid) raters who had rated OAI items on all 103 attributes; and (3) raters (both temporarily and permanently employed) who had not rated the OAI items on the complete set of attributes. Under this grouping arrangement, there were four raters in the first category, two in the second, and seven in the third. The ratings in the third category were combined to form three complete sets of ratings (i.e., three "pseudoraters") and one incomplete set containing

ratings on 54 attributes. Next, the sets of ratings (*i.e.*, raters and "pseudoraters") in each of the three categories were equally divided on a random basis into two separate samples. Thus, one sample contained five complete sets of ratings (*i.e.*, ratings of the OAI items on all 103 ARI attributes), and the second sample contained approximately four and one-half sets of ratings. This procedure ensured that the data for the two samples were obtained from comparable raters.

In the second step of the analysis of factorial stability, the previously described factor-analytic procedures were applied separately to each of the two samples. Thus, six factor analyses were carried out within each sample, and the same numbers of factors that were rotated in the original analyses were rotated in each of the two samples. Factor scores were computed for each attribute on all rotated factors.

The third and final step in the stability analysis consisted of comparing pairs of rotated factors across the two samples, within each of the six OAI sections. Two indices were used in these comparisons: (a) Tucker's (1951) coefficient of congruence, an index of relationship between factor loadings; and (b) the Pearson product-moment correlations between factor scores for attributes. These indices were computed between all possible pairs of factors across the two samples, within each OAI section. For example, 324 coefficients of congruence were computed for the first section (Information Received), in which 18 factors were rotated. Factors were matched across samples based on the highest coefficients.

#### Derivation of Higher-Order Factors

As noted earlier, the original factor analyses were carried out within each of six OAI sections. These six analyses yielded a total of 77 factors (described under Results, pp. 80-88). It was decided that the resulting factors should themselves be factor analyzed in order to (1) reduce the redundancy among these factors, (2) reduce the factors to a more manageable number, and (3) produce factors which (hopefully) could be interpreted in terms of the information-processing paradigm shown in Figure 1 (excluding the Mental Activities component). The data matrix for the overall, or "higher-order," factor analysis contained scores for 102 ARI attributes on the 77 first-order factors.<sup>1</sup> The factor-analytic procedures were the same as those used in the original factor analyses--*i.e.*, a principal components solution followed by oblique rotations.

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<sup>1</sup>One of the original 103 attributes (Item 96 in the ARI) was excluded from the first-order factor analyses because of its low inter-rater reliability.

## RESULTS

The presentation of the results is organized in accordance with the preceding description of the analyses.

### Mean Attribute-Requirement Profiles

The mean attribute-requirement profiles of the OAI work elements are presented in Appendix C. As noted earlier, the mean was selected as the measure of central tendency, instead of the median, because (a) it is easier to compute, (b) it is more frequently used in statistical procedures, and (c) previous research has shown high correlations between mean and median attribute profiles of activity statements (Mecham and McCormick, 1969a). The weight of each attribute on an OAI work element can be interpreted as an estimate of the "relevance" of the attribute to the OAI element when that element is a "very significant" part of a job (see ARI instructions, Appendix B).

### Reliabilities of Attribute Ratings

Indices of inter-rater agreement on the attribute ratings were computed for each of the 103 ARI attributes, treating the 581 OAI work elements as cases and individual raters as variables (Winer, 1962). The four different reliability estimates obtained for each attribute are shown in Appendix D. Table 1 contains a frequency distribution of the unadjusted reliability coefficients for mean ratings. The median of this distribution falls in the .90 - .94 interval. Each coefficient is an estimate of the reliability of the mean ratings of 581 OAI work elements on a single ARI attribute. The unadjusted coefficient for mean ratings was selected as the most representative reliability index, instead of the coefficient adjusted for differences in rating tendencies, since such differences affect the mean attribute profiles (especially with small groups of raters). The data for one attribute, Moral Values (ARI item 96), were excluded from the subsequent factor analyses because of an unacceptably low reliability coefficient.

### Factors Derived Within Six Sections of the OAI

The following numbers of factors were rotated in the six sections of the OAI: (1) Information Received, 18 factors; (2) Physical Work Behavior, 18 factors; (3) Representational Work Behavior, 7 factors; (4) Interpersonal Work Behavior, 6 factors; (5) Work Goals, 16 factors; and (6) Work Context, 12 factors. A total of 77 factors was obtained. The factor correlation matrices for the six sectional analyses are presented in Appendix E. Tables 2 through 7 present the rotated factor loadings obtained from the six analyses. In accordance with Guilford's (1954) suggested criterion, only loadings of .29 or greater were

considered significant; loadings lower than .29 were excluded from Tables 2 through 7. The factors represented in these tables are described in the following paragraphs.

Table 1. Frequency Distribution of the Unadjusted Coefficients of Reliability for the Mean Ratings of 581 OAI Work Elements on 103 Human Attributes

Coefficient of Reliability	Frequency	Proportion	Cumulative Proportion
.95 - 1.00	16	.155	.999
.90 - .94	42	.408	.844
.85 - .89	27	.262	.436
.80 - .84	12	.116	.174
.75 - .79	2	.019	.058
.70 - .74	0	.000	.039
.65 - .69	2	.019	.039
.60 - .64	1	.010	.020
.55 - .59	0	.000	.010
.50 - .54	0	.000	.010
.00 - .49	1	.010	.010

#### Dimensions of Information Received

From the principal components analysis of work elements in the Information Received section of the OAI, 18 factors were extracted and rotated. These factors accounted for 91 percent of the total variance, and all 18 were interpreted. The work elements with substantial loadings on the Information Received factors are presented in Table 2.

Dimension A-1: Information concerning mechanical devices/processes. This dimension centers around information concerning the functioning of mechanical devices. Most important is direct information received from these devices, with a secondary emphasis on indirect or written information.

Table 2. Dimensions of Information Received

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension A-1: Information concerning mechanical devices/processes.</b>	
7i Mechanical motion	.94
5i Control or regulation of mechanical devices	.93
3i State of preventive maintenance	.91
1i Overall state of mechanical fastening	.89
4i Malfunction of specific parts or components	.89
6i Interrelations of mechanical parts	.84
2i Quantity and quality of machine output in relation to standards of performance or quality control standards	.69
9i Displays	.58
11i Written material pertaining to mechanical devices	.46
10i Mechanical test equipment and measuring devices	.37
12i Written material pertaining to mechanical or physical principles	.32
8i Mechanical drawings	.30
17i Regulation and control of electrical and electronic systems	.30
24i Interrelation, position, and fit of <u>connected</u> parts or objects	.30
14i State of preventive maintenance	.29
<b>Dimension A-2: Technical written information.</b>	
12i Written material pertaining to mechanical or physical principles	.80
60i Written material pertaining to the environment	.78
32i Written material pertaining to basic principles of structures	.77
23i Written material pertaining to basic principles of electricity/electronics	.71
49i Technical written material concerning physical or chemical properties of materials or substances	.70

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension A-2: (continued)</b>	
79i Content or meaning	.66
11i Written material pertaining to mechanical devices	.61
31i Written material pertaining to interrelated parts and objects	.60
68i Written material pertaining to art or decorations	.56
48i Nontechnical written material pertaining to materials or substances	.53
22i Written material pertaining to electrical or electronic devices	.51
100i Contracts and other legal written information	.50
78i Written material pertaining to biology, health, or nutrition	.44
99i Written business information	.43
114i Descriptions of events involving people	.39
84i Complexity of numbers	.32
82i Grammar or expression	.30
85i Signs and symbols representing numerical operations and relations	.29
<b>Dimension A-3: Health information.</b>	
70i State of health and hygiene	.93
73i Materials and devices related to biology or health	.93
69i Dietary needs or deficiencies	.88
77i Verbal information concerning symptoms, feelings, activities, requests	.86
71i Miscellaneous biological characteristics of people or animals	.85
76i Measuring or testing devices	.85
75i Pictures or diagrams	.84

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension A-3: (continued)</b>	
78i Written material pertaining to biology, health, or nutrition	.80
72i Gestures, sounds, or facial expressions indicating physical feelings such as pain	.76
74i Materials, objects, and devices related to nutrition	.67
101i Physical condition of people	.65
109i Emergency situations involving people	.39
43i Hazard	.34
112i Descriptions of individuals	.30
<b>Dimension A-4: Information pertaining to aesthetic appearance and arrangement.</b>	
62i Form or shape of objects	.63
63i Location of objects or people in space for aesthetic purposes	.55
54i Celestial objects and events	.48
61i Colors and color schemes	.45
66i Sketches, models, or other graphic information	.40
34i Surface characteristics	.38
27i Interrelation or arrangement of <u>unconnected</u> objects within a prescribed space or area	.35
55i Weather and atmospheric conditions	.29
<b>Dimension A-5: Numerical/symbolic information.</b>	
86i Frequency of numerical information	.93
87i Tables and graphs	.92
85i Signs and symbols representing numerical operations and relations	.88

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension A-5: (continued)	
88i Information in numerical form concerning characteristics of things, events, or people	.88
84i Complexity of numbers	.87
97i Numerical business information	.85
98i Business graphs, charts, or diagrams	.82
115i Tables, diagrams, graphs, etc., conveying information about people	.82
59i Tables and graphs	.75
90i Special symbols	.57
93i Money or other medium of exchange	.46
92i Numerical or coded information	.44
Dimension A-6: Materials information.	
39i Consistency	.89
41i Elasticity	.89
35i Weight	.87
37i Physical state	.87
40i Malleability/ductility	.86
44i Chemical reactivity	.86
42i Hardness	.85
36i Flavor, odor, or edibility	.83
38i Fragility or strength	.82
43i Hazard	.82
45i Conductivity	.74
47i Symbol systems pertaining to materials or substances	.74
33i Overall quality	.73
34i Surface characteristics	.67
46i Materials measuring and testing devices	.57

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension A-6: (continued)	
48i Nontechnical written material pertaining to materials or substances	.51
49i Technical written material concerning physical or chemical properties of materials or substances	.51
74i Materials, objects, and devices related to nutrition, sanitation, or food preparation	.35
25i Connections and fastening of objects and parts	.32
26i Appearance of assembled or constructed objects in relation to prescribed standards	.29
Dimension A-7: Business/sales information.	
94i Merchandise	.95
95i Advertising materials	.81
93i Money or other medium of exchange	.74
96i Customers and clients	.72
99i Written business information	.51
113i Characteristics of groups of people and people in general	.42
97i Numerical business information	.37
100i Contracts and other legal written information	.35
107i Mood, attitudes, feelings, intentions, desires, etc.	.35
98i Business graphs, charts, or diagrams	.33
Dimension A-8: Environmental information.	
51i Soil	.91
50i Plant life	.84
53i Water conditions	.82
52i Terrain and geological features	.79
56i Environmental emergencies	.79

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension A-8: (continued)	
551 Weather and atmospheric conditions	.68
1031 Grooming and appearance of animals	.45
541 Celestial objects and events	.41
1051 Performance of animals	.37
581 Environmental test equipment and measuring devices	.36
591 Tables and graphs	.30
Dimension A-9: Spatial information.	
291 Drawings, patterns, or diagrams pertaining to the layout or placement of <u>unconnected</u> parts or objects	.89
891 Diagrams, drawings, or maps	.83
281 Drawings, plans, or diagrams pertaining to the arrangement, placement, and fastening of <u>interconnected</u> parts	.81
81 Mechanical drawings	.76
571 Charts or maps	.72
271 Interrelation or arrangement for <u>unconnected</u> objects within a prescribed space or area	.62
181 Electrical/electronic schematics and diagrams	.57
661 Sketches, models, or other graphic information	.57
241 Interrelation, position, and fit of <u>connected</u> parts or objects	.53
301 Measuring and layout devices	.42
751 Pictures or diagrams	.38
631 Location of objects or people in space for aesthetic purposes	.32
261 Appearance of assembled or constructed objects in relation to prescribed standards	.31
541 Celestial objects and events	.30
621 Form or shape of objects	.29

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension A-10: Information pertaining to human events and characteristics.</b>	
1131 Characteristics of groups of people and people in general	-.30
541 Celestial objects and events	-.32
561 Environmental emergencies	-.32
1071 Mood, attitudes, feelings, intentions, desires, etc.	-.43
1141 Descriptions of events involving people	-.43
1101 Habitat of people	-.65
1111 Group settings	-.69
1091 Emergency situations involving people	-.79
1081 Crowd situations	-.87
<b>Dimension A-11: Electrical/electronic information.</b>	
231 Written material pertaining to basic principles of electricity/electronics	-.57
451 Conductivity	-.57
221 Written material pertaining to electrical or electronic devices	-.65
181 Electrical/electronic schematics and diagrams	-.66
211 Electrical/electronic test equipment and measuring devices	-.66
151 Interrelations or interconnections of electrical or electronic parts	-.75
131 Overall performance of electrical/electronic devices in relation to standards	-.77
171 Regulation and control of electrical and electronic systems	-.77
201 Displays conveying electrical/electronic information	-.77
141 State of preventive maintenance	-.81

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension A-11: (continued)	
16i Malfunctions of specific electrical/electronic parts or components	.83
19i Electrical/electronic symbols and codes	.87
Dimension A-12: Clerical information.	
83i Proper classification	.98
80i Correspondence of contents of one manuscript or list with contents of another	.96
81i Format, punctuation, or spelling	.92
82i Grammar or expression	.82
91i Verbal information	.55
90i Special symbols	.43
100i Contracts and other legal written information	.37
79i Content or meaning	.33
99i Written business information	.32
92i Numerical or coded information	.31
48i Nontechnical written material pertaining to materials or substances	.30
Dimension A-13: Information from measuring and testing devices.	
58i Environmental test equipment and measuring devices	.71
10i Mechanical test equipment and measuring devices	.65
30i Measuring and layout devices	.65
21i Electrical/electronic test equipment and measuring devices	.55
46i Materials measuring and testing devices	.54
76i Measuring or testing devices	.43

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension A-13: (continued)	
91 Displays	.38
21 Quantity and quality of machine output in relation to standards of performance or quality control standards	.35
Dimension A-14: Information pertaining to the performance of humans and animals.	
1041 Physical performance of people	.97
1051 Performance of animals	.80
1061 Knowledge, verbal performance, and experience	.66
1121 Descriptions of individuals	.47
1131 Characteristics of groups of people and people in general	.35
1111 Group settings	.34
Dimension A-15: Art/decorative information.	
641 Music	.93
671 Musical notation	.86
651 Facial expressions, body movements, speech or voice characteristics of a performer	.77
681 Written material pertaining to art or decorations	.54
631 Location of objects or people in space for aesthetic purposes	.38
661 Sketches, models, or other graphic information	.36
611 Colors and color schemes	.32
Dimension A-16: Oral/auditory information.	
921 Numerical or coded information	.68
911 Verbal information	.42

Table 2 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension A-17: Structural information.</b>	
381 Fragility or strength	-.32
321 Written material pertaining to basic principles of structures	-.32
311 Written material pertaining to interrelated parts and objects	-.33
241 Interrelation, position, and fit of <u>connected</u> parts or objects	-.44
261 Appearance of assembled or constructed objects in relation to prescribed standards	-.57
251 Connections and fastening of objects and parts	-.66
<b>Dimension A-18: Personal service information.</b>	
1071 Mood, attitudes, feelings, desires, etc.	-.33
1011 Physical condition of people	-.38
611 Colors and color schemes	-.49
1031 Grooming and appearance of animals	-.54
1021 Grooming, style, and poise of people	-.84

<sup>a</sup>Rotated loadings less than .29 were omitted.

Dimension A-2: Technical written information. All of the items loading substantially on this factor pertain to written information, mostly of a technical nature. The information ranges from that pertaining to mechanics, electricity, structures, and chemical properties, to information pertaining to business, biology, and the environment.

Dimension A-3: Health information. Items loading substantially on this factor are primarily concerned with the state of health or biological condition of people. Important are items such as materials and devices related to biology or health, state of health and hygiene, dietary needs, and physical condition of people. Also important are the different indications of the state of health and hygiene of people.

Dimension A-4: Information pertaining to aesthetic appearance and arrangement. The items loading substantially on this factor deal primarily with information concerning the aesthetic appearance or spatial arrangement of objects. A strong emphasis on perception is indicated by the fact that all but one of the items pertain to direct information.

Dimension A-5: Numerical/symbolic information. This factor emphasizes numerical and other types of symbolic input. Items with high loadings pertain to numerical descriptions of things and events, signs and symbols, complexity of numbers, tables and graphs, and frequency of numerical information. Some business and environmental items (93i, 97i, 98i, 59i) also load on this factor, along with items concerning indirect information about people. Most of these latter items deal with information of a numerical or symbolic nature.

Dimension A-6: Materials information. Items pertaining to such basic material and chemical properties as elasticity, ductility, chemical reactivity, conductivity, etc., are combined with items indicating such physical properties as weight, physical state, overall quality, surface characteristics, etc., to form a well-defined materials factor. The loadings on two spatial/structural items (25i, 26i) are consistent with this interpretation, since information about the physical and chemical properties of materials is involved in the fastening, connecting, or assembling of objects.

Dimension A-7: Business/sales information. This factor concerns different aspects of business and sales information. It includes direct (on-the-scene) as well as indirect (semantic and symbolic) types of information. Two items concerning attitudes, feelings, and characteristics of people also load on this factor, which is understandable in view of the importance of this information in the sales field. With the exception of these two items, all items loading on this factor were contained in the OAI section titled Business/Sales Information.

Dimension A-8: Environmental information. This dimension emphasizes a variety of environmental variables, including all of the items dealing with direct environmental information and two items dealing with indirect environmental information. The only significant

elements falling outside the OAI Environmental Information group are two items pertaining to animals (103i and 105i).

Dimension A-9: Spatial information. Work elements from several different areas of Information Received are combined in this dimension. Most of these items pertain to the positions and relationships of figures or objects. They include information from diagrams, charts, drawings, and sketches, as well as a few items (24i, 26i, 27i, and 63i) dealing with direct information concerning the arrangement and position of objects. There seems to be an underlying emphasis on the visualization of spatial arrangements.

Dimension A-10: Information pertaining to human events and characteristics. This dimension is comprised of items describing human events, characteristics, and environment. All but two of these items (113i and 114i) deal with direct (on-the-scene) information.

Dimension A-11: Electrical/electronic information. This factor is defined by work elements which convey direct and indirect information concerning electrical and electronic devices and systems. With the exception of Item 45i (conductivity), the variables comprising this factor are contained exclusively in the OAI group titled Electrical and Electronic Information.

Dimension A-12: Clerical information. The items loading most heavily on this factor include: proper classification (including filing); comparison of lists for accuracy; grammar; and format, punctuation, or spelling. All of these work elements are involved in clerical tasks. Other items loading on this factor--such as special symbols, verbal and business information, content or meaning, and items concerning written information--also lend themselves to a clerical interpretation.

Dimension A-13: Information from measuring and testing devices. All of the work elements in this group, except one, pertain directly to information from various types of testing or measuring equipment. The other item in this factor (2i) deals with the comparison of machine output to quality and quantity standards, a type of information that often involves measurement and testing.

Dimension A-14: Information pertaining to the performance of humans and animals. The items loading most heavily on this factor describe direct information concerning the performance by humans and animals of various physical and mental tasks. All of the items for this factor are contained in the OAI group titled Information About People and Animals.

Dimension A-15: Art/decorative information. All of the items in this dimension belong to the OAI group titled Art/Decorative Information. The factor seems to be most heavily oriented toward music and the performing arts, with lesser loadings on spatial and color arrangements.

Dimension A-16: Oral/auditory information. The two items defining this factor both fall under the OAI heading of Oral/Auditory Information. These work elements deal with semantic and symbolic information received orally by the worker.

Dimension A-17: Structural information. The items in this factor are related to the construction or assembly of parts and objects. Four of the items pertain to direct information from constructed or assembled objects and parts, while two items (311 and 321) deal with written information about the interrelation of parts and objects and the principles of structure.

Dimension A-18: Personal service information. This dimension emphasizes information pertaining to personal service, especially in relation to the appearance of others. For example, the items concerning information about color and color schemes might pertain to tailoring and cosmetology; the items dealing with grooming and physical condition are also relevant to appearance. Information regarding the emotional state of others, another critical variable in personal service, is also important to this factor.

#### Dimensions of Physical Work Behavior

Following the principal components analysis of the work elements in this section, 18 factors were rotated. These 18 factors accounted for 91 percent of the total variance. All of these factors were interpreted and are presented in Table 3.

Dimension B-1: Tool usage. This dimension is characterized by items related to both non-powered and portable powered tool usage. Most forms of material parting, joining, forming, and shaping are represented, as well as earth working and surface preparation. A high level of manual dexterity and eye-hand coordination are required, as indicated by the factor scores for these attributes. The most heavily loading items deal with cutting and abrasion.

Dimension B-2: Use of measuring devices. The items loading on this factor emphasize the use of measuring and layout devices, along with the performance of measuring, testing, and inspecting activities. The items dealing with basic measuring devices (those measuring weight, volume, physical extent, electricity, time, pressure, temperature, etc.) load the highest on this factor.

Dimension B-3: Mechanized equipment operation. This dimension includes all of the OAI work elements involving mechanized equipment operation, as well as items related to physical coordination and the use of control devices. The small but significant loading on the sporting equipment item is probably related to the emphasis on physical coordination.

