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The Identification, Measurement and Factor Analyses of "Worker-Oriented" Job Variables

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THE IDENTIFICATION, MEASUREMENT AND FACTOR ANALYSES OF "WORKER-ORIENTED" JOB VARIABLES

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ABSTRACT

This study was an attempt to identify, measure and explore the dimensions of "worker-oriented job variables." A worker-oriented variable is defined as one which describes an activity in terms of what actions the worker is performing without reference to the job or product involved. An example of one such element may be the activity of "listening." This alone tells one that the worker is receiving (or waiting to receive) certain auditory stimuli, but does not indicate exactly what job he is performing (e.g., piano tuner, radio operator, etc.).

The first stage of the study dealt with the development of an appropriate format for the measurement of worker-oriented variables. A review of the literature in addition to some group interviews yielded a number of variables which might be considered as worker-oriented.

These variables were then translated into checklist items. Some of the items were of the dichotomous yes - no type, whereas others provided for responses across a number of categories. A somewhat unique feature of some of these items was that various psychological scaling techniques were applied to their construction. An initial reliability study was conducted with the checklist (which was then titled The Worker Activity Profile), and items were revised where appropriate. The final application of The Worker Activity Profile was made with a sample of 400 jobs representative of the percentages of jobs in the major occupational areas of The Dictionary of Occupational Titles. A reliability analysis was also conducted at this point with a subsample of 100 jobs.

A series of factor analyses were then conducted, the first being performed on a total of 119 items which had been used with sufficient frequency and reliability. Five other analyses were conducted within groups of items, categorized along an information theory context. These groups were: (A) Mediation activities (decision making, evaluating, etc.), (B) Physical output activities, (C) Communications activities, (D) Situational aspects and (E) Environmental aspects.

The factor analysis of 119 variables resulted in seven factors which were designated: (I) Varied intellectual vs. physical activities, (II) Decision making and communications activities, (III) Skilled physical activities, (IV) Hierarchical person to person interaction, (V) Man-machine control activities, (VI) Unnamed and (VII) Pleasant vs. unpleasant working conditions. The factor analyses of the five areas resulted in an additional 21 factors which were designated: (M1) Varied intellectual activities vs. structured, repetitive activities, (M2) Direct supervisory activities, (M3) Decisions directly affecting people, (M4) Management decisions, (P1) Varied intellectual vs. routine physical activities, (P2) Precise physical activities, (P3) Gross muscular activities, (P4) Body balancing activities, (P5) Knee bending activities, (C1) Informative communication activities, (C2) Persuasive communication activities, (C3) Varied communication

activities, (C4) Communication of data, (S1) Public contact, (S2) Job security vs. performance-dependent income, (S3) Salary vs. hourly pay, (S4) Apparel: specific uniform, (S5) Apparel: working clothes vs. apparel: optional clothing, (E1) Annoying environment, (E2) Outdoor work and (E3) Unpleasant environment. It should be noted that some of these factors are quite similar to each other as a result of overlapping items between the areas.

The following conclusions were drawn from the results of the study:

1. Jobs can be viewed from a framework of the activities that the incumbent performs, yet this framework need not be so specific that it cannot be generalized across different jobs, occupations, industries or geographical areas.

2. The application of psychological scaling techniques to the measurement of job variables is quite fruitful, even in the light of the effort that must be expended in scale construction. In each reliability study, the average reliability of the scaled items was clearly superior to that of the other items.

3. The factor analyses of worker-oriented variables defined a number of dimensions which seemed to be both meaningful and potentially useful. It was especially encouraging to note relationships between the factors emerging from this study, and those found in other studies of worker traits or job requirements.

INTRODUCTION

Basic to many programs such as selection, classification, training and job evaluation is the description of the jobs to be included within the program. However, "job description" is not, in itself, a term that is universally understood to mean one specific thing. Jobs may be "described" in a variety of ways, ranging from narrative statements to the use of scales or checklists. One of the key reasons for this variation in job descriptions is that since the description of jobs is usually not an end unto itself, the information that is presented typically has been focused upon the particular objectives in mind. There are numerous possible objectives, one author (Zerga, 1941) noting twenty, ranging from wage setting to occupational therapy.

To date, most programs of job description have been conducted for specific purposes and are useful primarily to specific companies or other organizations. A notable exception to this generally restricted scope is in the efforts of the United States Employment Service (USES), and the work with The Dictionary of Occupational Titles (DOT)(1949). However, while the USES has gathered job information on a very large number of jobs in many industries and locations, this information is not always in a form which allows for direct quantitative comparisons of various types of information across jobs.

The present study was conceived as a step toward the development of a system which would allow for the conversion of job information (for example, that developed by the USES) into a form which would provide a common basis for analysis across several dimensions (e.g., occupations, levels, industries and geographical areas). It should be noted that the system described in this study is not intended to supplant other job analysis methods, but rather to provide a method which can be applied directly to certain contexts, such as synthetic validity, which require broadly based, quantitative information.

The approach to this problem follows McCormick's (1959) conception of "worker-oriented job elements." These characteristics, as contrasted with "job-oriented elements," have the advantage of being independent of the product produced, or the specific situation in which the job is performed. A worker-oriented element is defined as one which describes an activity in terms of what actions the worker is performing without reference to the job or product involved. An example of one such element may be the activity of "listening." This alone tells one that the worker is receiving (or waiting to receive) certain auditory stimuli, but does not indicate exactly what job he is performing (e.g., piano tuner, radio operator, etc.). A job-oriented element might be represented by the activity of "labeling." In this instance one knows that the worker is attaching some type of identification to an article or idea, but one has no indication of what actions the worker is performing. He may be pasting labels

on a box, operating a machine, or even dreaming up names for a new toothpaste (Gordon & McCormick, 1962).

Background

As suggested earlier, job analysis is a critically important aspect of many personnel and organizational considerations. In light of this fact, a great deal of study has been devoted to the area. A recent review (Morsh, 1962) lists a total of 1511 articles dealing with this subject. However, until relatively recent times, the bulk of this work was concerned with descriptions written in narrative style, offering little in the way of quantification of various aspects of the job. It seems evident that if basic research into job components and interrelationships is to be conducted, the variables must, in some way, be put into a quantifiable form. In addition, the number of variables affecting jobs and workers, whether they are activities, requirements, worker traits or job elements, usually are so large that some type of economy of measurement is highly desirable for making the measures meaningful.

A number of investigators, utilizing various techniques, have concentrated their efforts on these problems of quantification and economy. One of the early attempts at quantifying job variables is described by Viteles (1932). This author presents a "psychograph" consisting of 32 traits, such as endurance, auditory memory and judgment, each of which is rated on a 5-point scale according to the extent to which it is essential on a given job. The high ratings then describe a profile of essential trait requirements for successful performance on the job. While this early approach attacks the problem of quantification directly, the list of 32 traits is possibly not all inclusive, and no indication is given concerning the interrelationships between traits. However, the approach does contain a number of sound elements, and subsequent investigations have borrowed heavily from this basic technique.

Most investigators who have attempted to effect some