Dimension B-4: Medical/veterinary activities. This dimension clearly emphasizes the medical treatment of people and animals. Several

Table 3. Dimensions of Physical Work Behavior

Job Dimension	Rotated Loading <sup>a</sup>
Dimension B-1: Tool usage.	
22t Cutting by shearing (portable powered)	.60
35t Grinding (portable powered)	.60
23t Cutting by blade (portable powered)	.59
24t Cutting by abrasion (portable powered)	.59
21t Cutting by sawing (portable powered)	.58
33t Perforating/boring (portable powered)	.57
32t Scraping (portable powered)	.56
36t Combining/separating (portable powered)	.56
2t Cutting by shearing (non-powered)	.55
13t Perforating/boring (non-powered)	.55
4t Cutting by abrasion (non-powered)	.54
1t Cutting by sawing (non-powered)	.53
31t Abrading/polishing (portable powered)	.53
34t Shaping (portable powered)	.53
25t Cutting by heat (portable powered)	.52
3t Cutting by blade (non-powered)	.49
37t Earth working (portable powered)	.49
10t Scraping (non-powered)	.48
12t Shaping (non-powered)	.48
8t Liquid application/coating (non-powered)	.45
9t Abrading/polishing (non-powered)	.45
28t Stitching (portable powered)	.45
30t Liquid application/coating (portable powered)	.42
11t Forming (non-powered)	.41
29t Mechanical fastening (portable powered)	.41
27t Bonding (portable powered)	.40
14t Handling (non-powered)	.39
16t Earth working (non-powered)	.38

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-1: (continued)</b>	
26t Fusion (portable powered)	.37
6t Mechanical fastening (non-powered)	.35
15t Cleaning (non-powered)	.35
29j Non-powered hand tools and work equipment	.35
5t Bonding/sealing (non-powered)	.33
7t Stitching/wiring (non-powered)	.33
38t Sporting equipment (portable powered)	.33
31a Laying/covering (work activities)	.33
39t Medical equipment (portable powered)	.32
17t Sporting equipment (non-powered)	.30
<b>Dimension B-2: Use of measuring devices.</b>	
85t Weight/volume	.96
90t Motion/force	.96
89t Time	.95
88t Pressure/temperature	.93
86t Physical extent	.92
91t Physical characteristics	.90
48a Measuring/counting	.85
87t Electrical	.82
92t Work layout	.60
33j Professional, measurement, and scientific instruments	.58
94t Navigation/guidance/detection	.56
50a Testing	.49
93t Optical devices	.47
49a Inspecting	.30
34j Equipment/systems, not elsewhere defined	.30

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-3: Mechanized equipment operation.</b>	
69t Large highway vehicles	.97
70t Medium/light highway vehicles	.96
72t Rail vehicles	.94
67t Heavy equipment	.92
68t Medium/light equipment	.92
71t Off-road vehicles	.92
73t Air vehicles	.92
74t Water vehicles	.92
26a Driving/operating	.84
3a Tracking	.65
76t People conveyors	.59
81t Hand-operated (discrete controls)	.58
83t Hand-operated (continuous controls)	.58
82t Foot-operated (discrete controls)	.57
84t Foot-operated (continuous controls)	.57
30j Transportation and mechanized equipment	.56
2a Control precision	.50
7a Reaction time	.50
75t Material conveyors	.49
8a Multilimb coordination	.39
1a Eye-hand coordination	.36
17t Sporting equipment (non-powered)	.33
<b>Dimension B-4: Medical/veterinary activities.</b>	
53a Physical treatment, excluding surgery	.98
52a Examining	.95
55a Applying medicines	.92
18t Medical devices (non-powered)	.80

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-4. (continued)</b>	
54a Surgical treatment	.78
39t Medical equipment, powered (portable powered)	.74
3j People	.74
18j Medical materials	.73
2j Animals and marine life	.69
51a Handling	.61
20t Precision in hand tool usage (non-powered)	.39
41t Precision in portable powered tool/equipment usage	.31
<b>Dimension B-5: Strenuous work activities.</b>	
19a General body strength	.98
22a Dynamic strength	.90
18a Finger/hand/arm strength	.87
21a Endurance/stamina	.85
20a Explosive strength	.84
45a Earth working	.48
12a Running	.40
45t Non-powered wheeled equipment (portable)	.35
16a Kneeling/stooping/crawling	.35
44a Material and object handling	.35
16t Earth working (non-powered)	.34
17a Lying	.29
<b>Dimension B-6: Construction work.</b>	
38j Outdoor passageways and structures, other than buildings	.90
21j Pre-fabricated construction components of wood and related materials	.89

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension B-6: (continued)	
35j Exteriors of large buildings	.89
36j Exteriors of small buildings	.88
20j Pre-fabricated construction components of metal and concrete	.87
37j Interiors of buildings	.84
33a Constructing/building	.57
41j Miscellaneous wooden products	.53
26j Miscellaneous wooden parts, excluding construction components	.52
39j Man-made land features	.51
11j Earth materials	.49
37a Material forming	.48
25j Miscellaneous metal parts, excluding mechanical and electrical parts and construction components	.48
40j Miscellaneous metal products, not elsewhere defined	.48
10j Lumber and related materials	.45
9j Metal, excluding precious metals	.42
22j Mechanical parts	.39
24j Screws, non-electric wire, and wire products	.38
34a Assembling	.35
43t Supporting (portable non-powered)	.33
36a Material shaping	.31
12j Rubber, plastic, and related synthetic materials	.31
32a Installing/connecting	.30
42j Rubber and plastic products	.29

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-7: Material processing.</b>	
7j Non-processed or minimally-processed animal materials	-.30
42j Rubber and plastic products	-.30
38a Surface finishing	-.31
42a Heat or pressure treating, except in forming	-.32
8j Non-processed or minimally-processed plant materials, other than wood	-.32
39a Combining/separating	-.33
41a Electrically treating	-.38
9j Metal, excluding precious metals	-.44
11j Earth materials	-.44
16j Textile and leather materials, including synthetics	-.44
10j Lumber and related materials	-.45
5j Non-processed geological materials	-.48
18j Medical materials	-.48
6j Non-processed woods	-.51
40a Chemically treating	-.62
17j Paper and paper materials	-.63
12j Rubber, plastic, and related synthetic materials	-.68
13j Surface preparation and bonding substances	-.69
14j Chemical and petroleum materials and substances	-.79
<b>Dimension B-8: Eye-hand versus eye-foot coordination.</b>	
84t Foot-operated (continuous controls)	.36
82t Foot-operated (discrete controls)	.35
47a Monitoring	-.31

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-8: (continued)</b>	
49a Inspecting	-.34
38t Sporting equipment (portable powered)	-.36
3a Tracking	-.36
17t Sporting equipment (non-powered)	-.42
1a Eye-hand coordination	-.42
<b>Dimension B-9: Physical activities associated with personal service and treatment.</b>	
15a Sitting	.81
14a Standing	.79
11a Walking	.57
3j People	.41
80t Foot-operated (continuous settings)	.36
78t Foot-operated (discrete settings)	.33
76t People conveyors	.31
17a Lying	.31
<b>Dimension B-10: Agriculturally related activities.</b>	
37t Earth working (portable powered)	-.32
45t Non-powered wheeled equipment (portable)	-.39
39j Man-made land features	-.49
8j Non-processed or minimally-processed plant materials, other than wood	-.55
7j Non-processed or minimally-processed animal materials	-.57
2j Animals and marine life	-.59
4j Terrain features	-.67
1j Plant life, including crops, trees, and shrubs	-.82

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-11: Mechanical and electrical maintenance and repair.</b>	
30a Diagnosing/troubleshooting	.84
32j Electrical/electronic equipment and components	.62
27a Repairing	.61
50a Testing	.61
28a Servicing	.57
29a Adjusting/tuning	.55
31j Machines and mechanical components, excluding transportation and mechanized equipment	.51
41a Electrically treating	.49
23j Electrical and electronic parts and components	.45
47a Monitoring	.43
49a Inspecting	.40
30j Transportation and mechanized equipment	.40
32a Installing/connecting	.36
34j Equipment/systems, not elsewhere defined	.33
22j Mechanical parts	.31
33j Professional, measurement, and scientific instruments	.31
29j Non-powered hand tools and work equipment	.29
<b>Dimension B-12: Stationary equipment operation.</b>	
63t Pressing	.82
49t Cutting by shearing	.81
60t Grinding	.81
50t Cutting by blade	.80
57t Abrading	.80
62t Heat application	.80
58t Drilling/perforating	.79

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-12: (continued)</b>	
48t Cutting by abrasion	.78
47t Cutting by sawing	.77
51t Cutting by heat	.77
59t Shaping	.77
64t Combining/separating	.77
55t Mechanical fastening	.75
61t Forming	.75
53t Bonding	.73
65t Handling/supporting	.71
52t Fusion	.70
54t Stitching, knitting, and weaving	.70
56t Liquid application/coating	.63
25a Operating/controlling	.61
24a Tending	.55
23a Feeding/offbearing	.49
9j Metal, excluding precious metals	.47
37a Material forming	.44
36a Material shaping	.42
79t Hand-operated (continuous settings)	.39
10j Lumber and related materials	.38
75t Material conveyors	.35
80t Foot-operated (continuous settings)	.35
17j Paper and paper materials	.33
78t Foot-operated (discrete settings)	.32
<b>Dimension B-13: Joining/connecting activities.</b>	
24j Screws, non-electric wire, and wire products	.59
26t Fusion (portable powered)	.54

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension B-13: (continued)	
27t Bonding (portable powered)	.53
29t Mechanical fastening (portable powered)	.52
28j Miscellaneous parts of materials other than metal, wood, or textiles--such as rubber, plastic, fiberglass, ceramics, etc.	.52
5t Bonding/sealing (non-powered)	.51
23j Electrical and electronic parts and components	.51
6t Mechanical fastening (non-powered)	.48
32a Installing/connecting	.46
52t Fusion (stationary machines and equipment)	.43
34a Assembling	.42
28t Stitching (portable powered)	.41
35a Fiber/thread working	.41
7t Stitching/wiring (non-powered)	.40
53t Bonding (stationary machines and equipment)	.40
42t Holding (portable non-powered)	.39
25j Miscellaneous metal parts, excluding mechanical and electrical parts and construction components	.38
55t Mechanical fastening (stationary machines and equipment)	.37
20j Pre-fabricated construction components of metal and concrete	.35
26j Miscellaneous wooden parts, excluding construction components	.34
54t Stitching, knitting, and weaving (stationary machines and equipment)	.33
22j Mechanical parts	.32
27j Textile, leather, and related synthetic parts	.32

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-14: Precise control operations versus general body activities.</b>	
* Arm-hand manipulations without visual control	.57
* Ear-hand or ear-foot coordination	.50
4a Finger dexterity	.39
5a Manual dexterity	.39
6a Arm-hand steadiness	.38
2a Control precision	.34
83t Hand-operated (continuous controls)	.33
84t Foot-operated (continuous controls)	.30
78t Foot-operated (discrete settings)	.29
82t Foot-operated (discrete controls)	.29
13a Climbing	-.47
12a Running	-.55
<b>Dimension B-15: Food processing.</b>	
19j Processed foods, which require further preparation--mixing, cooking, baking, etc.	.80
42a Heat or pressure treating, except in forming	.59
39a Combining/separating	.48
35a Fiber/thread working	.36
40a Chemically treating	.34
43a Cleaning	.30
<b>Dimension B-16: General body coordination.</b>	
9a Balance	.83
10a General body coordination	.75
13a Climbing	.60
16a Kneeling/stooping/crawling	.56

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension B-16: (continued)</b>	
8a Multilimb coordination	.53
17a Lying	.48
11a Walking	.45
12a Running	.45
* Arm-hand manipulations without visual control	.37
<b>Dimension B-17: Unskilled machine-related activities.</b>	
7a Reaction time	.30
9t Abrading/polishing (non-powered)	-.29
43t Supporting (portable non-powered)	-.29
77t Hand-operated (discrete settings)	-.29
28a Servicing	-.29
10t Scraping (non-powered)	-.30
24a Tending	-.31
14t Handling (non-powered)	-.32
43a Cleaning	-.33
16t Earth working (non-powered)	-.34
81t Hand-operated (discrete controls)	-.38
15t Cleaning (non-powered)	-.39
23a Feeding/offbearing	-.45
44a Material and object handling	-.49
<b>Dimension B-18 Handicraft activities.</b>	
15j Art and craft materials	.86
43j Apparel and finished textile and leather products	.71
44j Fabricated products of miscellaneous materials, not elsewhere defined	.67
93t Optical devices	.54

Table 3 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension B-18: (continued)	
4a Finger dexterity	.48
38a Surface finishing	.44
16j Textile and leather materials, including synthetics	.42
20t Precision in hand tool usage (non-powered)	.40
41j Miscellaneous wooden products	.40
46a Precision working	.39
6a Arm-hand steadiness	.36
27j Textile, leather, and related synthetic parts	.36
11t Forming (non-powered)	.34
8t Liquid application/coating (non-powered)	.31
35a Fiber/thread working	.29

<sup>a</sup>Rotated loadings less than .29 were omitted.

\*These items were later deleted from the OAI.

aspects of medical and veterinary treatment are included. Items dealing with the use of medical materials and devices also load on this factor, as well as precision in tool usage.

Dimension B-5: Strenuous work activities. This dimension includes elements involving the various types of strength and movement required in strenuous work activities, such as earth working and material handling.

Dimension B-6: Construction work. This dimension contains work elements pertaining to building activities. The range of structures included extends from small buildings (such as houses) to large buildings, bridges, and highways. Work on building exteriors and interiors, construction of outdoor structures, and associated earth-working activities are included. Because of the variety of objects acted upon and range of construction-related activities included, it appears that this factor encompasses all phases of construction, including interior finishing.

Dimension B-7: Material processing. This dimension is concerned with the treatment and processing of crude and processed materials. Items loading on this factor define both the types of materials to be treated or processed and the types of processing or treatment activities to be carried out (e.g., electrical, chemical, and heat treatment).

Dimension B-8: Eye-hand versus eye-foot coordination. This dimension is bi-polar, with negatively loading items emphasizing visual-hand coordination and positively loading items dealing with foot-control devices (which require eye-foot coordination). The two negatively loading items related to sporting equipment, as well as the negatively loading monitoring item, are consistent with this interpretation.

Dimension B-9: Physical activities associated with personal service and treatment. This factor includes four general body activities, in addition to items dealing with people as objects, foot-control devices, and people conveyors. This combination of work elements suggests a factor emphasizing the physical activities associated with personal service and treatment and other kinds of work in which people are acted upon.

Dimension B-10: Agriculturally related activities. This dimension is comprised of items dealing with plant and animal life, land features, nonprocessed plant and animal materials, and related equipment.

Dimension B-11: Mechanical and electrical maintenance and repair. The maintenance and repair of electrical and mechanical devices is clearly emphasized in this factor. Besides the substantial loadings of maintenance-related items, items pertaining to troubleshooting, installing, and electrical and mechanical parts load on this dimension.

Dimension B-12: Stationary equipment operation. The elements with the highest loadings on this factor include all of the OAI group

titled Stationary Machines and Equipment. Also loading on this factor are items pertaining to activities and objects typically associated with stationary machine operation. Machine-related operations such as operating/controlling, tending, and feeding/offbearing are included, as well as items dealing with metal, lumber, paper, and setting devices.

Dimension B-13: Joining/connecting activities. This dimension emphasizes material joining activities, including fusion, bonding, mechanical fastening, and stitching. The classes of objects involved include miscellaneous parts, electrical/electronic parts, mechanical parts, pre-fabricated construction components, wooden parts, textiles, leather, and synthetic parts. This factor would appear to be relevant to installation, assembly, fabrication, and possibly construction.

Dimension B-14: Precise control operations versus general body activities. This is a bi-polar dimension with the positively loading items emphasizing precise limb, hand, and finger movements in connection with the operation of hand- and foot-operated control devices; the two highest positive loadings suggest control operations without visual cues. The negatively loading items on this dimension define two general body activities (climbing and running) which are dependent upon vision.

Dimension B-15: Food processing. The items loading on this factor seem, for the most part, to be related to food processing. The relationship of the fiber/thread working element to this dimension is not clear, although it might be related to food processing within a general housekeeping context.

Dimension B-16: General body coordination. The items loading on this factor are concerned with the movement, position, and coordination of the body. All of the items in this dimension are contained in the OAI group titled General Physical Requirements.

Dimension B-17: Unskilled machine-related activities. The work elements defining this factor pertain to manual activities performed on and around machines. The machine-related activities include operating, tending, and servicing the equipment. Also included are several items dealing with non-powered tools and equipment. Although Item 7a (Reaction Time) received a substantial positive loading, as opposed to the negatively loading items characterizing this dimension, neither the magnitude of the loading nor the nature of the element seem to justify a bi-polar interpretation.

Dimension B-18: Handicraft activities. This factor deals with precise handwork involving arts and crafts materials, textiles, leather, wood, and miscellaneous materials. Activities such as forming, finishing, liquid application/coating, and fiber/thread working are included, with an emphasis on dexterity, steadiness, and precision.

### Dimensions of Representational Work Behavior

The analysis of the Representational Work Behavior section of the OAI yielded seven dimensions which accounted for 85 percent of the total variance. All of these factors were interpreted and are presented in Table 4.

Dimension C-1: Verbal communication. Both written and oral communication are represented in the verbal communication factor. The written aspect of this dimension includes items ranging from informal writing to written communications containing technical terms. The items pertaining to oral communication include ordinary conversational English, dictating, and formal and technical language. Information processing activities related to communication (i.e., analysis and synthesis) are also included in this dimension, as well as such miscellaneous aspects of communication such as precision of communication and various devices to transmit communication.

Dimension C-2: Mathematical/computational activities. This dimension emphasizes numerical elements such as calculating/computing, complexity of numerical information, and communication with numbers. Computing devices, ranging from electronic computers to hand devices, have high loadings on this factor, and three data-processing items (analyzing, compiling, and synthesizing) have small but significant loadings.

Dimension C-3: Clerical activities. This factor emphasizes activities typically associated with clerical work, such as transcribing, classifying, checking, and the use of keyboard devices.

Dimension C-4: Pictorial representation. Work elements loading on this dimension pertain to drawing, pictorial communication, and various associated devices, including drawing, still picture, audio-visual, and writing devices. Artistic and layout abilities appear to be an important aspect of the factor.

Dimension C-5: Communication by visual and auditory code. This dimension seems to involve communication by visual and auditory codes. The factor includes one item concerning communication by auditory code, and two items pertaining to devices which transmit audio-visual communications.

Dimension C-6: Interpersonal communication. The items in this dimension concern communication with others in situations ranging from the routine and personal to the structured and formal. It should be noted that the ARI attribute of social intelligence has a high score on this factor.

Dimension C-7: Abstract versus machine-aided representational activities. A distinction is made between representational activities requiring relatively high levels of thought versus the processing of information with the use of machines (i.e., reproducing, transcribing, calculating, and recording). The negative loading on Item 18r

Table 4. Dimensions of Representational Work Behavior

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension C-1: Verbal communication.</b>	
15r Writing - level of difficulty	.97
19r Formal, grammatically correct English	.86
21r Foreign language	.84
17r Speaking - level of difficulty	.83
20r Technical terms	.76
38r Analyzing	.76
39r Synthesizing	.76
28r Communication ratio	.75
14r Writing	.73
29r Communication precision	.65
16r Speaking	.59
18r Ordinary conversational English	.58
37r Compiling	.53
7r Voice transmission and storage devices	.34
1r Writing devices	.30
<b>Dimension C-2: Mathematical/computational activities.</b>	
27r Complexity of numerical information communicated	.93
36r Calculating/computing - level of difficulty	.93
9r Hand computing devices	.91
12r Uses computer programs which were written by others and which are entered on the computer by others	.91
13r Writes computer programs for use by self or others and may or may not enter the programs on the computer	.88
35r Calculating/computing	.88
10r Mechanical computing devices	.82
26r Communicates with numbers	.82

Table 4 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension C-2: (continued)</b>	
11r Data-card processing devices	.66
38r Analyzing	.33
37r Compiling	.32
39r Synthesizing	.32
<b>Dimension C-3: Clerical activities.</b>	
34r Classifying/categorizing	.95
32r Comparing/checking	.94
33r Copying/recording	.92
23r Communicates with special written codes	.68
6r Office reproducing devices	.51
3r Keyboard devices	.49
37r Compiling	.47
14r Writing	.42
1r Writing devices	.37
<b>Dimension C-4: Pictorial representation.</b>	
2r Drawing devices	.88
25r Communicates by drawing	.81
4r Still picture devices	.75
1r Writing devices	.52
8r Audio-visual transmission and storage devices	.44
5r Visual signaling devices	.33
24r Communicates with auditory codes	-.29

Table 4 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension C-5: Communication by visual and auditory code.</b>	
22r Signals by visual means	.82
5r Visual signaling devices	.76
8r Audio-visual transmission and storage devices	.55
24r Communicates with auditory codes	.54
<b>Dimension C-6: Interpersonal communication.</b>	
30r Personalness of subject matter	.85
31r Formality or structure of communicative interaction	.66
16r Speaking	.48
24r Communicates with auditory codes	.45
18r Ordinary conversational English	.36
7r Voice transmission and storage devices	.29
<b>Dimension C-7: Abstract versus machine-aided representational activities.</b>	
25r Communicates by drawing	.38
39r Synthesizing	.38
38r Analyzing	.34
1r Writing devices	-.31
18r Ordinary conversational English	-.34
8r Audio-visual transmission and storage devices	-.35
10r Mechanical computing devices	-.37
11r Data-card processing devices	-.48
3r Keyboard devices	-.53
6r Office reproducing devices	-.54
7r Voice transmission and storage devices	-.58

<sup>a</sup>Rotated loadings less than .29 were omitted.

(Ordinary conversational English) is consistent with this interpretation, since conversation would ordinarily be associated with the use of the negatively loading representational devices.

#### Dimensions of Interpersonal Work Behavior

Six factors from this section of the OAI were rotated and interpreted. These six factors, which accounted for 87 percent of the total variance, are presented in Table 5.

Dimension D-1: Conflict resolution. The first factor to emerge from this analysis emphasizes the various methods of resolving disagreements. The highest loading items include: discussing, mediating, negotiating, arbitrating, and pacifying. Among the lesser loading items are: advising persuading, socializing, and instructing. The item pertaining to consultants and advisors also has a substantial loading.

Dimension D-2: Supervising. This component clearly emphasizes supervisory activities. Included in addition to two supervision items, are evaluating, disciplining, organizing, and personnel actions.

Dimension D-3: Multiple-status interpersonal interaction. This dimension emphasizes interaction with people of varying levels of status. Items specifying the persons with whom the incumbent interacts include others with different job statuses (peers, supervisors, consultants, and subordinates) as well as clients or patients. The subordinate role is the most heavily emphasized, since it is represented by three highly loading items (3p, 4p, and 25p).

Dimension D-4: Medically related interpersonal activities. Treating, assisting, and serving/catering all load heavily on this dimension, with clients or patients as the relevant person types. The substantial loadings on assisting and serving/catering suggest a subordinate role (e.g., a nurse-doctor relationship).

Dimension D-5: Sales/customer-service activities. All of the items loading on this factor combine into an easily interpretable dimension. The fundamentals of selling include interaction with customers or the general public and the use of sales techniques such as demonstrating, persuading, catering, giving and receiving information, and socializing and entertaining.

Dimension D-6: Teaching/instructing activities. The items loading on this factor define a well-formed dimension which specifies the activities engaged in by a teacher or instructor. The activities include: teaching/instructing, demonstrating, giving information to others, advising/counseling, evaluating, and obtaining information from others. The highest loading item defines the most relevant person type--students.

**Table 5. Dimensions of Interpersonal Work Behavior**

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension D-1: Conflict resolution.</b>	
20p Debating/discussing	.95
19p Negotiating	.92
18p Arbitrating	.90
22p Mediating	.89
21p Pacifying/placating	.85
29p Consultants or advisors	.56
16p Advising/counseling	.55
14p Persuading	.49
24p Socializing	.47
23p Diverting/entertaining	.39
15p Teaching/instructing	.38
12p Obtaining information from others	.29
<b>Dimension D-2: Supervising.</b>	
6p General supervision	.95
5p Close supervision	.93
9p Organizing	.92
10p Disciplining	.92
8p Personnel actions	.89
7p Evaluating	.83
27p Subordinates	.77
4p Surveillance received	.34
<b>Dimension D-3: Multiple-status interpersonal interaction.</b>	
26p Peers	.76
3p Directions received - level of difficulty	.73
4p Surveillance received - level of difficulty	.73

Table 5 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension D-3: (continued)</b>	
25p Superiors	.59
29p Consultants or advisors	.56
28p Clients or patients	.44
27p Subordinates	.35
12p Obtaining information from others	.34
11p Giving information to others	.29
<b>Dimension D-4: Medically related interpersonal activities.</b>	
17p Treating	.89
1p Assisting	.73
2p Serving/catering	.57
28p Clients or patients	.36
<b>Dimension D-5: Sales/customer-service activities.</b>	
12p Obtaining information from others	-.30
14p Persuading	-.35
11p Giving information to others	-.43
23p Diverting/entertaining	-.51
13p Demonstrating	-.54
24p Socializing	-.58
2p Serving/catering	-.67
31p General public	-.88
30p Customers	-.92
<b>Dimension D-6: Teaching/instructing activities.</b>	
32p Students	.80
15p Teaching/instructing	.56

Table 5 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension D-6: (continued)	
11p Giving information to others	.48
13p Demonstrating	.44
16p Advising/counseling	.36
7p Evaluating	.32
12p Obtaining information from others	.32

<sup>a</sup>Rotated loadings less than .29 were omitted.

### Dimensions of Work Goals

The analysis of the OAI Work Goals section produced 16 interpretable factors accounting for 88 percent of the total variance. These factors are presented in Table 6.

Dimension E-1: Objectives pertaining to installation, assembly, and construction. This dimension is primarily concerned with objectives related to the installation, assembly, and construction of devices, structures, and objects. Three items in this factor are subsumed under Connecting/Attaching Objectives in the OAI, and two other items (5g and 16g) refer specifically to installation and assembly objectives. This factor is relevant to mechanical work, as reflected by the four significant items from the OAI Mechanical Objectives group. Also included are items relating to Electrical Objectives and Objectives Accomplished Through Material/Object Arrangement or Modification.

Dimension E-2: Objectives pertaining to written communication. This factor includes all of the OAI items pertaining to written objectives, plus one item (77g) dealing with oral communication.

Dimension E-3: Planning and innovation. This dimension emphasizes planning and innovation in technology, science, business, and situations involving people (e.g., education).

Dimension E-4: Health and biological objectives. All of the OAI items dealing with biological/health objectives load significantly on this factor. These work elements cover objectives concerned with preventing, identifying, and treating health problems, along with other health and biological objectives.

Dimension E-5: Numerical/symbolic objectives. This factor contains all of the OAI items dealing with numerical objectives, plus three items pertaining to Business/Organizational Objectives. The two remaining items (55g and 85g) which have the lowest loadings on the factor, deal with encoded information and environmental charts, diagrams, and maps.

Dimension E-6: Spatial relations objectives. This dimension emphasizes work goals related to the spatial arrangement of objects or figures. Three items (33g, 34g, and 57g) deal with the arrangement of objects, while seven items (9g, 19g, 35g, 39g, 55g, 61g, and 84g) pertain to diagrams, drawing, and charts. Several content areas are represented in this factor, including: environment, astronomy, mechanics, art/decoration, electrical/electronic, and construction.

Dimension E-7: Business/sales objectives. Important to this dimension are items directly concerned with techniques related to sales, including merchandising, advertising, and public relation objectives. Also important are work elements associated with the accomplishment of business/organizational goals, such as employee relations, organizational plans and innovations, business communication, and contracts. Additional objectives concern attitude change

**Table 6. Dimensions of Work Goals**

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension E-1: Objectives pertaining to installation, assembly, and construction.</b>	
24g Installed or attached objects	.53
5g Mechanical devices installed or assembled	.50
22g Completed structures and other constructed objects	.49
23g Assembled or fabricated objects	.49
39g Drawings or diagrams of constructed, assembled, modified, fabricated, or arranged objects/ materials	.41
9g Mechanical drawings	.38
3g Mechanical functioning maintained	.36
4g Proper mechanical functioning restored	.36
16g Electrical/electronic devices installed or assembled	.29
<b>Dimension E-2: Objectives pertaining to written communication.</b>	
54g Written communications pertaining to water, atmospheric or astronomical conditions or events	.94
49g Written communications concerning terrain/earth features	.93
44g Written communications concerning plant life	.91
38g Written communications pertaining to material/object modification, assembly, or fabrication	.90
11g Written communication of mechanical information	.89
112g Written communications pertaining to animals	.89
37g Written communications pertaining to construction, installation, or spatial arrangement	.85
21g Written communication of electrical/electronic information	.82
109g Written communications pertaining to people	.76
70g Written biological/health communication completed	.73

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension E-2: (continued)</b>	
99g Written business/organizational communication	.69
98g Contracts and other legal documents drawn up	.67
73g Non-standard or innovative written output	.65
62g Art/decorative information communicated	.62
74g Written material reviewed or edited for content	.57
75g Written material edited or checked for composition and format	.50
72g Routine written output	.49
77g Oral information communicated	.46
<b>Dimension E-3: Planning and innovation.</b>	
48g Innovations or plans concerning terrain/earth features	.87
10g Mechanical plans or innovations	.85
53g Innovations or plans concerning water, atmospheric, or astronomical conditions or events	.85
36g Innovations or plans in assembly, fabrication, or material modification	.84
20g Electrical/electronic innovations or plans	.80
35g Innovations or plans in construction, installation, or spatial arrangement of objects	.78
97g Organizational plans or innovations	.77
43g Innovations or plans related to plant life	.75
71g Biological/health innovations or plans	.67
108g Innovations or plans pertaining to people	.64
80g Solutions to advanced mathematical problems	.39
60g Innovations in performing arts	.30

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension E-4: Health and biological objectives.</b>	
63g Causes or potential causes of health problems identified	.93
64g Health problems relieved or eliminated	.92
65g Potential health problems prevented or mitigated	.91
68g Biological/health tests performed	.86
69g Biological/health measurements taken	.86
66g Medically related service tasks completed	.63
70g Written biological/health communication completed	.62
67g Biological/health inspections performed	.61
71g Biological/health innovations or plans	.60
<b>Dimension E-5: Numerical/symbolic objectives.</b>	
79g Solutions to standard arithmetic problems	.94
82g Numerical data displayed	.89
83g Numerical information orally communicated	.86
94g Balanced, verified, or updated business/organizational records	.86
96g Business/organizational data gathered, compiled, or displayed	.85
81g Records or transcribed numerical data	.82
80g Solutions to advanced mathematical problems	.74
95g Satisfactory index of organizational performance attained	.46
85g Information encoded into written symbols or codes	.45
55g Environmental charts, diagrams, or maps produced	.39

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension E-6: Spatial relations objectives.</b>	
33g Spatially arranged objects	.79
52g Astronomical events predicted, observed, or recorded	.68
84g Completed diagrams, charts, and maps	.68
55g Environmental charts, diagrams, or maps produced	.67
9g Mechanical drawings	.65
39g Drawings or diagrams of constructed, assembled, modified, fabricated, or arranged objects/materials	.65
34g Properly located or placed objects	.63
57g Aesthetically arranged objects or things	.58
51g Atmospheric conditions monitored or forecasted	.54
19g Electrical/electronic schematics and/or diagrams	.50
61g Completed art/decorative plans or designs	.47
56g Environmental emergencies detected, prepared for, or dealt with	.39
35g Innovations or plans in construction, installation, or spatial arrangement of objects	.29
<b>Dimension E-7: Business/sales objectives.</b>	
89g Completed sales or business/organizational transactions	.84
93g Public relations accomplishments	.76
90g Merchandise shelved, packaged, stored, demonstrated, or otherwise handled	.64
91g Advertising material produced, displayed, or disseminated	.64
92g Employee relations accomplishments	.63
103g Attitude, opinion, or belief change in others	.53
95g Satisfactory index of organizational performance attained	.51

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension E-7: (continued)	
97g Organizational plans or innovations	.42
99g Written business/organizational communication	.41
98g Contracts and other legal documents drawn up	.34
106g Financial or legal position of others improved or maintained	.32
107g Enjoyment, satisfaction, or mood change of others	.31
77g Oral information communicated	.30
Dimension E-8: Agricultural objectives.	
40g Soil prepared and/or plants, shrubs, or trees planted	.94
42g Plant products harvested or extracted	.93
41g Plant life maintained	.92
45g Raw geological materials extracted	.71
46g Terrain or earth features modified	.71
47g Satisfactory condition of earth/terrain features maintained	.71
56g Environmental emergencies detected, prepared for, or dealt with	.54
43g Innovations or plans related to plant life	.41
34g Properly located or placed objects	.39
90g Merchandise shelved, packaged, stored, demonstrated, or otherwise handled	.38
111g Performance of animals improved, assessed, or controlled	.36
44g Written communications concerning plant life	.30

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension E-9: Inspection/testing objectives.</b>	
32g Satisfactory condition or state of modified objects, materials, or substances, including formed, shaped, and treated materials and finished surfaces	.77
31g Satisfactory condition of assembled or fabricated objects, excluding mechanical and electrical/electronic devices	.73
30g Satisfactory condition of structures and other constructed objects	.71
50g Maintenance of satisfactory water conditions and/or detection of unsatisfactory water conditions	.60
67g Biological/health inspections performed	.51
1g Substandard conditions of mechanical devices detected	.48
6g Satisfactory output from mechanical devices	.43
12g Substandard conditions of electrical/electronic devices detected	.42
18g Satisfactory output from electrical/electronic devices	.33
68g Biological/health tests performed	.33
2g Causes of mechanical malfunction located or identified	.32
<b>Dimension E-10: Clerical objectives.</b>	
87g Reproduced semantic/symbolic material	.91
88g Semantic/symbolic material verified	.91
76g Written material categorized	.90
78g Verbal material transcribed	.83
75g Written material edited or checked for composition and format	.68

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension E-10: (continued)	
85g Information encoded into written symbols or codes	.64
72g Routine written output	.56
74g Written material reviewed or edited for content	.55
81g Recorded or transcribed numerical data	.40
Dimension E-11: Electrical/electronic objectives.	
14g Electrical/electronic functioning maintained	.81
13g Causes of electrical/electronic malfunction located or identified	.78
15g Electrical/electronic functioning restored	.78
18g Satisfactory output from electrical/electronic devices	.77
17g Electrical/electronic devices regulated, adjusted, or controlled	.76
16g Electrical/electronic devices installed or assembled	.72
12g Substandard conditions of electrical/electronic devices detected	.71
19g Electrical/electronic schematics and/or diagrams	.66
21g Written communication of electrical/electronic information	.45
20g Electrical/electronic innovations or plans	.40
Dimension E-12: Objectives related to the behavior of others.	
77g Oral information communicated	-.32
92g Employee relations accomplishments	-.39
106g Financial or legal position of others improved or maintained	-.48
107g Enjoyment, satisfaction, or mood change of others	-.49

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension E-12: (continued)	
108g Innovations or plans pertaining to people	-.50
103g Attitude, opinion, or belief change in others	-.53
111g Performance of animals improved, assessed, or controlled	-.61
104g Others' compliance with directions, rules, or laws insured or monitored	-.78
105g Improved adjustment or adaption of others	-.80
101g Physical competence of others improved or assessed	-.89
102g Others' knowledge improved or assessed	-.89
Dimension E-13: Art/decorative objectives.	
59g Successfully completed performance	.91
60g Innovations in performing arts	.82
86g Information transmitted by non-written codes and signals	.64
62g Art/decorative information communicated	.54
61g Completed art/decorative plans or designs	.50
58g Original art objects	.35
57g Aesthetically arranged objects or things	.34
Dimension E-14: Mechanical objectives.	
5g Mechanical devices installed or assembled	-.51
8g People, objects, or materials transported	-.58
4g Proper mechanical functioning restored	-.65
6g Satisfactory output from mechanical devices	-.65
1g Substandard conditions of mechanical devices detected	-.66
3g Mechanical functioning maintained	-.68

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension E-14: (continued)	
7g Properly regulated or controlled mechanical devices	-.71
2g Causes of mechanical malfunction located or identified	-.73
Dimension E-15: Objectives related to the aesthetic appearance of people and animals.	
110g Improved state of grooming or appearance of animals	.72
100g Improved state of grooming or appearance of people	.71
58g Original art objects	.50
57g Aesthetically arranged objects or things	.39
61g Completed art/decorative plans or designs	.36
91g Advertising material produced, displayed, or disseminated	.33
111g Performance of animals improved, assessed, or controlled	.30
86g Information transmitted by non-written codes and signals	-.29
Dimension E-16: Material modification/arrangement objectives.	
45g Raw geological materials extracted	-.29
24g Installed or attached objects	-.31
31g Satisfactory condition of assembled or fabricated objects, excluding mechanical and electrical/electronic devices	-.32
30g Satisfactory condition of structures and other constructed objects	-.33
22g Completed structures and other constructed objects	-.36

Table 6 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension E-16: (continued)	
32g Satisfactory condition or state of modified objects, materials, or substances, including formed, shaped, and treated materials and finished surfaces	-.38
23g Assembled or fabricated objects	-.39
25g Shaped objects	-.73
29g Treated materials or substances	-.81
27g Finished or prepared surfaces	-.82
26g Formed objects	-.86
28g Materials/substances modified by miscellaneous mechanical actions, excluding material removal and forming	-.91

<sup>a</sup>Rotated loadings less than .29 were omitted.

in others, improved financial or legal position of others, and the enjoyment or satisfaction of others--all of which are consistent with business and sales goals.

Dimension E-8: Agricultural objectives. This factor emphasizes work elements concerned with agricultural and terrain/earth objectives. In addition to items dealing with plant life, soil preparation and maintenance, and animals, this factor incorporates one item pertaining to merchandising (90g).

Dimension E-9: Inspection/testing objectives. This dimension is marked by items concerned with the outcomes of inspecting, testing, and monitoring. The work objectives in this factor deal with the condition or functioning of objects, structures, devices, certain aspects of the environment, and organisms or biological material. Some of the elements suggest the involvement of maintenance (or correction), as well as detection, objectives.

Dimension E-10: Clerical objectives. Work elements pertaining to secretarial and other related clerical tasks define this factor. The objectives included involve verifying, categorizing, reproducing, transcribing, editing, encoding, and recording.

Dimension E-11: Electrical/electronic objectives. This factor emphasizes objectives related to electrical/electronic maintenance, troubleshooting, repair, and installation. All of the items in the OAI Electrical Objectives group are contained in the factor. Electrical objectives requiring direct contact with electrical components are stressed over indirect objectives (e.g., the production of diagrams, drawings, written communications, or plans), although three items dealing with the latter types of objectives do load on the factor.

Dimension E-12: Objectives related to the behavior of others. This dimension contains a variety of work elements involving interaction with people (and in one instance animals). The objectives defined in these work elements deal primarily with improving, evaluating, or controlling the behavior of others. The heaviest loading items concern others' knowledge, physical competence, adjustment, and compliance.

Dimension E-13: Art/decorative objectives. This dimension contains work elements pertaining to art and decorative objectives. The two highest loading items concern the performing arts; lesser loading items deal with communication, plans and designs, art objects, and aesthetic arrangement. The substantial loading on Item 86g is consistent with the emphasis on the performing arts (e.g., music and stage). With the exception of Item 86g, all of the elements defining this factor belong to the OAI group titled Art/Decorative Objectives.

Dimension E-14: Mechanical objectives. This is a broad dimension involving objectives related to machine operation, maintenance, repair, and installation. The inclusion of Items 7g and 8g suggests the operation of transportation equipment. Only objectives requiring direct contact with mechanical devices are included in this dimension; indirect mechanical objectives, such as producing drawings, written communications, and innovations related to mechanical devices, do not load on this factor.

Dimension E-15: Objectives related to the aesthetic appearance of people and animals. This dimension seems to be primarily oriented toward the improved appearance of people or animals. Besides the items dealing directly with people and animals, several items (producing original art objects, art/decorative plans or designs, and advertising material) suggest the representation of people and animals in an aesthetically pleasing manner. The objective of aesthetically arranging objects (57g) might involve providing an appealing background or environment for people or animals, or working directly on the aesthetic arrangement of clothes, accessories, etc.

Dimension E-16: Material modification/arrangement objectives. The highest loading items on this factor pertain to the modification of materials through shaping, forming, treating, and abrading/coating. Lesser loading items define objectives involving connecting/attaching (assembly, construction, and installation), and ensuring the satisfactory condition of modified and connected/attached materials and objects.

#### Dimensions of Work Context

The principal components analysis of the Work Context section yielded 12 interpretable factors accounting for 80 percent of the total variance. The items with significant loadings on these factors are listed in Table 7.

Dimension F-1: White collar working conditions. The items loading on this dimension refer to aspects of the work context which are typically associated with white collar work. Business attire, a consistent daytime schedule, working individually in a specified area (e.g., a desk), and the possibility of social interaction all suggest an office environment. Item 23c, casual apparel, might apply to the less formal attire worn in some offices.

Dimension F-2: Unpleasant physical working conditions. The second dimension to emerge from this section emphasizes working conditions which cause physical discomfort. Included are such conditions as undesirable temperature (high, low, or fluctuating), exposure to weather, uncomfortable body positions, humidity, wetness, and vibration.

Dimension F-3: Situations requiring social interaction. This factor is defined by items concerned with work situations requiring

Table 7. Dimensions of Work Context

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension F-1: White collar working conditions.</b>	
25c Business attire	.82
23c Casual apparel	.50
38c Day hours	.47
52c Working individually in the presence of co-workers or others where social interaction is possible	.40
35c Consistent schedule	.37
43c Confinement to a specified work space	.30
<b>Dimension F-2: Unpleasant physical working conditions.</b>	
11c Low temperature	1.00
10c High temperature	.92
12c Sudden temperature changes	.88
7c Uncomfortable body positions	.78
9c Unpleasant weather conditions	.69
6c Vibration	.68
3c Humid	.55
2c Wet	.43
<b>Dimension F-3: Situations requiring social interaction.</b>	
60c Social obligations	.89
59c Civic obligations	.84
58c Unpleasant social relationships	.83
57c Interpersonal conflict	.77
53c Working jointly with others as part of a team where social interaction and co-operation are necessary	.72

Table 7 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
Dimension F-3: (continued)	
54c Working individually in a one-to-one relationship with a customer, client, student, etc., where social interaction is restricted primarily to that person	.60
41c Distractions or interruptions	.39
55c Conflicting job demands	.39
56c Moral value conflict	.38
52c Working individually in the presence of co-workers or others where social interaction is possible	.31
Dimension F-4: Novel work situations.	
31c Task diversity	.90
42c Novel situations	.89
41c Distractions or interruptions	.47
51c Working alone with little or no opportunity for social interaction	.43
34c Irregular work	.40
37c Variable hours	.36
44c Rush situations	.34
46c Updating knowledges, techniques, and skills	.30
Dimension F-5: Hazardous working conditions.	
48c Safety consequences of errors	-.30
4c Dirty environment	-.34
18c Toxic conditions	-.47
17c Electrical hazards	-.53
5c Improper illumination	-.58
13c Mechanical hazards	-.61

Table 7 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension F-5: (continued)</b>	
16c Exposure to burns	-.69
15c High places	-.74
20c Overall hazard of the job	-.78
19c Other hazards	-.87
14c Moving or falling objects	-.88
<b>Dimension F-6: Seasonal outdoor work.</b>	
33c Seasonal work	.85
22c Work clothes	.79
4c Dirty environment	.64
1c Work location	.59
2c Wet	.47
3c Humid	.35
34c Irregular work	.35
23c Casual apparel	.33
<b>Dimension F-7: Responsibility.</b>	
47c Financial or material consequences of errors	.85
49c Intangible consequences of errors	.80
50c Organizational responsibility	.79
48c Safety consequences of errors	.69
46c Updating knowledges, techniques, and skills	.42
56c Moral value conflict	.30
<b>Dimension F-8: Uniformed personal service situations.</b>	
48c Safety consequences of errors	-.29
53c Working jointly with others as part of a team where social interaction and co-operation are necessary	-.32

Table 7 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension F-8: (continued)</b>	
54c Working individually in a one-to-one relationship with a customer, client, student, etc., where social interaction is restricted primarily to that person	-.36
36c Changing shift work	-.57
39c Night hours	-.71
40c Variable day-night hours	-.75
24c Uniform	-.76
<b>Dimension F-9: Hazardous mechanical environment.</b>	
8c Noise intensity	.67
51c Working alone with little or no opportunity for social interaction	.48
6c Vibration	.46
21c Safety apparel	.46
13c Mechanical hazards	.31
<b>Dimension F-10: High places.</b>	
1c Work location	.60
15c High places	.39
7c Uncomfortable body positions	.34
2c Wet	-.30
3c Humid	-.36
<b>Dimension F-11: Inconsistent work demands.</b>	
45c Time away from home	.72
55c Conflicting job demands	.56
37c Variable hours	.52

Table 7 (continued)

Job Dimension	Rotated Loading <sup>a</sup>
<b>Dimension F-11: (continued)</b>	
34c Irregular work	.45
56c Moral value conflict	.45
40c Variable day-night hours	.40
39c Night hours	.36
57c Interpersonal conflict	.30
<b>Dimension F-12: Work structure.</b>	
27c Timing and sequence	.83
28c Speed	.81
26c Work procedures	.77
30c Goals	.77
29c Performance standards	.69
43c Confinement to a specified work space	.58
32c Steady work	.46
21c Safety apparel	.45
35c Consistent schedule	.44
36c Changing shift work	.43
22c Work clothes	.41
44c Rush situations	.38
23c Casual apparel	.35
41c Distractions or interruptions	.34
38c Day hours	.31

<sup>a</sup>Rotated loadings less than .29 were omitted.

social interaction. Substantial loading items deal with social and civic obligations, working as a member of a team, interpersonal conflict, unpleasant social relationships, and working in one-to-one relationships with others. The sizable loadings of social and civic obligations suggest that this factor might characterize the social requirements of managerial positions.

Dimension F-4: Novel work situations. This factor specifies situations in which the worker performs diverse and novel tasks, often under a demanding and irregular work schedule. The significant loadings of two apparently contradictory items--distractions and interruptions (41c) versus working alone with little opportunity for social interaction (51c)--suggest the possibility of two different types of work situations. Moreover, an element of creativity is implied by the high factor scores received by ARI attributes pertaining to literary interest, artistic interest, and the need for creativity (ARI Items 74, 81, and 94).

Dimension F-5: Hazardous working conditions. This dimension contains work elements pertaining to situations in which the incumbent is exposed to hazards. All of the OAI elements dealing with hazards are represented, including moving or falling objects, high places, exposure to burns, mechanical and electrical hazards, and toxic conditions.

Dimension F-6: Seasonal outdoor work. The work elements loading substantially on this dimension include: seasonal and irregular work; outdoor environment; work clothes and casual apparel; and dirty, wet, and humid work conditions. These conditions would be characteristic of farm and construction work.

Dimension F-7: Responsibility. All of the OAI items dealing with the consequences of errors contribute to this factor, including financial, intangible, and safety consequences, as well as organizational responsibility. The significant loading on the updating of knowledge and skill (46c) is consistent with this interpretation.

Dimension F-8: Uniformed personal service situations. This factor seems oriented toward situations in which uniformed personal service or care is provided. The elements with substantial loadings involve: wearing a uniform, working irregular hours, working with customers and clients, and working jointly with others. Such conditions would apply to jobs ranging from bellboy to nurse. Consistent with the above interpretation, the ARI attributes with high factor scores on this dimension (e.g., Personal service, #65; Nursing and related technical services, #71; Skilled personal service, #72) pertain to both skilled and unskilled service activities.

Dimension F-9: Hazardous mechanical environment. The items comprising this factor pertain to noise, vibration, mechanical hazards, and working alone. This combination of elements suggests a job situation in which the incumbent works on or near dangerous, powerful mechanical equipment.

Dimension F-10: High places. The nature of this factor is somewhat unclear. However, the positive loadings on outdoor work, high places, and uncomfortable body positions suggest elevated work situations such as those encountered by power linemen and structural steel workers. The negative loadings on wet and humid conditions are consistent with this interpretation, since elevated work locations are usually dry and work is usually not conducted in such locations under wet conditions.

Dimension F-11: Inconsistent work demands. The combination of items comprising this factor define a type of work situation involving irregular hours, time away from home, and conflicting demands. This kind of job context is similar to that encountered by doctors, salesmen, artists, and entertainers.

Dimension F-12: Work structure. The items with the highest loadings on this factor specify various constraints on the worker's activities, including timing and sequence, pace, procedures, goals, performance standards, and physical location. The remaining items deal with various elements that one might expect to find in a highly structured work situation.

#### Estimates of Factorial Stability

As previously noted, comparisons were made between factors derived independently from two samples of attribute-rating data (*i.e.*, halves of the original data set). These comparisons were made for each of the six sectional factor analyses. The resulting matrices of Tucker and Pearson coefficients are shown in Appendix F. Each matrix of coefficients was examined to identify for each factor in one sample the closest correspondent in the other sample. This comparison was performed in both directions (*i.e.*, from Sample 1 to Sample 2, and vice versa), since in a few instances, a factor's closest correspondent in the other sample (Sample 2) was, in turn, more highly related to a third factor in the first sample. However, in the few cases where such nonreciprocities occurred, the coefficients of relationship were low, indicating that the factors in question had no direct correspondents in opposite samples. Tables 8 and 9 contain frequency distributions of the highest Tucker and Pearson coefficients for the factors in Sample 1 when compared with the factors in Sample 2. These distributions were compiled from the highest values in the columns of the matrices in Appendix F. Thus, the total number of observations in each distribution is 77, or the number of factors obtained from the six sectional analyses.

In order to determine whether Pearson correlations (based on factor scores) yielded results similar to the Tucker coefficients (based on factor loadings), the entries in corresponding matrices of coefficients were correlated; that is, for each of the six sectional analyses, the entire set of entries in the matrix of Tucker coefficients was correlated with the set of entries in the corresponding

Table 8. Frequency Distribution of the Coefficients of Congruence for 77 Factors Derived from Six Sections of the OAI

Coefficients of Congruence	Frequency	Proportion	Cumulative Proportion
.90 - .99	33	.428	1.000
.80 - .89	14	.182	.572
.70 - .79	12	.156	.390
.60 - .69	7	.091	.234
.50 - .59	6	.078	.143
.40 - .49	3	.039	.065
.30 - .39	1	.013	.026
.20 - .29	1	.013	.013
.10 - .19	0	.000	.000
.00 - .09	0	.000	.000
<b>Total</b>	<b>77</b>		

Table 9. Frequency Distribution of the Correlation Coefficients for 77 Factors Derived from Six Sections of the OAI

Correlation Coefficients	Frequency	Proportion	Cumulative Proportion
.90 - .99	16	.208	1.000
.80 - .89	21	.273	.793
.70 - .79	17	.221	.520
.60 - .69	9	.117	.299
.50 - .59	8	.104	.182
.40 - .49	4	.052	.078
.30 - .39	1	.013	.026
.20 - .29	0	.000	.013
.10 - .19	1	.013	.013
.00 - .09	0	.000	.000
<b>Total</b>	<b>77</b>		

matrix of Pearson coefficients. The product-moment correlations between the six pairs of matrices were as follows: (1) .94, (2) .93, (3) .98, (4) .92, (5) .95, and (6) .87. Thus, it would appear that the two methods of estimating factorial stability yield comparable results.

Higher-Order Factors

The 21 factors obtained from the higher-order analysis are shown in Table 10. This table contains the substantial rotated loadings for each of the higher-order factors on the 77 original (first-order) factors. The higher-order factors will not be described here but can be interpreted by referring to the descriptions of the first-order factors comprising them. The correlation matrix for the higher-order factors is presented in Appendix G.

Factor 1  
 Factor 2  
 Factor 3  
 Factor 4  
 Factor 5  
 Factor 6  
 Factor 7  
 Factor 8  
 Factor 9  
 Factor 10  
 Factor 11  
 Factor 12  
 Factor 13  
 Factor 14  
 Factor 15  
 Factor 16  
 Factor 17  
 Factor 18  
 Factor 19  
 Factor 20  
 Factor 21

Factor 1  
 Factor 2  
 Factor 3  
 Factor 4  
 Factor 5  
 Factor 6  
 Factor 7  
 Factor 8  
 Factor 9  
 Factor 10  
 Factor 11  
 Factor 12  
 Factor 13  
 Factor 14  
 Factor 15  
 Factor 16  
 Factor 17  
 Factor 18  
 Factor 19  
 Factor 20  
 Factor 21

Factor 1  
 Factor 2  
 Factor 3  
 Factor 4  
 Factor 5  
 Factor 6  
 Factor 7  
 Factor 8  
 Factor 9  
 Factor 10  
 Factor 11  
 Factor 12  
 Factor 13  
 Factor 14  
 Factor 15  
 Factor 16  
 Factor 17  
 Factor 18  
 Factor 19  
 Factor 20  
 Factor 21

TABLE 10. Higher-order factors and their loadings on the 77 original factors. (The loadings are given in Appendix G.)



Table 10. Higher-Order Work Dimensions

Work Dimension		Rotated Loadings
Dimension H-1: Machine operation, maintenance, and repair.		
<u>First-Order Factors</u>		
C-7	Abstract versus machine-aided representational activities	.31 <sup>a</sup>
C-5	Communication by visual and auditory code	-.29
B-14	Precise control operations versus general body activities	-.37 <sup>a</sup>
F-9	Hazardous mechanical environment	-.40
F-5	Hazardous working conditions	-.44 <sup>b</sup>
B-12	Stationary equipment operation	-.57
A-1	Information concerning mechanical devices/processes	-.71
B-3	Mechanized equipment operation	-.71
E-14	Mechanical objectives	-.82 <sup>b</sup>
Dimension H-2: Behavior modification and control.		
<u>First-Order Factors</u>		
E-12	Objectives related to the behavior of others	.90 <sup>b</sup>
A-14	Information pertaining to the performance of humans and animals	.84
D-2	Supervising	.72
D-6	Teaching/instructing activities	.70
A-10	Information pertaining to human events and characteristics	.44 <sup>b</sup>
F-3	Situations requiring social interaction	.43
C-6	Interpersonal communication	.42

Table 10 (continued)

Work Dimension	Rotated Loadings
<b>Dimension H-3: Mathematical symbolic activities.</b>	
<u>First-Order Factors</u>	
A-5 Numerical/symbolic information	.96
E-5 Numerical/symbolic objectives	.94
C-2 Mathematical/computational activities	.93
<b>Dimension H-4: Health related activities.</b>	
<u>First-Order Factors</u>	
E-4 Health and biological objectives	.94
B-4 Medical/veterinary activities	.93
A-3 Health information	.92
D-4 Medically related interpersonal activities	.77
F-3 Uniformed personal service situations	.44 <sup>b</sup>
F-1 White collar working conditions	-.29
<b>Dimension H-5: Figural arrangements and relationships.</b>	
<u>First-Order Factors</u>	
E-6 Spatial relations objectives	.85
A-9 Spatial information	.73
C-4 Pictorial representation	.55
A-4 Information pertaining to aesthetic appearance and arrangement	.53
A-10 Information pertaining to human events and characteristics	.36 <sup>b</sup>
B-18 Handicraft activities	.36

Table 10 (continued)

Work Dimension		Rotated Loadings
Dimension H-5: (continued)		
<u>First-Order Factors</u>		
F-5	Hazardous working conditions	.32 <sup>b</sup>
B-8	Eye-hand versus eye-foot coordination	-.40 <sup>a</sup>
Dimension H-6: Personal service activities.		
<u>First-Order Factors</u>		
A-18	Personal service information	.83 <sup>b</sup>
E-15	Objectives related to the aesthetic appearance of people and animals	.78
F-1	White collar working conditions	.46
B-9	Physical activities associated with personal service and treatment	.40
B-18	Handicraft activities	.38
B-15	Food processing	.37
F-8	Uniformed personal service situations	.34 <sup>b</sup>
C-4	Pictorial representation	.29
Dimension H-7: Agricultural activities.		
<u>First-Order Factors</u>		
B-10	Agriculturally related activities	.92 <sup>b</sup>
A-8	Environmental information	.89
F-6	Seasonal outdoor work	.78
E-8	Agricultural objectives	.77

Table 10 (continued)

Work Dimension	Rotated Loadings
<b>Dimension H-8: Clerical activities.</b>	
<u>First-Order Factors</u>	
B-8      Eye-hand versus eye-foot coordination	.35 <sup>a</sup>
F-1      White collar working conditions	-.29
F-12     Work structure	-.36
A-12     Clerical information	-.90
C-3      Clerical activities	-.92
E-10     Clerical objectives	-.97
<b>Dimension H-9: Verbal activities.</b>	
<u>First-Order Factors</u>	
A-2      Technical written information	.92
E-2      Objectives pertaining to written communication	.90
C-1      Verbal communication	.75
D-1      Conflict resolution	.43
D-6      Teaching/instructing activities	.39
<b>Dimension H-10: Art/decorative activities.</b>	
<u>First-Order Factors</u>	
A-15     Art/decorative information	.94
E-13     Art/decorative objectives	.88
C-5      Communication by visual and auditory code	.44
F-9      Hazardous mechanical environment	.37

Table 10 (continued)

Work Dimension	Rotated Loadings
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Dimension H-11: Material processing and modification.

First-Order  
Factors

E-9	Inspection/testing objectives	-.30
B-6	Construction work	-.33
B-15	Food processing	-.55
E-16	Material modification/arrangement objectives	-.72 <sup>b</sup>
A-6	Materials information	-.82
B-7	Material processing	-.90 <sup>b</sup>

Dimension H-12: Business/sales activities.

First-Order  
Factors

E-7	Business/sales objectives	.93
A-7	Business/sales information	.91
D-5	Sales/customer-service activities	.72 <sup>b</sup>
F-3	Situations requiring social interactions	.50
F-11	Inconsistent work demands	.43
D-1	Conflict resolution	.35
A-10	Information pertaining to human events and characteristics	.31 <sup>b</sup>

Dimension H-13: Work activities requiring balance and body coordination.

First-Order  
Factor

B-16	General body coordination	.75
F-10	High places	.57 <sup>a</sup>
B-5	Strenuous work activities	.38
E-8	Agricultural objectives	.32

Table 10 (continued)

Work Dimension		Rotated Loadings
Dimension H-14: Medically related responsibility.		
<u>First-Order Factors</u>		
D-4	Medically related interpersonal activities	.68
F-7	Responsibility	.63
F-11	Inconsistent work demands	.51
F-4	Novel work situations	.43
F-12	Work structure	.40
B-9	Physical activities associated with personal service and treatment	.36
F-8	Uniformed personal service situations	.32 <sup>b</sup>
Dimension H-15: Construction and assembly activities.		
<u>First-Order Factors</u>		
A-17	Structural information	.88 <sup>b</sup>
B-6	Construction work	.73
E-1	Objectives pertaining to installation, assembly, and construction	.71
B-13	Joining/connecting activities	.50
Dimension H-16: Planning and innovation.		
<u>First-Order Factors</u>		
D-2	Supervising	-.29
F-7	Responsibility	-.32
C-7	Abstract versus machine-aided representational activities	-.46 <sup>a</sup>
F-4	Novel work situations	-.46
E-3	Planning and innovation	-.76

Table 10 (continued)

Work Dimension		Rotated Loadings
Dimension H-17: Direct interpersonal communication.		
<u>First-Order Factors</u>		
A-16	Oral/auditory information	.88
C-6	Interpersonal communication	.32
D-5	Sales/customer-service activities	.29
B-18	Handicraft activities	-.31
F-11	Inconsistent work demands	-.36
C-4	Pictorial representation	-.38
Dimension H-18: Electrical/electronic maintenance and repair.		
<u>First-Order Factors</u>		
B-13	Joining/connecting activities	-.46
B-11	Mechanical and electrical maintenance and repair	-.65
E-11	Electrical/electronic objectives	-.94
A-11	Electrical/electronic information	-.96 <sup>b</sup>
Dimension H-19: Inspecting, measuring, and testing.		
<u>First-Order Factors</u>		
A-13	Information from measuring and testing devices	.90
B-2	Use of measuring devices	.80
E-9	Inspection/testing objectives	.57
A-6	Materials information	.29

Table 10 (continued)

Work Dimension		Rotated Loadings
Dimension H-20: General tool usage.		
<u>First-Order</u>		
<u>Factors</u>		
B-1	Tool usage	.60
E-1	Objective pertaining to installation, assembly, and construction	.47
B-17	Unskilled machine-related activities	.45 <sup>b</sup>
E-16	Material modification/arrangement objectives	.37 <sup>b</sup>
B-5	Strenuous work activities	.36
E-9	Inspection/testing objectives	-.31
Dimension H-21: General physical labor.		
<u>First-Order</u>		
<u>Factors</u>		
F-2	Unpleasant physical working conditions	.65
B-5	Strenuous work activities	.39
B-8	Eye-hand versus eye-foot coordination	.36
B-14	Precise control operations versus general body activities	-.46

<sup>a</sup>This is a bipolar first-order factor. The sign of the loading identifies the pole of the first-order factor that is positively related to the higher-order factor.

<sup>b</sup>The sign of this loading has been reversed. Since all significant loadings on the first-order factor were negative, the sign of its loading on the higher-order factor was reversed to allow for correct interpretation.

## DISCUSSION

The first phase of this study involved the development of the Attribute Requirement Inventory (ARI) and the subsequent derivation of attribute-requirement estimates for the work elements in the Occupation Analysis Inventory (OAI). In the development of the ARI, human attributes were selected which (a) seemed relevant to work analysis, (b) were defined concretely enough to be potentially ratable, and (c) were measured by existing tests. For each selected attribute, an item was constructed which included a verbal definition plus cited examples of job activities requiring the attribute.

In the derivation of the attribute-requirement estimates for OAI work elements, steps were taken to ensure favorable rating conditions. The first step involved efforts to construct comprehensive descriptions of the selected attributes, including concrete examples of work activities. It was hoped that such descriptions would give the raters a clear understanding of each attribute, thereby reducing the possibility of different interpretations by individual raters. Secondly, the ARI rating instructions clearly pointed out to the rater the possibility of reversing the rating procedure--i.e., rating the attribute on the OAI work element, rather than rating the contribution of the attribute to that work element. This particular problem was noted in a similar study reported by Mecham and McCormick (1969a). Finally, a distinction was made in the rating instructions between two categories of attributes: (1) abilities, including General Vocational Capabilities, Cognitive Abilities, Psychomotor Abilities, and Sensory Capacities; and (2) affective attributes, including Interests and Needs. The rater was instructed to rate the abilities in terms of the "amount" or "level" of the attribute in question required of the worker in order to deal effectively with the OAI work element. On the other hand, the rater was asked to rate the affective attributes on the extent to which the attribute in question was "compatible" (or would lead to satisfaction) with the OAI work element. This distinction seemed appropriate, since the effect of abilities upon job performance is probably considerably more direct than that of interests and needs.

The reliabilities of the attribute weights for OAI items are substantial. Only six of the 103 unadjusted coefficients for mean attribute ratings fell below .80, and the median value fell within the .90 to .94 range (see Table 1). Further, only one of the 103 sets of mean attribute ratings was too unreliable for use. The low reliability of the mean ratings on Moral Values (Item 96 of the ARI) seems attributable to an inappropriate wording of its item description. The remaining five attribute reliabilities that were below .80 could probably be raised above that value by increasing the number of raters contributing to the mean attribute estimates and, in some instances, by revising the ARI items. The distribution of the reliability coefficients in this study is comparable to that obtained by Mecham and McCormick (1969a) from attribute ratings of the job elements in the Position Analysis Questionnaire.

Tables 11 and 12 summarize the factors obtained in this study. These 77 first-order and 21 higher-order factors seem quite meaningful; all 98 of these factors were interpreted. Moreover, the factor comparisons across split analyses provide some evidence for the stability of the factor structures obtained in the six sectional analyses. Of the 77 coefficients of congruence represented in Table 8, 47 are above .79 and 57 (or 77 percent) exceed .70; among the 77 Pearson coefficients (Table 9), 37 exceed .79, 54 exceed .70, and 63 (82 percent) are above .59.<sup>2</sup> The two sets of coefficients follow quite similar patterns, as evidenced by the high correlations between the entries in corresponding matrices of Tucker and Pearson coefficients (see p. 79). It would appear, then, that the two different procedures for determining relationships between factors yield similar results, even though one employs factor loadings and the other factor scores.

Unfortunately, there is no test of significance for the coefficient of congruence, and its interpretation is somewhat ambiguous (Pinneau and Newhouse, 1964). Tucker (1951) has described a congruence coefficient of .9398 as "moderately high," and coefficients of .9997 and above as "high." As noted by Struening and Cohen (1963), however, ". . . the variables in Tucker's study were tests or item composites rather than single . . . items with known high errors of measurement." Accordingly, in comparing factors derived from test items, these investigators accepted the considerably lower value of .787 as an indication of ". . . a moderate degree of congruence"; and Thomson (1963), in a comparison of factors based on life-history items, designated a value of .60 as a criterion for factorial congruence, provided the two factors being compared had three or more loadings of .15 or greater in common (a requirement also proposed by Tucker).

The reliabilities of the variables employed in the present study (the OAI items) would undoubtedly be lower than the reliabilities of test scores but probably somewhat higher than those of individual test items. However, no direct estimates were made of the reliabilities of the OAI items. Instead, reliabilities were computed for the mean attribute ratings of the OAI items, per attribute. Although the mean attribute estimates derived from the total sample had substantial reliabilities (see Table 1), the factors obtained in the split analyses were derived from mean ratings based on only half of the total data. Therefore, the reliabilities of both the rating means and the derived factors, if computed, would be considerably lower in the split analyses than in the analyses employing the total set of data. To the extent that dividing the total sample reduced item reliabilities, the Tucker and Pearson coefficients obtained in the factor comparisons between the split samples could be expected to underestimate the invariance of the factors derived

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<sup>2</sup>A Pearson product-moment correlation of .60 is significant beyond the .001 level ( $t = 9.38$ ,  $df = 100$ ).

Table 11. Summary of the 77 Work Dimensions Obtained from the Six Sectional Factor Analyses

OAI Section and Dimension	Title of Dimension
<u>Information Received</u>	
A-1	Information concerning mechanical devices/processes
A-2	Technical written information
A-3	Health information
A-4	Information pertaining to aesthetic appearance and arrangement
A-5	Numerical/symbolic information
A-6	Materials information
A-7	Business/sales information
A-8	Environmental information
A-9	Spatial information
A-10	Information pertaining to human events and characteristics
A-11	Electrical/electronic information
A-12	Clerical information
A-13	Information from measuring and testing devices
A-14	Information pertaining to the performance of humans and animals
A-15	Art/decorative information
A-16	Oral/auditory information
A-17	Structural information
A-18	Personal service information
<u>Physical Work Behavior</u>	
B-1	Tool usage
B-2	Use of measuring devices
B-3	Mechanized equipment operation
B-4	Medical/veterinary activities
B-5	Strenuous work activities
B-6	Construction work
B-7	Material processing
B-8	Eye-hand versus eye-foot coordination
B-9	Physical activities associated with personal service and treatment
B-10	Agriculturally related activities
B-11	Mechanical and electrical maintenance and repair
B-12	Stationary equipment operation
B-13	Joining/connecting activities
B-14	Precise control operations versus general body activities

Table 11 (continued)

OAI Section and Dimension	Title of Dimension
<u>Physical Work Behavior (continued)</u>	
B-15	Food processing
B-16	General body coordination
B-17	Unskilled machine-related activities
B-18	Handicraft activities
<u>Representational Work Behavior</u>	
C-1	Verbal communication
C-2	Mathematical/computational activities
C-3	Clerical activities
C-4	Pictorial representation
C-5	Communication by visual and auditory code
C-6	Interpersonal communication
C-7	Abstract versus machine-aided representational activities
<u>Interpersonal Work Behavior</u>	
D-1	Conflict resolution
D-2	Supervising
D-3	Multiple-status interpersonal interaction
D-4	Medically related interpersonal activities
D-5	Sales/customer-service activities
D-6	Teaching/instructing activities
<u>Work Goals</u>	
E-1	Objectives pertaining to installation, assembly, and construction
E-2	Objectives pertaining to written communication
E-3	Planning and innovation
E-4	Health and biological objectives
E-5	Numerical/symbolic objectives
E-6	Spatial relations objectives
E-7	Business/sales objectives
E-8	Agricultural objectives
E-9	Inspection/testing objectives
E-10	Clerical objectives
E-11	Electrical/electronic objectives

Table 11 (continued)

OAI Section and Dimension	Title of Dimension
<u>Work Goals (continued)</u>	
E-12	Objectives related to the behavior of others
E-13	Art/decorative objectives
E-14	Mechanical objectives
E-15	Objectives related to the aesthetic appearance of people and animals
E-16	Material modification/arrangement objectives
<u>Work Context</u>	
F-1	White collar working conditions
F-2	Unpleasant physical working conditions
F-3	Situations requiring social interaction
F-4	Novel work situations
F-5	Hazardous working conditions
F-6	Seasonal outdoor work
F-7	Responsibility
F-8	Uniformed personal service situations
F-9	Hazardous mechanical environment
F-10	High places
F-11	Inconsistent work demands
F-12	Work structure

Table 12. Summary of the 21 Higher-Order Work Dimensions

Dimension	Title of Work Dimension
H-1	Machine operation, maintenance, and repair
H-2	Behavior modification and control
H-3	Mathematical/symbolic activities
H-4	Health related activities
H-5	Figural arrangements and relationships
H-6	Personal service activities
H-7	Agricultural activities
H-8	Clerical activities
H-9	Verbal activities
H-10	Art/decorative activities
H-11	Material processing and modification
H-12	Business/sales activities
H-13	Work activities requiring balance and body coordination
H-14	Medically related responsibility
H-15	Construction and assembly activities
H-16	Planning and innovation
H-17	Direct interpersonal communication
H-18	Electrical/electronic maintenance and repair
H-19	Inspecting, measuring, and testing
H-20	General tool usage
H-21	General physical labor

from the total sample of ratings; i.e., the coefficients obtained in this study are considerably lower than would be the case if the factors derived from the total set of data (and presented in Tables 2 through 7) were compared with factors derived from a second, comparable sample of the same size.

In addition to the aforementioned attenuation due to decreased reliability the Pearson coefficients were further reduced by the use of independently derived factor coefficients to compute factor scores in each of the two samples. This procedure is contrary to the recommendation of Pinneau and Newhouse (1964) that the same set of factor loadings be used in deriving factor scores for both samples, in order to eliminate from the between-sample comparisons the error associated with the factor loadings (hence with the factor coefficients).

On the other hand, it must also be noted that both the Tucker and Pearson coefficients represented in Tables 8 and 9 were obtained by selecting the highest coefficient in each column of the matrices in Appendix F, rather than on the basis of a priori matching of factors prior to the computation of the entries in these matrices. The use of this a posteriori procedure, as opposed to the a priori approach, increases the likelihood of selecting coefficients that are merely chance occurrences. However, the time required to interpret and match the factors obtained from the two separate samples would have been prohibitive, since only the factors based on the total set of data were to be retained for future use.

Finally, a distinction should be made between the factors obtained in this study, in which work elements were rated in terms of their human attribute requirements, and factors derived from the ratings of jobs on work elements. Since the factors in the present study are comprised of work elements (activities and conditions) which tend to have similar attribute-requirement profiles, these factors do not necessarily represent classes of work activities and conditions as they actually occur in the world of work. Instead, the factors based on the attribute profiles of work elements represent classes of activities and conditions which are relatively homogeneous in terms of their estimated human attribute requirements. An alternative factor-analytic data base, described in two subsequent reports (Riccobono and Cunningham, 1971a, 1971b), consists of the ratings of a large and representative sample of jobs on the OAI work elements. The OAI factors derived from the job-rating data represent classes of work elements which tend to coexist in the world of work. Although the factors based on job ratings may better represent the existing work structure than factors based on attribute ratings, their constituent work elements are less likely to be homogeneous in terms of human attribute requirements. In discussing the relative potential of these two kinds of work dimensions, Jeanneret and McCormick (1969) noted:

. . . there is little substantive evidence available that can be brought to bear on the question as to which set of dimensions is the more useful. In fact, the answer to this question is highly dependent upon the particular purpose for which the dimensions might be used, and should be the subject of further empirical investigation [p. 98].

It might be speculated, however, that the OAI dimensions based on attribute ratings would prove the more useful in estimating the human attribute requirements of jobs and occupations, while the dimensions based on job ratings would be more appropriately used in describing and grouping jobs in terms of component work activities and conditions.

Subsequent reports in the Ergometric Research and Development Series will describe attempts to validate occupational clusters and attribute-requirement estimates based on the OAI work dimensions (Bates and Cunningham, 1972; Tuttle and Cunningham, 1972).

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**APPENDICES**

**Appendix A**

**Tests Corresponding to ARI Attributes**

The following table includes the tests which can be used to measure the attributes defined in the Attribute Requirement Inventory. When an "X" appears, it signifies that the name of the test is the same as the name of the ARI attribute. Below are listed the abbreviations used in the table along with the corresponding name of the Test Battery:

- ETS - Educational Testing Service (French, Ekstrom, and Price, 1963)
- DAT - Differential Aptitude Tests (Bennett, Seashore, and Wesman, 1966)
- GATB - General Aptitude Test Battery (U. S. Employment Service)
- SVIB - Strong Vocational Interest Blank (Strong, 1966)
- OVIS - Ohio Vocational Interest Survey (Ohio Testing Services, 1969)
- OIS - Kuder Occupational Interest Survey (Kuder, 1966)
- MIQ - Minnesota Interest Questionnaire (Weiss, Dawis, Lofquist, and England, 1966)
- ALT - Altman's General Vocational Capability Tests (Altman, 1966)
- MAJT - Meier Art Judgment Tests (Meier, 1942)
- SMMT - Seashore Measures of Musical Talents (Seashore, 1938)

Table 13. Tests Corresponding to ARI Attributes

Attribute	No(s).	Test Battery									
		ETS	DAT	GATB	SVIB	OVIS	OIS	MIQ	OTHER		
Gen. Vocational Capabilities	1-24										ALT
Closure	25	Cf, Cs									
Form Perception	26					X					
Perceptual Speed	27	P								Clerical Perception	
Spatial Scanning	28	X									
Spatial Orientation	29	X									
Visualization	30	X	Space Relations	Spatial							
Number Facility	31	X	Numerical Ability	Numerical							
Memory	32	Ma, Ms									
Verbal Comprehension	33	X	Verbal Reasoning	Verbal							
Grammar	34								X		

Table 13 (continued)

Attribute	No(s).	Test Battery									
		ETS	DAT	GATB	SVIB	OVIS	OIS	MIQ	OTHER		
Spelling	35		X								
Expressional Fluency	36	X									
Ideational Fluency	37	X									
Sensitivity to Problems	38	X									
Deductive Reasoning	39	Rs									
Inductive Reasoning	40	I									
Originality	41	X									
Social Intelligence	42										
Aesthetic Judgment	43										MAT
Musical Aptitude	44										SMMT
Manual Work	63								X	Outdoor	

Table 13 (continued)

Attribute	No(s).	Test Battery									
		ETS	DAT	GATB	SVIB	OVIS	OIS	MIQ	OTHER		
Machine Work	64						X	Mechanical			
Personal Service	65					X					
Care of People or Animals	66					X					
Clerical Work	67				Office Procedures	X		Clerical			
Inspecting and Testing	68						X				
Crafts and Precise Operations	69							Mechanical	X		
Customer Services	70							Merchandizing	X		
Nursing & Related Tech. Services	71								X		
Skilled Personal Service	72								X		
Training	73							Recreational Leadership	X		
Literary	74							Writing	X	X	

Table 13 (continued)

Attribute	No(s).	Test Battery									
		ETS	DAT	GATB	SVIB	OVIS	OIS	MIQ	OTHER		
Numerical	75				Mathematics	X	Computational				
Appraisal	76				Technical Supervision	X					
Agriculture	77				Nature, Agriculture	X					
Applied Technology	78				Science	X	Scientific				
Promotion & Communication	79				Public Speaking	X	Persuasive				
Management and Supervision	80				Business Management	X					
Artistic	81				Art	X	X				
Sales Rep.	82				Sales	X	Persuasive				
Music	83				X	X	Musical				
Entertainment & Performing Arts	84						X				
Teaching, Counseling, & Social Work	85				Teaching	X	Social Service				

Table 13 (continued)

Attribute	No(s).	Test Battery									
		ETS	DAT	GATB	SVIB	OVIS	OIS	MIQ	OTHER		
Medical	86				Medical Services	X	Scientific				
Needs	87-103									X	



**Appa dix B**

**The Attribute Requirement Inventory**

**FOR DISCUSSION PURPOSES ONLY**

**ATTRIBUTE REQUIREMENT INVENTORY**

**Robert W. Neeb, J. W. Cunningham, and  
Thomas C. Tuttle**

**This work was supported by the research program of the Center for Occupational Education located at North Carolina State University at Raleigh, North Carolina, in cooperation with the Division of Adult, Vocational, and Library Programs, Bureau of Research, U. S. Office of Education.**

**CENTER FOR OCCUPATIONAL EDUCATION  
North Carolina State University at Raleigh  
Raleigh, North Carolina**

**August, 1970**

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## RATING OF WORK ELEMENTS ON HUMAN ATTRIBUTE REQUIREMENTS

### INSTRUCTIONS

#### Materials To Be Used

The Occupation Analysis Inventory (OAI): A 540-item inventory describing work elements under five major headings: Information Input; Mental Processes; Behavioral Output; Work Goals; and Work Context.

Attribute Requirement Inventory (ARI): A 103-item inventory defining human attributes in the following categories: General Vocational Capabilities; Cognitive Abilities; Psychomotor Abilities; Sensory Capacities; Interests; and Needs.

Answer Sheets: Each item on the answer sheets is coded to correspond to an item in the Occupation Analysis Inventory. The scale values "0" to "5" appear in each item on the answer sheets.

#### What You Are To Do

##### Steps:

1. First, familiarize yourself with the Occupation Analysis Inventory (OAI) by reading through all of the items (work elements). However, do not confuse the instructions in the front of the OAI booklet with the instructions which you are to carry out.

2. Then, carefully read one of the attribute definitions in the Attribute Requirement Inventory (ARI).

3. Next, read each OAI item (work element) and consider whether or not the ARI attribute in question is relevant to that work element; that is, whether or not the ARI attribute contributes to the worker's performance in dealing with that OAI work element. Then, by circling the appropriate value (0 through 5) on the answer sheet, rate the OAI item on the Degree of Relevance of the attribute in question to the work element described in that OAI item.

When rating OAI items on GENERAL VOCATIONAL CAPABILITIES, COGNITIVE ABILITIES, PSYCHOMOTOR ABILITIES, and SENSORY CAPACITIES, Degree of Relevance (of the attribute to the work element) should be thought of in terms of the level or amount of the human ability or capacity in question required of the incumbent in order for him to deal effectively with the

OAI element, when that work element is a very significant part of the job.\*

When rating OAI items on INTERESTS and NEEDS, Degree of Relevance (of the attribute to the work element) should be defined as the extent to which the attribute in question is compatible with the OAI work element; that is, the extent to which a worker who is high on the specified Interest or Need would find satisfaction in dealing with the OAI work element, assuming that work element was a very significant part of his job.\*

The scale which you are to use is defined below:

<u>Scale Value</u>	<u>Degree of Relevance</u>
0	Does not apply
1	Very limited relevance
2	Limited relevance
3	Moderate relevance
4	Substantial relevance
5	Very high relevance

4. For each ARI attribute which you are assigned, apply Step 3 (above) to every OAI item.

Caution:

In rating each OAI item, be sure to indicate the contribution of the attribute to the work element described in the item, and not vice versa. For example, if the attribute were the General Vocational Capability, Tools (Attribute 1 in the ARI), and the OAI item were Manual Dexterity (OAI item 5a), a rating of "0" would be assigned, since Manual Dexterity does not require tool skill even though tool skill might require Manual Dexterity. To insure against reversing the direction of a rating, it would be helpful to use the following format in performing a rating:

"This attribute is of (0-5) Degrees of Relevance in dealing with the work element described in OAI Item \_\_\_\_\_, when this work element is a very significant part of a job."

---

\*An OAI work element is a "very significant" part of a job, when the job receives the highest possible rating (usually a "5") on the OAI item which describes that element. (See Instructions, OAI)

**Example:**

Suppose you were rating OAI Item 791, Content or Meaning of Written Verbal Information (turn to this item in the OAI), on the ARI attribute of Verbal Comprehension (see ARI Attribute 33). Since a very high amount of Verbal Comprehension is required in dealing with the Content or Meaning of Written Information when this work element is a very significant part of a job, OAI Item 791 would receive the following rating on the answer sheet:

0 1 2 3 4 (5)

On the other hand, if you were rating OAI Item 791 (Content or Meaning of Written Verbal Information) on the ARI attribute of Multilimb Coordination (ARI Attribute 46), you would assign a rating of "0" [(0) 1 2 3 4 5], since Multilimb Coordination is not required in dealing with the Content or Meaning of Written Verbal Information when this work element is a very significant part of a job.

## GENERAL VOCATIONAL CAPABILITIES

Knowledges and skills which are relevant to a wide variety of occupations but which are more occupationally specific than basic aptitudes and academic abilities. General vocational capabilities can be thought of as falling on a hardware-to-people continuum divided into the following categories: Mechanical; Electrical; Spatial (including structures and layout and visualization); Chemical-Biological; Symbolic (including numerical operations and verbal communication); and People.

1. **Tools**: Knowledge and skill in the use of common hand tools, portable power tools and equipment (electrical, gasoline, pneumatic, etc.), and selected special tools including delicate precision tools. Examples of job activities requiring a substantial amount of tool skill and knowledge are: a jeweler cutting a gem; a mechanical assembler using an air screwdriver to emplace screws; a carpenter planing a board for a cabinet; an auto mechanic using wrenches to change sparkplugs; etc.
2. **Mechanical Systems**: A knowledge of elementary mechanical and physical principles and mechanical components, and skill in applying these to tasks. Included are: the principles of pulleys, screws, and inclined planes; common physical forces; gears and linkages; drive mechanisms; transmission of force and energy; leverage; vibration; friction; hydraulics applied to machines; aerodynamic principles applied to machines; etc. Examples of job activities requiring a substantial amount of mechanical knowledge and skill are: an aircraft mechanic troubleshooting an engine failure; a mechanical engineer installing a pneumatic system; a technician working on a prototype machine; a mechanics physicist researching a new type of rocket control system; etc.
3. **Stationary Machine and Equipment Operation**: Knowledge and skill in operating stationary equipment such as drill presses, lathes, book binding machines, meat slicers, milling machines, etc. Also includes a knowledge of the principles and safety procedures necessary for such operation. Examples of job activities requiring a substantial amount of this capability are: a lathe operator shaping a chair leg; a shoe repairman grinding down a new sole on a shoe; a punch press operator punching holes in sheet metal; a milling machine operator cutting gear teeth; etc.
4. **Vehicular Operation**: Knowledge and skill in operating vehicles effectively, including a knowledge of vehicular motion, maintenance, and safety. Besides vehicles such as trucks and cars, mechanized equipment such as bulldozers, road scrapers, steam rollers, cranes, etc., would be included. Examples of job activities requiring a substantial amount of this capability are: a bus driver on his route; a farmer combining wheat; a

highway maintenance man plowing snow off the roads; a crane operator hoisting building materials for a new skyscraper; etc.

5. **Connections and Fittings:** Knowledge and skill in the use of threads, flanges, solder joints, welds, packing, washers, etc. Examples of job activities requiring a substantial amount of knowledge and skill in the use of connections and fittings are: a solderer soldering a wire to a switch; a plumber installing a sink; a wireman wiring an electric appliance; a welder welding two beams together; etc.
6. **Fluid Systems:** An understanding of leak detection measures; solid, liquid, and gas transforms; pressure; valves; safety devices; and thermostats. Examples of job activities requiring a substantial knowledge of fluid systems are: a gas-leak locator checking for gas main leaks; a pressure foreman keeping the pressure in a boiler adjusted; an air conditioning repairman testing for freon leaks; etc.
7. **Measuring Instruments:** Competence in using measuring instruments including a knowledge of units of measurement and conversion of units, tolerances, and principles of measurement and estimation. Such competence would be demonstrated through the use of a voltmeter to check the voltage in a machine; a caliper to size a hole; a dial gauge to check the roundness of a piece of aluminum tubing; a pressure gauge to check the air pressure in a tire; a counting scale to count screws; a transit to survey land; a tape measure to measure the dimensions of a room; etc. Examples of job activities requiring a substantial knowledge of measuring instruments are: a surveyor laying out a plot of land; a weatherman checking temperature and barometric pressure; a quality inspector checking screw sizes with a micrometer; a quality inspector checking rubber hardness with a durometer; etc.
8. **Electricity:** Knowledge of the principles and concepts of electricity, electro-mechanics, or electronics. Includes knowledge of such things as electrical components; elementary circuits; common electro-mechanical devices and their functions; electro-mechanical circuits; electrical tests; electrical symbols; and safety. Examples of job activities requiring a substantial amount of electrical knowledge and skill are: an electrician wiring a house; a repairman fixing an electronic computer; a television repairman fixing a TV set; an electronics physicist developing a new transistor; etc.
9. **Layout and Visualization:** Knowledge and skill in doing layouts and drawings including the use of drawing tools, scaling and measuring instruments, labels and dimensions, and basic geometric principles. Includes the ability to take objects, photographs, and drawings and use them in preparing a new drawing or layout. Also important is the ability to visualize the spatial

relationships among objects and parts. Examples of job activities requiring a substantial amount of layout and visualization are: a draftsman drawing a new machine part; a landscaper drawing up a landscape layout; an architect designing a new house; etc.

10. **Structures**: Knowledge of the accepted standards of structural design including such principles as maximum strength, use of building materials and insulation, maximum weather protection, and removal of damaged structures. Also, the application of basic geometric concepts and elementary drawing techniques to problems of simple structural design and representation; determining relative size of interior and exterior surfaces; and knowledge of forming techniques. Examples of job activities requiring a substantial knowledge of structures are: a carpenter installing a new kitchen; an architect writing specifications for a house; a construction engineer drawing up the details of a new building and writing material and construction specifications; etc.
11. **Materials**: Knowledge of the characteristics, properties, and uses of common materials. Includes a knowledge of surfaces and their covering (such as wood finishing, floor coverings, etc.), easily damaged materials, strength and pliability of materials, consistency of material, weight and density of material, durability of material, etc. Examples of job activities requiring a substantial amount of knowledge and skill in the use of materials are: a civil engineer writing material requirements for a new bridge; a carpenter deciding what materials to use to finish a new cabinet; a head paint inspector determining what paint to use to cover up a discolored typewriter; etc.
12. **Chemicals**: Knowledge of common chemicals, chemical components, and their reactions and effects. Would include an understanding of combustion, its products and effects; common laboratory and industrial procedures; chemical cleaners and other chemical agents; etc. Examples of job activities requiring a substantial amount of knowledge in the use of chemicals are: a soil analyst testing soil composition; a chemist carrying out an experiment; a pharmacist preparing a prescription; a textile technician chemically testing cloth to see that it meets specifications; etc.
13. **Foods and Cooking**: Knowledge and understanding of common foods, their preparation and composition; basic food chemistry; diets; and food sanitation. Also, the ability to schedule cooking operations. Examples of job activities requiring a substantial knowledge of foods and cooking are: a dietician preparing a school menu; a chef supervising the preparation of a meal; a baker baking a cake; etc.

14. **Biological Systems:** Knowledge of anatomy, physiology, and the functioning of life systems. Would include skill in performing and interpreting common biological and medical laboratory tests; also, knowledge of biological reactions to common substances and chemicals. Examples of job activities requiring a substantial amount of this capability are: a physician interpreting X-rays; a physiologist studying cardiovascular responses in dogs; a medical technologist testing a blood sample; a biologist studying life processes in an amoeba; etc.
15. **Medical and First Aid:** Knowledge of medical and first aid practices and techniques and skill in using this knowledge in treating patients. Examples of job activities requiring a substantial amount of medical and first aid skills are: a doctor performing an emergency operation; a rescue squad worker administering oxygen; a veterinarian examining a horse with a broken ankle; a nurse giving a tetanus shot; etc.
16. **Arithmetic Computation:** Skill in carrying out basic arithmetic operations (+, -,  $\div$ ,  $\times$ ) and in applying these to practical problems. Would also include the use of fractions, decimals; percentages, and proportions; computing and bisecting angles; computing lengths using geometric relationships; using exponents; etc. Examples of job activities requiring a substantial amount of this capability are: a draftsman computing scale drawing dimensions; a machinist converting micrometer readings to fractions; an interior decorator figuring material requirements for a new house; a mathematician computing the answer to a problem; etc.
17. **Arithmetic Conventions:** Skill in using arithmetic and bookkeeping conventions including graphs, tables, charts, ledgers, etc. Also, the application of special purpose symbol systems (such as computer language; debit, credit, and asterisk symbols; etc.) to work situations. Examples of job activities requiring a substantial amount of skill in using arithmetic conventions are: a market analyst preparing tables and charts; an accountant preparing a financial statement; an actuary preparing insurance premium tables; a bookkeeper keeping a ledger; a computer programmer writing a program; etc.
18. **Clerical:** Knowledge of office routines, letter format, copying, filing procedures, and basic office machine operation (for example, typewriters, adding machines, postage meters); etc. Also, skill in taking notes from oral instruction including understanding and following instructions. Examples of job activities requiring a substantial amount of clerical capability include: a stenographer taking dictation; a typist typing a letter; an office girl filing letters; a secretary proofreading a report; a bank teller entering a deposit; etc.

19. Verbal Communication: Skill in oral and written expression and comprehension including the ability to give effective instructions; write letters and prepare reports; defend opinions; read rapidly with high retention; understand lectures and briefings; speak effectively; etc. Would include knowledge of grammar; punctuation and format; content selection; vocabulary; sentence variety and clarity; correct diction; etc. Examples of job activities requiring a substantial amount of verbal communication skills are: a professor giving a lecture; a writer writing a novel; an executive giving a briefing; an advertising salesman discussing the placement of a magazine ad with new customers; etc.
20. Sales: Skill in assessing customer's needs and then matching customer, product, and sales technique. Includes appropriate use of persuasion and sales procedures, knowledge of customer problems, and the ability to handle merchandising and advertising. Examples of job activities requiring a substantial amount of sales knowledge and skill are: a real estate agent trying to sell a house; a technical salesman selling a copying machine; an advertising manager preparing a magazine ad; etc.
21. Service: Knowledge of your customer's or client's rights and needs and the rules and procedures of effective service, including the ability to use this knowledge to your client's advantage and satisfaction. Examples of job activities requiring a substantial amount of this capability are: a travel agent helping to plan a trip; a headwaiter overseeing the operation of a restaurant; an airline stewardess serving passengers; etc.
22. Dealing with Social Situations: Skill in perceiving social situations correctly and reacting appropriately. This would include skill in dealing with non-routine, awkward, or unusual social situations when they arise. Also includes skill in interpreting gestures, actions, etc. Examples of job activities requiring a substantial amount of skill in dealing with social situations are: a school teacher handling an unruly class; a social worker aiding a poor family; a minister giving advice; an airline pilot trying to reassure passengers on a hijacked airplane; a supervisor handling an employee grievance; etc.
23. Etiquette and Social Grace: Knowledge of the social behavior, manners, and ceremonies established by convention as acceptable in society or in a profession, and the ability to follow these rules. Also, skill in conducting oneself with grace and bearing. Examples of job activities requiring a substantial amount of etiquette and social grace are: a butler serving important guests; a maitre d' carrying out his duties; a ballroom dance teacher giving lessons; a company executive entertaining out-of-town customers; etc.

24. Style and Grooming: Knowledge and skill in proper attire and grooming. Includes skill in enhancing one's own appearance, as well as the appearance of others. Examples of job activities requiring a substantial amount of knowledge and skill in style and grooming are: a model showing clothes; a beautician styling a woman's hair; a barber giving a haircut; a fashion designer designing new clothes; etc.

## COGNITIVE ABILITIES

General and relatively stable intellectual capacities involving perceiving, recognizing, remembering, conceiving, reasoning, creative thinking, judging, etc. Cognitive abilities are prerequisite to performance on a wide variety of specific tasks. A distinguishing characteristic of cognitive abilities--in comparison to psychomotor abilities and affective states (such as needs and interests)--is a relatively high state of consciousness or awareness of one's behavior.

25. Closure: The ability to organize a disorganized or ambiguous visual field into a single percept or impression, with or without knowledge of any of the specific configurations contained in the field. Examples of job activities requiring a substantial amount of closure are: an aerial-photograph interpreter examining a photograph for camouflaged military installations; a technician examining cell patterns under a microscope; an astronomer interpreting celestial phenomena; etc.
26. Form Perception: The ability to perceive pertinent detail in objects or in pictorial or graphic material; to make fine visual comparisons and discriminations among characteristics such as shapes and shadings of figures or objects and widths and lengths of lines. Examples of jobs activities requiring a substantial amount of form perception are: a fingerprint classifier comparing fingerprints; a hand decorator painting designs on pottery; a topographical draftsman distinguishing terrain features on maps; etc.
27. Perceptual Speed: The ability to rapidly perceive pertinent detail in verbal or tabular material and to rapidly perform simple visual discrimination tasks. This would include such tasks as proofreading, making comparisons of written material, discriminating between symbols, detecting differences in copy, etc. Examples of job activities requiring a substantial amount of perceptual speed are: a proofreader checking a proof against the original copy; a stenographer typing a letter from shorthand notes; a bookkeeping-machine operator transposing information from sales slips or invoices to the machine; etc.
28. Spatial Scanning:<sup>3</sup> Speed in visually exploring a wide or complicated field with the objective of identifying or detecting objects. Examples of job activities requiring a substantial amount of spatial scanning are: a radar operator looking for unidentified objects on a radar screen; a forest ranger spotting forest fires; an insurance underwriter looking for an insurance premium in an actuarial table; etc.

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<sup>3</sup>This item is a modification of an original item used in the present study.

29. **Spatial Orientation:** The ability to perceive spatial patterns and to orient oneself in relation to the position and configuration of surrounding objects. Examples of job activities requiring a substantial amount of spatial orientation are: a single engine airplane pilot making a landing; a motor launch operator conducting a tour of a lake; a mountain climber climbing a mountain; etc.
30. **Visualization:** The ability to comprehend spatial patterns in two or three dimensions and to mentally manipulate or transform them into other spatial patterns; the ability to visualize objects of two or three dimensions; to think visually of geometric forms. (For example, to see a three-dimensional drawing of a square with various sides shaded and to be able to visualize how that square would look if it were opened up and laid out flat.) Visualization differs from spatial orientation in that in visualization the observer is removed from the spatial pattern, whereas in spatial orientation he is the center of the pattern. Examples of job activities requiring a substantial amount of visualization are: a dentist using a mirror to fill a tooth; an architect sketching a proposed building; an artist painting a landscape; etc.
31. **Number Facility:** The ability to manipulate numbers in arithmetical operations (especially addition, subtraction, multiplication, and division) rapidly and accurately. Number facility also includes counting, plotting on numbered coordinates, etc. Examples of job activities requiring a substantial amount of number facility are: an insurance underwriter computing compound interest and premium rates; a chemist computing the answer to a mathematical equation; a bookkeeper adding or subtracting debits and credits; a draftsman computing scale representations of objects; etc.
32. **Memory:** The ability to mentally store pertinent information and to recall it perfectly for reproduction within a short period of time (one minute to eight hours). Examples of job activities requiring memory are: a telephone operator remembering names of people, companies, telephone numbers, etc.; a taxicab driver remembering dispatch addresses; a student cramming for an exam at the last minute; a politician giving an acceptance speech from memory; etc.
33. **Verbal Comprehension:** The ability to understand meanings of words and the ideas associated with them, and to use them effectively; the ability to comprehend language, to understand relationships between words, and to understand meanings of whole sentences and paragraphs. Examples of job activities requiring a substantial amount of verbal comprehension are: a case worker preparing a case history; a civil lawyer preparing a case; a newspaper editor writing an editorial; a research engineer reviewing a technical report; etc.

34. **Grammar**: The ability to deal with forms and structures of words and their customary arrangement in phrases and sentences. Included is the ability to recognize good and bad grammar and to recognize correct punctuation and word usage. Examples of job activities requiring a substantial knowledge of grammar are: an editor checking a manuscript; an advertising manager preparing an ad; an English teacher reading term papers; etc.
35. **Spelling**: The ability to use letters properly to form words. Spelling also includes the ability to distinguish between correctly spelled and misspelled words. Examples of job activities requiring a substantial knowledge of spelling are: a proofreader checking type script; a secretary checking a letter before it goes out; a stenographer typing a letter from shorthand; a technical writer preparing a report; etc.
36. **Expressional Fluency**: The ability to rapidly put ideas into words, especially in oral or written connected discourse. Expressional fluency differs from ideational fluency (below) in that expressional fluency does not involve coming up with ideas (as does ideational fluency) but, rather, the verbal expression of these ideas. Examples of job activities requiring a substantial amount of expressional fluency are: a lawyer questioning a witness; a politician in a nationally televised debate; a newspaper reporter writing an article; etc.
37. **Ideational Fluency**: The ability to rapidly produce ideas about a given topic where quantity rather than quality of ideas is stressed (for example, producing as many ideas as possible about a given topic in five minutes). Examples of job activities requiring a substantial amount of ideational fluency are: a marketing manager throwing out ideas about naming a new product; an advertising agent giving suggestions for a new mailer; an automotive engineer suggesting style changes for next year's cars; etc.
38. **Sensitivity to Problems**: The ability to recognize practical problems (for example, improvements that could be made in electrical appliances, etc.); deficiencies in courses of action or organizational plans (for example, why a road should not be repaved when it would have to be torn up in the near future to install new sewer pipes); or implications of activities (for example, if the activity is building a dog house, the ability to infer that the entrance must be large enough to accommodate the dog, that the roof should be slanted so that rain will run off, that the entrance should be pointed away from the normal direction of the wind, etc.). Examples of job activities requiring a substantial amount of sensitivity to problems are: an industrial consultant investigating decreasing production in a company; a civil engineer evaluating a plan to build a new super highway; a building contractor planning the construction of a new house; a high school teacher trying to

anticipate the problems that could arise on a planned class trip and also, what measures to take if such problems do arise; etc.

39. **Deductive Reasoning**: The ability to take given premises and reason to their necessary conclusion. For example, given: "All holidays are paid and no Sundays are paid," the ability to deduce that "No Sundays are holidays." Examples of job activities requiring a substantial amount of deductive reasoning are: a district attorney prosecuting a case; an electronic troubleshooter trying to solve a novel computer problem; a mathematician solving a problem; etc.
40. **Inductive Reasoning**: The ability to take specific sets of information and to generate or conceive of general concepts which give structure and meaning to the information; that is, finding a general concept, principle, rule, or hypothesis to explain a set of specific instances. This factor is tested for by requiring the examinee to derive a principle from a number of particular instances. (For example, given the nonsense syllables ABC, MNO, XYZ, PQS, GHI, the ability to discover that PQS is different from the others, since the rule for the formation of the others is alphabetical order.) Includes the ability to discern basic differences and relationships among symbols, figures, and figure patterns (usually measured through the use of figure diagrams arranged in accordance with underlying principles). Examples of job activities requiring a substantial amount of inductive reasoning are: a physicist developing a theory to explain a series of laboratory findings; a cryptanalyst decoding a secret message; a bio-chemist breaking down DNA codes; a social psychologist formulating a theory to explain voting behavior; etc.
41. **Originality**: The ability to produce responses or ideas which are either clever or uncommon. For example, the ability to produce clever titles to story plots or to produce novel consequences of a hypothetical situation (such as what if everyone went blind). Examples of job activities requiring a substantial amount of originality are: an advertising manager producing a new twist for an ad; a marketing manager thinking of an unusual name for a new product; a cartoonist drawing a satirical cartoon; etc.
42. **Social Intelligence**: The ability to correctly process behavioral information obtained through social interaction. Includes an awareness of, or sensitivity to, the behavioral indicators of attention, thoughts, desires, moods, emotions, intentions, etc. Such behavioral indicators include gestures, postures, actions, expressions, voice inflections, etc. Examples of job activities requiring a substantial amount of social intelligence are: a politician campaigning for office; a shop foreman supervising

his subordinates; a nurse working with elderly patients in a nursing home; a salesman varying his sales approach according to customer reaction; etc.

43. Aesthetic Judgment: The ability to make judgments concerning the compositional organization of art objects on the basis of variations in unity, proportion, form, color, and design. Examples of job activities requiring aesthetic judgment include: an art teacher criticizing students' work; an art appraiser determining the value of a painting; an artist painting a picture; a sculptor carving a design in stone; an architect judging the aesthetic quality of a design; etc.
44. Musical Aptitude: Musical aptitude consists of a combination of sensory, psychomotor, and cognitive capabilities which have been found to underlie success in music. These capacities include sense of pitch, rhythm, time, and tonal memory. Job activities requiring musical aptitude are: playing a musical instrument; singing; directing an orchestra; judging a music contest; etc.

## PSYCHOMOTOR ABILITIES

Capacities involving bodily or muscular movement, usually in coordination with the sensory processes.

45. **Control Precision**: The ability to make rapid, yet precise, highly controlled muscular movements to adjust the position of a control mechanism (such as joysticks, levers, pedals, rudders, etc.). The adjustments are made through the use of either the arm and hand or leg and foot. Many adjustments may be required, with the number and magnitude determined through feedback of the effectiveness of previous adjustments. Examples of job activities requiring a substantial amount of control precision are: an airline pilot operating a joystick to steer an aircraft; a lathe operator manipulating the die, through the use of a lever, to shape a chair leg; a crane operator positioning a building section; etc.
46. **Multilimb Coordination**: The ability to use more than one limb (both hands, both feet, or hands and feet) simultaneously, in a coordinated manner. Examples of job activities requiring a substantial amount of multilimb coordination are: manually changing gears on an automobile using the shift and clutch; playing baseball; playing a piano; etc.
47. **Reaction Time**: The ability to respond rapidly to a stimulus when it appears. Examples of job activities requiring a substantial amount of reaction time are: using the brakes of an automobile so as not to hit a child; stopping an electronic card sorter when a card jams; reacting to the starting gun at a track or swim meet; etc.
48. **Eye-Hand Coordination**: The ability to make rapid and accurate hand movements in coordination with visual stimuli. This ability is tested for by requiring the examinee to place dots in small circles as rapidly as possible. Examples of job activities requiring a substantial amount of eye-hand coordination are: a switchboard operator connecting a call by placing the correct wire in the correct hole; a bricklayer laying bricks; a mechanical assembler soldering wires together; etc.
49. **Manual Dexterity**: The ability to make rapid and accurate arm-hand movements in manipulating fairly large objects. Examples of job activities requiring a substantial amount of manual dexterity are: a mechanic tuning a car; a sewing machine operator making a dress; a gift wrapper wrapping gifts in a clothing store; etc.
50. **Finger Dexterity**: The ability to make precise manipulations of small objects with the fingers. Examples of job activities requiring a substantial amount of finger dexterity are: a

surgeon performing a critical operation; a watchmaker assembling a watch; an engraver cutting designs in jewelry; a repairman rewiring an appliance; etc.

51. **Arm-Hand Steadiness**: The ability to make precise arm-hand positioning movements and to maintain steadiness while making these movements, where strength and speed are unimportant. Also, the ability to minimize movement while the arms and hands are in a set position. Examples of job activities requiring a substantial amount of arm-hand steadiness are: an artist painting a picture; a policeman firing a pistol; a chemist transferring liquids from one test tube to another; a make-up artist lining an actor's face; etc.
52. **Explosive Strength**: The ability to apply a maximum amount of force through one or more short bursts of effort. Examples of job activities requiring a substantial amount of explosive strength are: a construction worker driving a metal stake into the ground; a carpenter sawing a piece of wood; a sailor throwing a line to shore; etc.
53. **Static Strength**: The ability to exert considerable force against external objects for a brief period, as in lifting, pushing, pulling, squeezing, carrying, etc. It applies to different muscle groups (hand, arm, back, shoulder, leg) and to different kinds of tasks. Examples of job activities requiring a substantial amount of static strength are: a moving man moving furniture; a laborer loading 100 pound sacks of concrete on a truck; a weightlifter lifting weights; a longshoreman unloading boats; a construction worker using bolt cutters to cut up heavy metal rods; etc.
54. **Dynamic Strength**: The ability to exert force repeatedly or continuously over time so as to move or support the body. Muscular endurance and resistance to muscular fatigue are important in this ability. Examples of job activities requiring a substantial amount of dynamic strength are: a ballerina performing; a gymnast performing on the horizontal bar; an assembler using a screwdriver constantly to emplace screws; etc.
55. **Body Equilibrium**: The ability to maintain or regain body balance and orientation when equilibrium is threatened or temporarily lost, placing primary reliance on nonvisual cues (for example, kinesthetic and vestibular cues). Examples of job activities requiring a substantial amount of body equilibrium are: painting from a ladder; walking on a steel beam; climbing a telephone pole to do repair work; installing an antenna on an A-frame house; etc.

56. Stamina: The ability to exert the body through continuous effort over an extended period of time (cardiovascular endurance). Examples of job activities requiring a substantial amount of stamina are: fighting a fire; digging irrigation ditches; running cross country; etc.

## SENSORY CAPACITIES

Capabilities involving use of sense organs.

57. Near Visual Acuity: The ability to visually discriminate detail at normal reading distance or less. Examples of job activities requiring a substantial amount of near visual acuity are: a jeweler cutting a gem; a handcarver carving small figurines; an editor proofreading an editorial; etc.
58. Far Visual Acuity: The ability to perceive detail at distances beyond normal reading distance. Examples of job activities requiring a substantial amount of far visual acuity are: a forest ranger spotting forest fires; a store detective watching for shoplifters; a crane operator moving building materials; an airplane pilot searching for wreckage of another airplane; a truck driver making deliveries; etc.
59. Depth Perception: The ability to perceive distances, such as: from the observer to an object; between objects along the observer's line of vision; from the front to the back of an object so that it is seen three-dimensionally; etc. Examples of job activities requiring a substantial amount of depth perception are: an airplane pilot making a landing; moving objects with a forklift; painting a landscape; etc.
60. Color Discrimination: The ability to perceive similarities or differences in colors. Includes the ability to identify a particular color, recognize harmonious or contrasting color combinations, or to match colors adequately. Examples of job activities requiring a substantial amount of color discrimination are: an artist painting a portrait; an interior decorator choosing color schemes; a glazier artist selecting glass for a stained glass window; etc.
61. Auditory Acuity: The ability to perceive relevant sound cues and to discriminate between sounds in terms of their intensity, pitch, or tonal quality. Examples of job activities requiring a substantial amount of auditory acuity are: a piano tuner tuning a piano; a general practitioner examining a patient's chest with a stethoscope; a night watchman listening for intruders; a telephone operator taking phone numbers; etc.
62. Tactual Discrimination: The ability to discriminate characteristics of objects (such as size, shape, texture, etc.) through the use of touch. Examples of job activities requiring a substantial amount of tactual discrimination are: a surgeon performing a heart operation; a sculptor modeling a small plastic statue; a cloth examiner inspecting cloth by feeling for defective weaving; etc.

66. Care of People or Animals: Preference for work activities which involve taking care of people or animals. Work activities related to care of people include: (1) taking care of the safety, health, and personal hygiene of children and/or those who are ill; (2) feeding; (3) dressing; (4) bathing; (5) reading to; (6) otherwise maintaining the comfort of the person. Work activities related to the care of animals include: (1) handling and exercising; (2) feeding and watering; (3) training; (4) grooming; (5) treating for minor illness and injury. Examples of jobs for which this interest is relevant include: practical nurse; child-care attendant; orderly; horse exerciser; dog groomer; pet shop attendant; etc.
67. Clerical Work: Preference for work activities which involve general office work. Work activities include: (1) sorting, classifying, recording, and filing records, reports, correspondence; (2) keeping records according to some already established plan or system; (3) typing, taking and transcribing shorthand; (4) operating business machines or calculating machines. Examples of jobs for which this interest is relevant include: music librarian; file clerk; stenographer; bookkeeper; production clerk; medical-record clerk; proofreader; meter reader; typist; key punch operator; etc.
68. Inspecting and Testing: This interest area involves a preference for the following types of work activities: (1) examining materials and supplies and keeping inventory records; (2) using precision measuring instruments such as gauges, calipers, micrometers, or test apparatus for the purpose of grading, sorting, detecting flaws, or checking to make sure that products meet specified standards; (3) performing laboratory or other scientific tests according to standardized procedures. Examples of jobs for which this interest is important include: fire inspector; battery tester; sorter; thermostat adjuster; scientific helper; meat grader; weaving inspector; quality-control technician; etc.
69. Crafts and Precise Operations: Preference for work activities which involve the application of high level manual skills and an organized body of knowledge to one or more of a wide variety of crafts and precision operations. Work activities involving crafts and precise operations interests include: (1) operation of radio, television, and motion picture equipment; (2) precision operation of machine tools; (3) application of skills and knowledge regarding tools and materials to construction, fabricating, and maintenance crafts; (4) set-up, operation, and maintenance of data-processing, type-setting, duplicating, and similar machines; (5) precision operation of diesel, gasoline, steam, or electric powered vehicles or equipment to test their performance, transport cargo, or provide special services. Examples of jobs for which this interest is important include: digital-computer operator; jeweler; carpet layer; plumber; test pilot; motion picture projectionist; radio station operator;

auto mechanic; machinist; carpenter; hand engraver; watch assembler; electrician; etc.

70. Customer Services: Preference for work activities which involve providing services to people in a variety of business situations. Knowledge of the product or techniques of service and the ability to deal with people are important. Work activities involving customer services include: (1) receiving money and keeping records of the transactions; (2) transporting passengers or merchandise; (3) collecting, organizing, and dispensing information; (4) operating a telephone switchboard, taking messages and supplying information; (5) demonstrating and selling products to customers; (6) providing other public services. Examples of jobs for which this interest is important include: receptionist; ticket agent; teller; sales attendant; taxi driver; cashier-checker; dispatcher; recreation facility attendant; etc.
71. Nursing and Related Technical Services: Preference for work activities which involve caring for the sick and injured and providing nursing services concerned with the prevention of illness and the promotion of good health. These activities are, in most cases, performed under the supervision of a doctor or other specialist. Work activities involving nursing and related technical services include: (1) the use of X-ray and other medical laboratory equipment for diagnostic or therapeutic purposes; (2) providing physical therapy through exercise; the use of mechanical apparatus; or the application of heat, light, water, or electricity. Examples of jobs for which this interest is important include: office nurse; dental hygienist; X-ray clerk; physical therapist; audiometrist; surgical technician; etc.
72. Skilled Personal Services: This interest area involves a preference for the following types of work activities: (1) providing skilled services such as tailoring or altering clothing to fit the wearer; (2) planning and preparing meals in homes, restaurants, or other eating places; (3) providing services related to the care and physical appearance of people such as barbering, treatment of skin and nails, make-up analysis, and cosmetology. Examples of jobs for which this interest is important include: dressmaker; cook; barber; manicurist; cosmetologist; costumer; etc.
73. Training: Preference for work activities which involve the training of people, or sometimes animals, in a variety of settings and for a variety of purposes. The trainer or instructor must himself be skilled in the area of work which he is teaching and be able to examine and evaluate the progress of his trainee. Work activities involving training include: (1) training individuals in the organization, policy, regulations, procedures, and methods of work in a business or industry; (2) teaching recreational or hobby activities; (3) training animals for show or performance; (4) training guide dogs; (5) providing instruction in such

fields as flying, boating, etc. Examples of jobs for which this interest is important include: police academy instructors; flying instructors; camp counselor; dog trainer; YMCA leader; bus driving instructor; training supervisor; etc.

74. Literary: This interest area involves a preference for the following types of work activities which often require a high degree of abstract-verbal ability: (1) preparing correspondence, reports, legal and business documents, or written descriptions of technical operations and processes; (2) doing creative writing and editing; (3) translating from one language to another; (4) conducting and reporting research investigations in the political, social, and psychological sciences. Examples of jobs for which this interest is important include: claim examiner; job analyst; poet; censor; foreign-news translator; historian; editorial writer; law clerk; political scientist; technical writer; etc.
75. Numerical: This interest area involves a preference for the following types of work activities: (1) applying the principles of accounting, cost analysis, and statistical analysis to problems of business management, including (a) advising, accounting, and auditing systems and procedures, (b) evaluating costing methods, and (c) collecting and analyzing business data; (2) investigating such areas as the theoretical aspects of physics and mathematics; atmospheric, astronomical and geographic phenomena and conditions; and automatic data-processing systems and programs, including (a) analyzing data-processing problems, (b) formulating and testing theories, and (c) developing new mathematical and statistical methods. Examples of jobs for which this interest is important include: tax accountant; appraiser; auditor; actuary; business programmer; meteorologist; mathematician; statistician; etc.
76. Appraisal: This interest area involves a preference for the following types of work activities: (1) applying engineering knowledge to the planning, installation, direction, and operation of projects and systems in a specific field of engineering such as civil, mechanical, chemical, electrical, or industrial; (2) carrying out appraising, analytical, or investigating work related to surveying, exploring, mining, construction, merchandising, or materials analysis. Examples of jobs for which this interest is important include: cost-analysis engineer; space analyst; surveyor; gemologist; real estate appraiser; quality-control engineer; mining investigator; weather observer; water purification chemist; sanitary inspector; insurance claims adjuster; building construction inspector; etc.
77. Agriculture: This interest area involves a preference for the following types of work activities: (1) farming; (2) gardening; (3) animal herding; (4) applying the principles of chemistry, physics, biology, and genetics to scientific agriculture so as to advance man's knowledge of agricultural principles. Examples

of jobs for which this interest is important include: flower grower; dairy farmer; botanist; zoologist; forester; landscaper; soil conservationist; animal breeder; etc.

78. Applied Technology: Preference for work activities which involve applying engineering and research principles and knowledge to the design of new structures, machines, and tools, and to the development or evaluation of new techniques, processes, and products; working in the translation of ideas, sketches, or specifications into complete and accurate working plans; or applying engineering and related technical knowledge in such specialized fields as research, design, and development. Examples of jobs for which this interest is important include: architect; civil engineer; mechanical draftsman; electronic technician; geologist; mechanical engineer; organic chemist; physicist; electrical engineer; etc.
79. Promotion and Communication: This interest area involves a preference for the following types of work activities: (1) planning, directing, and conducting advertising and public relations programs; (2) writing or editing material designed to influence or inform the public; (3) gathering newsworthy information and writing related articles for publication or presentation via radio or TV; (4) performing legal or related work; (5) conducting investigations and examinations or enforcing laws and regulations; (6) negotiating contracts or promoting the interests of individuals or organizations; (7) performing such executive secretarial tasks as making appointments, handling telephone calls, and performing minor executive duties, in addition to taking and transcribing dictation or initiating correspondence. Examples of jobs for which this interest is important include: lobbyist; business agent; placement officer; legal secretary; disc jockey; patrolman; judge; columnist; news reporter; booking agent; personnel recruiter; lawyer; public relations man; journalist; etc.
80. Management and Supervision: Preference for work activities which involve the formulation and administration of management policies and procedures or the supervision, control, and coordination of a wide variety of work activities. Involved are examining methods, procedures, or problems and recommending improvements or solutions. Examples of jobs for which this interest is important include: sales manager; police chief; production supervisor; postmaster; foreman; school superintendent; library director; hotel manager; air-traffic coordinator; chef; etc.
81. Artistic: Preference for work activities which involve the creative expression of ideas, feelings, and moods. The worker must be talented in his area of specialization. At times, the worker consults with customers or consumers. Work activities involving artistic interests include: (1) producing decorative or artistic effects through clothing design, interior decoration,

- commercial art, etc.; (2) photographing people, objects, or materials with still or motion picture cameras; (3) creating fine art such as painting and portraiture, sculpture, ceramics, and murals; (4) arranging, decorating, or restoring objects and materials to produce an acceptable artistic effect or product. Examples of jobs for which this interest is important include: set director; commercial photographer; illustrator; artist; interior decorator; cameraman; furniture designer; sculptor; taxidermist; sign writer; etc.
82. Sales Representative: Preference for work activities which involve sale and installation of products or services and may include the servicing of machines or equipment sold. Work activities involving sales interests include: (1) applying a knowledge of engineering and business principles, customer problems, marketing conditions, and product design and function to sales and service work; (2) making appointments; (3) visiting customers; (4) working with customers to solve technical problems; (5) working out comparative cost factors. Examples of jobs for which this interest is important include: sales engineer; buyer; service engineer; insurance salesman; purchasing agent; manufacturer's field representative; home-service representative; etc.
83. Music: Preference for work activities which involve performing or creating in the field of music. Work activities involving music include: (1) singing or directing others in singing; (2) entertaining audiences by playing musical instruments or conducting orchestras; (3) composing or arranging instrumental or vocal music. Examples of jobs for which this interest is important include: orchestra leader; concert singer; arranger; composer; choral director; etc.
84. Entertainment and Performing Arts: Preference for work activities which involve entertaining others. Work activities involving entertaining and performing include: (1) creating and performing original acts or interpreting stock routines in an original style; (2) performing in a dramatic production before a live audience or television or motion picture cameras; (3) performing in rhythmic and dance, individual or team sports, or exhibitions of unusual or distinctive skills; (4) explaining or presenting some type of entertainment or diversion such as a stage show, contest, or game of chance. Examples of jobs for which this interest is important include: comedian; actor; dancer; athlete; ring master; show girl; acrobat; magician; side-show operator; etc.
85. Teaching, Counseling, and Social Work: This interest area involves a preference for the following types of work activities: (1) teaching elementary school; (2) teaching academic or vocational subjects at the high school, college, or graduate level; (3) instructing in the theater, fine arts, or sports and physical

development; (4) planning, organizing, and conducting educational programs in a specialized field such as nursing or medical technology; (5) providing guidance counseling and welfare services to individuals or groups in the solution of occupational, educational, personal, or social problems. Examples of jobs for which this interest is important include: music teacher; caseworker; clergyman; home economist; university faculty member; athletic coach; kindergarten teacher; county agricultural agent; psychologist; etc.

86. Medical: Preference for work activities which involve the application of knowledge of medical science to the diagnosis, prevention, and treatment of human or animal diseases, disorders, and injuries. Work activities involving specialized medical applications include: (1) surgery; (2) conducting research and devising programs to protect workers in various settings from health hazards; (3) planning, organizing, and directing or conducting programs designed to aid in the rehabilitation of the physically or mentally ill or handicapped. Examples of jobs for which this interest is important include: oral surgeon; dentist; veterinarian; optometrist; recreational therapist; pediatrician; general practitioner; radiologist; audiologist; etc.

## NEEDS<sup>5</sup>

Preferences, desires, or felt wants for various classes of outcomes and conditions which, for the respondent, are associated with satisfaction or reward. Needs are usually measured by questions concerning the examinee's preference for or strength of attraction toward specified outcomes or conditions.

87. Ability Utilization: The need to do work that makes full use of one's abilities; work that is challenging in terms of skill, knowledge, or mental ability. (Think in terms of the abilities of the "average man.")
88. Achievement: The need to feel a sense of accomplishment in one's work.
89. Activity: The need to keep busy through physical activity, job-related social contact, or mental activity.
90. Advancement: The need to occupy a position which offers opportunity for promotion or other forms of advancement.
91. Authority: The need to direct or supervise the activities of others.
92. Compensation: One's need to feel that he is being well rewarded through pay and benefits in comparison to other persons with his ability and education.
93. Co-Workers: The need to occupy a position which allows social interaction and the opportunity to establish friendships with one's co-workers.
94. Creativity: The need to apply one's initiative, ingenuity, and creativity to the work situation; to produce new and original products and ideas; to apply one's own ideas.
95. Independence: The need to plan, direct, and carry out one's own activities rather than be directed by others.
96. Moral Values: The need to avoid a work situation which conflicts with commonly accepted moral and social values.
97. Recognition: The need for explicit acknowledgement or appreciation for one's work accomplishments. Recognition can come from within one's organization (e.g., from management or one's peers) or from outside the organization (e.g., from the community, from professional organizations, etc.).

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<sup>5</sup>The need definitions (Items 87-103) were adapted from the Manual for the Minnesota Importance Questionnaire, copyright 1971 by the Work Adjustment Project, Industrial Relations Center, University of Minnesota. Adapted by special permission of the publisher.

98. Responsibility: The need to use one's own judgment, to make decisions, and to be accountable for the effects of one's decisions and actions.
99. Security: The need to be assured that one's job or income is steady and does not depend upon seasonal fluctuations, fluctuations in the economic situation, etc.
100. Social Service: The need to work with people to improve their well-being; the need to do things for others.
101. Social Status: The need to hold a position of prestige or standing in the community by virtue of one's job position or occupation.
102. Variety: The need to perform a number of different job activities rather than one or two activities repeatedly; to have new tasks to perform from day to day.
103. Working Conditions: The need to work in an environment with acceptable or pleasant physical working conditions, including such factors as freedom from hazards, comfortable temperature, proper illumination, low noise level, necessary equipment, attractive surroundings, etc.

**Appendix C**

**Attribute-Requirement Profiles of the  
OAI Work Elements**



























































**Appendix D**

**Reliability Estimates of Attribute-  
Requirement Ratings**

Table 15. Reliability Estimates of Attribute-Requirement Ratings

Attribute Number	Number of Raters (n)	Unadjusted Correlation Coefficient for (n) Raters	Unadjusted Intraclass Correlation Coefficient	Adjusted Correlation Coefficient for (n) Raters	Adjusted Intraclass Correlation Coefficient
1	10	.950	.657	.953	.667
2	10	.918	.529	.924	.550
3	10	.944	.628	.947	.640
4	10	.942	.618	.945	.634
5	10	.945	.630	.945	.633
6	10	.832	.331	.846	.354
7	10	.936	.594	.943	.623
8	10	.969	.757	.971	.767
9	10	.955	.682	.956	.686
10	10	.943	.622	.947	.640
11	10	.962	.718	.963	.725
12	10	.888	.442	.903	.482
13	10	.880	.424	.891	.449
14	10	.963	.723	.966	.739
15	10	.963	.723	.967	.745
16	10	.898	.468	.918	.527
17	10	.952	.665	.954	.676
18	10	.957	.689	.958	.695
19	10	.955	.678	.956	.685
20	10	.932	.579	.935	.588
21	10	.889	.444	.894	.458
22	10	.936	.594	.939	.604
23	10	.900	.475	.906	.489
24	10	.828	.325	.838	.341
25	10	.828	.325	.843	.349
26	10	.894	.458	.905	.488
27	10	.917	.524	.921	.539
28	10	.806	.293	.851	.364

Table 15 (continued)

Attribute Number	Number of Raters (n)	Unadjusted Correlation Coefficient for (n) Raters	Unadjusted Intraclass Correlation Coefficient	Adjusted Correlation Coefficient for (n) Raters	Adjusted Intraclass Correlation Coefficient
29	10	.884	.432	.889	.446
30	10	.897	.467	.902	.478
31	10	.944	.630	.947	.640
32	10	.823	.317	.857	.375
33	10	.948	.645	.955	.680
34	10	.961	.710	.962	.719
35	10	.943	.625	.946	.635
36	10	.951	.661	.953	.668
37	10	.904	.484	.912	.508
38	10	.847	.356	.864	.389
39	10	.893	.455	.909	.499
40	10	.856	.372	.866	.392
41	10	.929	.566	.934	.588
42	10	.956	.687	.958	.696
43	10	.975	.796	.975	.797
44	10	.938	.600	.938	.604
45	9	.877	.443	.889	.470
46	9	.896	.489	.902	.506
47	9	.862	.409	.872	.430
48	9	.919	.558	.930	.597
49	9	.945	.656	.950	.681
50	9	.846	.378	.870	.426
51	9	.881	.450	.892	.479
52	9	.872	.430	.876	.440
53	9	.849	.385	.859	.404
54	9	.824	.342	.833	.357
55	9	.881	.452	.885	.460
56	9	.804	.313	.824	.343

Table 15 (continued)

Attribute Number	Number of Raters (n)	Unadjusted Correlation Coefficient for (n) Raters	Unadjusted Intraclass Correlation Coefficient	Adjusted Correlation Coefficient for (n) Raters	Adjusted Intraclass Correlation Coefficient
57	10	.943	.622	.955	.679
58	10	.891	.449	.924	.549
59	10	.918	.527	.930	.569
60	10	.913	.511	.924	.550
61	10	.920	.534	.927	.558
62	10	.865	.391	.891	.450
63	10	.837	.339	.879	.421
64	10	.931	.574	.937	.600
65	10	.879	.421	.887	.439
66	10	.945	.634	.949	.649
67	9	.936	.620	.941	.640
68	9	.872	.430	.904	.510
69	9	.882	.453	.905	.515
70	9	.913	.537	.916	.547
71	9	.933	.608	.939	.631
72	9	.887	.465	.894	.485
73	9	.923	.570	.929	.591
74	9	.945	.658	.948	.668
75	9	.935	.613	.937	.624
76	9	.808	.319	.843	.373
77	9	.924	.573	.928	.589
78	9	.890	.474	.908	.523
79	9	.939	.629	.943	.647
80	9	.923	.572	.931	.600
81	9	.919	.559	.924	.576
82	9	.894	.483	.906	.516
83	9	.896	.489	.903	.510
84	9	.914	.542	.918	.554

Table 15 (continued)

Attribute Number	Number of Raters (n)	Unadjusted Correlation Coefficient for (n) Raters	Unadjusted Intraclass Correlation Coefficient	Adjusted Correlation Coefficient for (n) Raters	Adjusted Intraclass Correlation Coefficient
85	9	.929	.591	.933	.608
86	9	.943	.649	.949	.675
87	9	.751	.251	.841	.370
88	9	.792	.297	.876	.441
89	9	.679	.190	.799	.306
90	9	.673	.186	.752	.252
91	9	.911	.533	.917	.551
92	9	.879	.446	.884	.459
93	9	.893	.480	.902	.504
94	9	.935	.615	.941	.638
95	9	.830	.352	.842	.372
96	9	.022	.002	.029	.003
97	9	.855	.395	.861	.408
98	9	.827	.347	.838	.366
99	9	.897	.492	.900	.500
100	9	.929	.591	.931	.599
101	9	.827	.347	.840	.369
102	9	.830	.352	.846	.379
103	9	.631	.160	.666	.181

**Appendix E**

**Factor Correlation Matrices for Six  
Sectional Analyses**

Table 16. Factor Correlation Matrix for the Information Received Section of the OAI

	Factor																	
Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.00	.05	.01	.03	.01	.26	.02	.20	.26	.00	.47	.04	.30	-.03	.02	.00	-.29	.04
2		1.00	.02	-.08	.16	.08	.09	-.07	.07	-.01	.13	.33	.11	.10	.00	-.11	.00	.12
3			1.00	-.06	.04	.09	-.01	.14	-.01	.13	.02	.02	.07	.27	-.07	-.01	.07	-.21
4				1.00	-.10	-.04	.00	.25	.27	-.07	-.02	-.09	-.02	-.06	.17	-.10	-.08	-.13
5					1.00	.03	.15	.05	.21	.03	.11	.22	.23	.04	.00	-.02	.10	.11
6						1.00	-.02	.15	.10	.09	.22	.00	.28	-.05	-.02	-.04	-.16	-.04
7							1.00	-.04	.02	.19	.02	.21	.04	.18	.04	-.02	.04	-.17
8								1.00	.21	.06	.10	.06	.08	.06	-.01	-.10	-.04	-.08
9									1.00	.05	.25	.06	.15	-.05	.09	-.16	-.16	.00
10										1.00	.01	.04	.09	-.39	-.03	-.12	-.03	.10
11											1.00	.09	.28	.03	-.03	.05	.10	-.05
12												1.00	.07	.09	.09	-.14	.10	.07
13													1.00	-.01	.02	-.02	-.10	.04
14														1.00	.04	.02	.02	-.23
15															1.00	-.04	.03	-.14
16																1.00	.00	.00
17																	1.00	-.02
18																		1.00

Table 17. Factor Correlation Matrix for the Physical Work Behavior Section of the OAI

	Factor																	
Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.00	.11	.29	.22	.25	.26	-.10	-.18	-.08	-.05	.17	.44	.34	.15	.27	.16	-.37	.30
2		1.00	.16	.16	.10	.23	-.17	-.20	.10	-.15	.36	.19	.17	.14	.21	.07	-.05	.32
3			1.00	.11	.26	.21	.00	-.26	.11	-.19	.28	.45	.15	.22	.16	.34	-.21	.22
4				1.00	.11	.00	.00	-.18	.10	-.08	.05	.10	.12	.10	.20	.12	-.14	.18
5					1.00	.20	-.10	-.11	.21	-.18	.14	.27	.12	.02	.22	.38	-.34	.14
6						1.00	-.26	-.16	.01	-.24	.24	.26	.30	.01	.18	.14	-.19	.32
7							1.00	-.01	-.03	.13	-.10	-.25	-.06	.02	-.30	-.01	.02	-.20
8								1.00	.06	.10	-.10	-.15	-.11	-.04	-.15	-.15	.12	-.26
9									1.00	-.14	.02	.10	-.02	.05	.08	.14	-.03	.04
10										1.00	-.10	-.11	-.04	.07	-.11	.01	.13	-.11
11											1.00	.33	.21	.16	.12	.08	-.05	.18
12												1.00	.33	.25	.37	.15	-.31	.31
13													1.00	.16	.17	.06	-.26	.23
14														1.00	.12	.02	-.04	.23
15															1.00	.12	-.26	.30
16																1.00	-.15	.15
17																	1.00	-.20
18																		1.00

**Table 18. Factor Correlation Matrix for the Representational Work Behavior Section of the OAI**

	Factor						
	1	2	3	4	5	6	7
Factor							
1	1.00	.17	.23	.10	.06	.43	-.08
2		1.00	.34	.18	.05	-.02	.06
3			1.00	.24	.11	.00	-.23
4				1.00	.19	-.09	-.19
5					1.00	.12	-.01
6						1.00	-.09
7							1.00

**Table 19. Factor Correlation Matrix for the Interpersonal Work Behavior Section of the OAI**

	Factor					
	1	2	3	4	5	6
Factor						
1	1.00	.44	.18	.16	-.43	.48
2		1.00	.32	.26	-.17	.35
3			1.00	.31	-.34	.21
4				1.00	-.28	.08
5					1.00	-.36
6						1.00

Table 20. Factor Correlation Matrix for the Work Goals Section of the OAI

	Factor															
Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00	-.01	.00	-.06	-.02	.07	-.03	-.02	-.02	-.02	.16	.10	-.07	-.12	.09	-.26
2		1.00	.22	.06	.12	.02	.15	-.07	.06	.32	.06	-.13	.11	.06	-.07	.04
3			1.00	.07	.16	.19	.03	.00	.16	-.07	.08	-.07	.16	.03	-.07	.00
4				1.00	.06	.00	-.04	.12	.10	.00	.10	-.20	-.04	-.04	.15	.00
5					1.00	.12	.06	-.04	.07	.26	.12	-.02	-.05	.01	-.11	.03
6						1.00	-.04	.16	.22	.04	.15	.04	.11	-.10	.18	-.18
7							1.00	-.01	-.07	.13	-.02	-.29	.14	.02	.02	.04
8								1.00	.06	-.02	.13	.00	.00	-.27	.12	-.26
9									1.00	.00	.25	.04	-.05	-.21	-.04	-.20
10										1.00	.04	-.02	.04	-.04	-.01	.00
11											1.00	.05	-.02	-.36	.03	-.32
12												1.00	-.10	.01	.01	-.11
13													1.00	.05	.14	.01
14														1.00	.04	.34
15															1.00	-.13
16																1.00

Table 21. Factor Correlation Matrix for the Work Context Section of the OAI

	Factor											
Factor	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	.01	.17	.24	.10	.17	.09	-.22	.04	.05	.15	.27
2		1.00	-.05	-.10	-.37	.22	-.05	-.04	.19	-.02	-.05	.10
3			1.00	.22	.11	-.10	.18	-.16	-.05	.04	.15	.06
4				1.00	.18	.04	.30	-.23	.00	.07	.33	.16
5					1.00	-.12	-.01	-.02	-.17	.06	.06	-.05
6						1.00	.03	-.14	.21	-.03	.06	.18
7							1.00	-.14	-.01	.03	.22	.13
8								1.00	-.03	-.07	-.17	-.39
9									1.00	.01	-.04	.16
10										1.00	.05	.02
11											1.00	.17
12												1.00

**Appendix F**  
**Matrices Containing Coefficients of**  
**Factorial Stability**

Table 22. Coefficients of Congruence for Information Received Factors

Analysis A	Analysis B																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	.97	.08	.00	.09	.00	.02	.01	.10	.02	-.01	-.25	-.03	.21	-.02	.01	.20	.16	-.03
2	-.03	.3	.09	-.04	.05	-.20	.16	.02	.06	-.08	.01	-.30	.06	.20	.01	-.04	.00	.87
3	.00	.06	.98	.06	.02	-.05	-.01	.06	-.04	-.02	.00	-.11	.05	.20	.04	-.03	-.01	.17
4	.04	-.03	-.12	-.06	.02	.50	-.03	.54	-.03	-.01	-.06	-.36	-.02	-.07	-.05	-.05	.51	-.05
5	-.02	.15	.02	.02	.98	-.03	.08	.00	-.02	-.07	-.04	.00	.18	-.06	.04	-.02	.10	.02
6	.10	.05	.02	.96	.00	.10	-.03	.08	-.05	.00	-.10	.03	.23	.01	.00	.47	.00	-.02
7	.00	.06	-.02	.00	.16	-.07	.94	.01	.01	-.09	-.02	-.12	.04	.18	.15	-.01	.04	.06
8	.02	.05	-.02	.01	-.01	.32	.03	.02	.96	-.02	-.02	-.03	.02	.09	.07	.00	.12	.02
9	.09	-.01	.10	.13	.06	.00	-.01	.91	.01	.02	-.04	-.03	.11	.14	-.17	.06	-.04	.03
10	.25	.13	.02	.08	.03	.01	.03	.06	.00	-.04	-.09	.02	.21	.00	-.01	.11	.18	-.03
11	.00	-.03	.08	.01	-.03	-.11	.17	.06	.05	-.02	.01	-.89	-.05	.20	.24	-.02	-.06	.37
12	-.01	.33	-.02	.00	.10	-.06	.13	-.02	.01	-.97	-.03	.00	.06	-.03	.06	-.04	.04	.04
13	.22	.10	.06	.20	.13	.01	-.01	.09	.00	.01	-.24	.07	.91	-.06	.02	.08	.28	-.01
14	-.06	-.96	.01	-.08	-.08	.15	-.04	.01	.03	.17	.06	-.01	-.08	.08	-.03	-.02	-.06	-.03
15	.20	.12	-.02	.06	.00	.13	.00	.10	-.02	.01	-.10	-.02	.09	.00	-.05	.77	.68	-.02
16	.00	-.10	.05	.01	-.07	.52	.10	.12	.14	.07	.01	-.06	-.02	.84	-.01	-.02	.27	.10
17	.06	.05	.04	.20	.23	-.09	-.02	.06	.06	-.06	-.11	.00	.01	.03	-.24	-.15	.74	-.05
18	.03	-.27	.00	-.02	.06	-.35	-.19	-.02	-.08	.07	.00	.04	-.07	.00	.74	-.04	-.15	.04

Table 23. Coefficients of Congruence for Physical Work Behavior Factors

Analysis A	Analysis B																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	.92	.21	.04	-.20	.25	-.15	.19	.18	.12	-.03	.27	.18	-.33	.44	.10	-.45	.25	.28
2	-.11	-.06	-.04	.95	-.04	.02	-.05	-.13	-.23	-.03	-.08	-.36	.18	-.10	-.19	.21	-.09	-.30
3	.12	.13	-.03	-.19	.43	-.08	.06	.03	.71	-.10	.02	-.20	-.06	.08	.10	-.31	.10	-.15
4	.21	.01	.06	-.05	.05	.04	.97	.03	.06	.00	.11	.04	-.07	.12	.10	-.13	.11	.15
5	.15	.14	.95	-.04	.03	.04	.08	.20	.05	-.09	.18	.14	-.09	.15	.11	-.08	.18	.12
6	.18	.27	.10	-.05	.04	-.03	.02	.13	.06	-.88	.29	.06	-.23	.11	.19	.02	.49	.04
7	.15	.09	.06	-.13	.69	.13	.06	.04	.24	-.03	.04	.20	-.19	.10	.17	-.31	.10	.33
8	.25	.22	.17	-.12	-.02	-.10	.17	.06	.15	-.04	.84	.11	-.18	.17	.06	-.22	.17	.46
9	-.12	-.90	-.08	.13	-.06	.02	.01	-.22	-.06	.11	-.23	-.10	.07	-.19	-.24	.06	-.15	.09
10	-.25	-.02	.18	-.09	-.11	.01	.04	.18	-.09	.03	-.08	-.56	.01	-.25	-.03	.02	-.15	-.18
11	.18	.15	.20	-.19	.07	-.04	.09	.91	.06	.08	.25	.35	-.25	.27	.14	-.14	.13	.13
12	.32	.17	.05	-.16	.10	-.02	.07	.21	.16	-.13	.20	.39	-.95	.26	.14	-.14	.33	.22
13	.34	.34	.08	-.10	.08	-.06	.09	.28	.11	-.06	.27	.18	-.25	.90	.09	-.19	.13	.08
14	-.17	-.20	-.07	.18	-.23	-.07	-.08	-.12	-.11	.07	-.20	-.07	.14	-.09	-.86	.28	-.10	.13
15	.26	.08	.05	-.11	.19	-.01	.14	.08	-.00	.02	.31	.15	-.24	.27	.22	-.51	.70	.03
16	-.15	-.26	-.07	.05	-.25	.06	.00	-.03	.27	.30	-.22	-.15	.23	-.16	-.31	.12	-.19	.26
17	.44	.34	.03	-.08	.27	-.26	.12	.20	.26	-.07	.16	.17	-.21	.22	-.12	-.43	.22	.34
18	.01	.04	.05	-.08	.19	.80	.06	.02	.39	-.05	.10	.31	-.10	.01	.04	-.14	.16	.03

**Table 24. Coefficients of Congruence for Representational Work Behavior Factors**

		<u>Analysis B</u>						
		1	2	3	4	5	6	7
<u>Analysis A</u>								
1		.87	.21	-.06	.06	-.17	.11	-.18
2		-.09	-.97	-.18	-.18	-.13	.13	-.04
3		.24	-.12	.29	.45	-.08	-.61	.08
4		.20	.13	.96	.06	.13	.11	-.08
5		-.05	.01	.14	.79	.25	.59	.11
6		.50	-.07	.20	.33	.56	-.22	-.61
7		.60	.01	.08	-.13	.33	.08	-.68

**Table 25. Coefficients of Congruence for Interpersonal Work Behavior Factors**

		<u>Analysis B</u>					
		1	2	3	4	5	6
<u>Analysis A</u>							
1		.98	-.17	.10	.08	.26	.30
2		.15	-.97	.10	.11	.03	.31
3		.01	-.12	.71	.25	.01	-.12
4		.23	-.06	.27	-.10	.84	.60
5		.06	-.08	.26	.81	.43	.04
6		.16	-.11	.71	-.03	.26	.24

Table 26. Coefficients of Congruence for Work Goals Factors

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<u>Analysis A</u>																
1	.28	.01	-.09	-.05	-.04	-.08	-.03	.17	-.44	.37	.28	.01	.04	.39	-.05	-.62
2	.02	.98	.20	.03	.05	.05	.13	.01	-.02	-.01	.05	.11	-.10	-.01	.00	.04
3	.05	.13	-.04	.06	.09	.22	.05	-.00	.17	.01	.11	.96	-.10	.04	-.05	-.13
4	.06	.04	-.00	.97	.01	-.05	-.00	.06	.02	.00	.03	.04	-.11	.03	.03	.08
5	.03	.04	.17	.03	.96	-.08	.09	.02	.10	-.01	.17	.09	.01	-.01	.10	.02
6	.09	.02	.02	.03	.08	.37	-.05	.04	.37	.12	.89	.13	.03	.01	-.23	-.17
7	.00	.12	.05	-.01	.08	.09	.94	-.01	.01	-.05	-.10	.02	-.27	-.05	-.01	-.17
8	.07	-.02	-.02	.03	-.04	.03	-.07	.95	.29	.15	.02	.01	-.05	.12	-.07	-.18
9	.17	.07	-.03	.15	.07	.00	-.02	.01	.45	.44	.06	.08	-.07	.37	-.64	.14
10	.98	.02	.01	.06	.01	-.01	-.01	.08	.06	.14	.13	.05	.01	.31	-.04	-.02
11	.05	.24	.97	.00	.19	.00	.06	-.03	.01	.01	.01	-.04	-.05	.02	.00	-.04
12	-.02	.08	-.01	.12	-.01	-.08	.23	-.04	.05	-.03	.00	.04	-.94	-.05	.20	.04
13	.00	.09	.01	-.05	-.02	.78	.12	-.03	.02	-.01	-.06	.06	-.17	.00	.34	.05
14	-.29	.01	-.02	-.05	.01	.03	.02	-.14	-.17	-.18	-.05	-.01	-.01	-.95	.02	.10
15	.22	-.02	.03	.02	-.00	.09	-.06	.20	-.09	.90	.15	-.04	.07	.20	.00	-.18
16	-.02	.14	-.03	-.16	.06	-.50	-.07	-.24	.37	-.08	-.27	.06	.08	-.02	.24	-.28

**Table 27. Coefficients of Congruence for Work Context Factors**

		1	2	3	4	5	6	7	8	9	10	11	12
<b>Analysis A</b>													
1		.08	.28	-.02	.77	.02	.18	.02	.02	.51	.03	.28	.00
2		.29	-.01	.17	.03	.20	-.14	.21	.13	-.19	.72	-.35	-.01
3		.05	-.01	.66	-.04	.27	.07	.05	.26	.07	.16	-.26	.07
4		.07	.72	.02	.09	-.14	-.01	-.03	-.01	.21	-.11	.05	.40
5		.89	.01	.03	.00	.19	.15	.32	.06	.01	.37	.07	-.01
6		.11	.00	.12	.01	.10	.07	.04	.82	.05	.13	-.10	.16
7		-.25	-.02	-.06	.06	-.43	-.66	-.37	-.07	-.07	-.18	.14	.02
8		.03	-.04	.77	-.04	-.12	.04	.14	.12	.02	.10	.10	-.47
9		.06	-.04	.18	-.01	.58	-.05	.14	.36	-.17	.14	.14	-.02
10		-.27	.00	-.15	.01	-.27	-.04	-.80	-.13	.12	-.06	.02	-.13
11		.02	.62	-.08	.14	.01	.36	.02	-.02	-.21	.10	.22	.01
12		.16	.06	.28	.21	.28	.02	.24	.09	-.30	-.03	-.17	.03
<b>Analysis B</b>													

Table 28. Correlations Between Factors Obtained From Two Analyses of Information Received

Analysis A	Analysis B																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	.93	.19	-.03	.17	.04	.06	-.08	.28	.06	.04	-.45	-.05	.32	.01	-.01	.36	.32	-.16
2	-.08	.12	.24	-.08	.08	-.26	.11	.04	.02	-.13	.04	-.26	-.04	.38	.13	-.09	-.02	.80
3	-.04	-.01	.95	.11	-.03	-.11	-.07	.19	-.10	-.06	.04	-.02	-.10	.41	.10	-.09	-.02	.28
4	.30	.04	-.02	.01	.01	.54	-.08	.57	.01	.05	-.26	-.27	.14	-.01	-.10	.03	.54	-.24
5	-.02	.21	.09	.01	.92	-.05	.00	.10	-.09	-.09	-.12	-.11	.26	.07	.03	.03	.25	-.01
6	.24	.17	.05	.90	.11	.02	-.07	.00	-.11	-.02	-.14	.09	.34	.03	.00	.41	.05	-.01
7	-.04	.03	-.04	-.02	.24	-.07	.90	-.07	-.03	-.21	-.03	-.17	.05	.28	.15	-.06	.10	.20
8	.11	.03	-.04	.01	-.01	.22	.03	.02	.90	-.12	-.05	-.06	.06	.15	.01	-.07	.09	-.03
9	.27	.00	.17	.33	.12	-.01	-.03	.87	-.01	.07	-.22	.07	.27	.20	-.17	.14	.15	.01
10	.19	.19	-.04	.06	.05	-.03	-.02	.04	.03	-.04	-.92	.02	.08	-.04	.01	.10	.16	-.11
11	-.10	-.10	.21	.00	-.05	-.14	.14	-.02	.01	-.02	.08	-.78	-.13	.33	.28	-.06	-.12	.42
12	-.13	.32	-.03	-.05	.14	-.12	.09	-.16	.05	-.92	.08	-.10	-.02	-.02	-.08	-.10	-.07	.02
13	.35	.20	-.04	.27	.26	.00	-.10	.14	-.04	.10	-.36	-.03	.90	-.07	.07	.22	.33	-.14
14	.07	-.80	.07	.06	-.10	.20	-.04	.24	.05	.27	-.05	.15	.05	.09	-.08	.02	.11	-.02
15	.46	.19	-.03	.09	.05	.20	-.11	.31	.02	.03	-.29	-.02	.26	.00	-.15	.70	.68	-.21
16	.19	-.08	.13	.08	-.12	.50	.06	.32	.16	.12	-.16	.03	.14	.72	-.07	.01	.35	-.02
17	.17	.12	.09	.30	.32	-.02	-.06	.28	.07	-.05	-.25	-.10	.14	.12	-.31	-.05	.82	-.17
18	.05	-.23	.01	.08	-.02	-.30	-.17	-.04	-.11	.18	.01	.06	-.08	.02	.76	.07	-.15	.01

Table 29. Correlations Between Factors Obtained From Two Analyses of Physical Work Behavior

	Analysis B																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Analysis A																		
1	.86	.28	.11	-.35	.23	-.20	.40	.34	.26	.00	.32	.22	-.28	.39	.18	-.35	.24	.19
2	-.18	-.12	-.20	.88	-.08	.03	-.22	-.22	-.30	-.17	-.09	-.26	.20	-.18	-.19	.28	.01	-.25
3	.10	.12	.04	-.34	.47	.10	.17	.02	.80	-.01	.01	-.20	-.11	.10	.03	-.39	.00	-.11
4	.20	.11	.25	-.16	.06	.14	.86	.16	.10	.03	.13	.15	-.03	.19	.12	-.30	.08	.20
5	.16	.06	.88	-.11	.04	.07	.24	.29	.07	-.02	.13	.04	.03	.13	.13	-.26	.04	.09
6	.12	.22	.26	.01	.03	.04	.14	.22	.03	-.84	.36	.01	-.15	.04	.24	-.20	.41	.02
7	.02	.20	.10	-.24	.62	.10	.20	.23	.27	.01	.15	.21	-.20	.10	.23	-.35	.11	.17
8	.21	.03	.29	-.10	-.03	-.06	.23	.04	.20	.09	.60	.07	.00	.10	.00	-.38	-.08	.58
9	-.23	-.76	-.24	.08	-.17	.06	.01	-.25	-.15	.06	-.28	-.18	.08	-.36	-.21	.22	-.04	.19
10	-.29	-.04	.19	-.09	-.12	.01	-.04	.14	-.12	.09	-.06	-.54	.08	-.16	-.08	.09	-.24	-.22
11	.22	.04	.28	-.13	.11	-.08	.13	.71	.06	.14	.11	.28	-.14	.15	.09	-.20	.03	.08
12	.43	.29	.26	-.36	.19	-.10	.27	.39	.24	-.25	.38	.45	-.86	.37	.21	-.20	.38	.22
13	.33	.26	.12	-.04	.16	-.19	.18	.28	.16	.00	.22	.18	-.26	.86	-.05	-.29	.05	.15
14	-.19	-.14	-.15	.22	-.31	-.08	-.23	-.15	-.16	.00	-.21	-.17	.22	-.19	-.75	.35	-.07	.06
15	.29	.10	.12	-.26	.22	-.05	.37	.06	.14	.07	.25	.17	-.33	.28	.16	-.67	.65	.14
16	-.29	-.04	-.05	.09	-.36	.02	-.02	.14	.12	.16	.00	-.06	.26	-.10	-.04	.37	.01	.15
17	.38	.27	.07	-.10	.21	-.24	.17	.23	.37	-.10	.13	.21	-.20	.13	-.05	-.39	.14	.36
18	-.05	.03	.15	-.06	.13	.84	.15	.07	.21	-.05	.15	.27	-.07	-.06	.14	-.19	.11	-.02

**Table 30. Correlations Between Factors Obtained From Two Analyses of Representational Work Behavior**

		<u>Analysis B</u>						
		1	2	3	4	5	6	7
<u>Analysis A</u>								
1		.79	.25	-.06	.02	-.12	.21	-.20
2		-.15	-.92	-.36	-.19	-.08	.07	-.04
3		.24	-.04	.36	.41	-.11	-.59	.03
4		.23	.28	.90	.11	.20	.08	-.09
5		-.08	.07	.21	.69	.22	.41	.13
6		.55	-.05	.32	.26	.54	-.14	-.72
7		.49	-.02	.07	-.19	.28	.06	-.53

**Table 31. Correlations Between Factors Obtained From Two Analyses of Interpersonal Work Behavior**

		<u>Analysis B</u>					
		1	2	3	4	5	6
<u>Analysis A</u>							
1		.93	-.39	.19	.04	.47	.44
2		.46	-.84	.20	.21	.27	.44
3		.07	-.38	.45	.26	.04	.08
4		.40	-.16	.46	-.02	.85	.55
5		.16	-.11	.32	.76	.52	-.03
6		.30	-.25	.54	.17	.45	.24

Table 32. Correlations Between Factors Obtained From Two Analyses of Work Goals

		<u>Analysis B</u>															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<u>Analysis A</u>	1	.28	.00	-.04	-.10	-.03	-.05	.10	.16	-.46	.36	.32	-.10	.03	.36	.09	-.55
	2	.07	.91	.36	.01	.14	.01	.04	-.08	.01	-.03	.06	.13	-.04	-.01	-.06	.06
	3	-.14	.21	-.07	-.08	.10	.20	.10	-.14	.17	-.11	-.15	.80	-.08	-.13	-.02	-.10
	4	.03	.13	.09	.92	.10	-.04	-.01	.10	.05	-.10	.05	.06	-.24	.00	-.05	.24
	5	-.16	.08	.21	-.09	.85	-.23	.09	-.15	-.02	-.20	-.23	.02	.06	-.17	.22	.03
	6	.15	-.02	-.02	-.12	.18	.31	-.10	.10	.44	.14	.77	.02	.14	.11	-.31	-.22
	7	-.02	.19	.13	-.07	.12	.06	.91	-.02	.06	-.10	-.11	-.03	-.27	-.04	-.04	-.18
	8	.20	-.13	-.04	.12	-.10	.12	-.10	.86	.29	.14	.04	-.01	-.04	.24	-.13	-.10
	9	.32	.06	-.04	.20	.10	.04	-.11	.08	.42	.43	.20	-.05	-.01	.40	-.62	.15
	10	.91	.19	.09	.14	.12	.05	.02	.13	.04	.28	.25	.03	.02	.36	-.02	.02
	11	.08	.26	.86	.24	.25	.00	.05	.09	-.02	.01	.10	-.08	-.04	.13	.02	-.06
	12	-.04	.08	.04	.19	-.03	-.11	.24	.01	.05	-.05	-.02	.03	-.86	.00	.16	.06
	13	-.01	.12	.08	-.06	-.07	.73	.12	-.05	.08	-.02	.02	.00	-.15	-.04	.30	.05
	14	-.48	-.07	-.10	-.03	-.08	-.04	.04	-.24	-.23	-.38	-.15	.00	.01	-.89	.08	.09
	15	.31	-.02	.04	-.03	.03	.10	-.04	.24	-.14	.78	.28	-.10	.13	.21	.01	-.16
	16	-.03	.13	-.04	-.12	.12	-.60	-.18	-.32	.35	-.03	-.32	.04	.03	.01	.23	-.24

Table 33. Correlations Between Factors Obtained From Two Analyses of Work Context

	<u>Analysis B</u>											
<u>Analysis A</u>	1	2	3	4	5	6	7	8	9	10	11	12
1	.14	.26	-.15	.04	-.08	.25	.00	-.20	.05	-.09	.06	-.15
2	.35	-.07	.30	-.02	.20	-.09	.27	.18	-.16	.72	-.33	.06
3	.05	.02	.56	-.05	.23	.14	.15	.15	.04	.13	-.31	-.06
4	.00	.58	-.09	.09	-.14	-.02	-.14	-.09	.49	-.22	.09	.21
5	.77	.14	-.06	.08	.03	.12	.12	-.10	-.01	.08	.23	-.16
6	.07	.09	.27	.06	.03	.10	.03	.75	.22	.07	.00	-.06
7	-.45	.18	-.05	.04	-.19	-.66	-.10	-.10	.08	-.06	.08	-.01
8	.04	-.10	.71	-.11	-.11	.02	.18	.06	-.04	.19	.07	-.41
9	.16	-.05	.27	-.04	.61	-.01	.16	.37	-.10	.10	.12	-.09
10	-.48	-.13	-.22	.03	-.21	-.05	-.68	-.23	.08	-.14	.06	-.27
11	-.03	.64	-.18	.12	-.16	.28	-.16	-.17	-.08	-.03	.19	.09
12	.12	.12	.26	.19	.22	-.01	.20	.06	-.16	.06	-.07	-.10

**Appendix G**

**Factor Correlation Matrix for the  
Higher-Order Analysis**

Table 34. Factor Correlation Matrix for the Higher-Order Factor Analysis

	Factor																				
Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	1.00	.06	.07	.00	-.06	-.04	-.18	.12	.11	-.07	.14	.00	-.11	.02	-.12	-.05	-.01	.34	-.09	-.16	-.02
2		1.00	-.04	.19	.00	-.01	-.04	-.10	.21	.08	.08	.30	-.01	.17	-.07	-.03	.17	.05	-.07	-.03	.06
3			1.00	-.04	.05	-.04	-.04	-.16	.09	-.09	.02	-.04	-.02	.05	-.01	-.06	.00	-.10	.17	-.03	-.07
4				1.00	.02	.06	.02	-.03	-.04	-.02	-.04	.03	.00	.06	-.08	-.01	.05	-.02	.06	-.01	.04
5					1.00	-.01	.12	-.01	-.08	.10	-.06	-.02	.09	-.09	.06	-.08	-.10	-.07	-.02	-.07	-.02
6						1.00	.03	-.07	-.07	.04	-.02	.08	.02	.12	.03	.08	-.02	.05	.10	.02	-.06
7							1.00	-.02	-.08	-.03	-.14	-.06	.17	-.03	.07	-.05	-.09	-.07	.07	-.01	.16
8								1.00	-.08	.00	.01	-.13	-.03	-.07	.04	-.06	.02	.04	-.07	-.02	.06
9									1.00	.10	.06	.08	-.08	.08	-.06	-.06	.04	.00	-.01	-.02	-.02
10										1.00	.02	.09	.00	.04	-.06	-.03	.03	-.05	-.04	-.04	-.03
11											1.00	.07	.00	.02	-.08	.06	.09	.18	-.16	-.05	-.04
12												1.00	-.01	.12	-.08	.04	.05	.06	-.08	.00	.01
13													1.00	.01	.03	.00	-.04	-.01	-.03	.10	.06
14														1.00	.02	.05	.05	.00	.12	-.09	.00
15															1.00	.06	-.07	-.19	.12	.10	.01
16																1.00	.07	-.02	.00	-.01	-.01
17																	1.00	.08	-.02	-.07	.15
18																		1.00	-.22	-.15	-.01
19																			1.00	-.03	.01
20																				1.00	-.06
21																					1.00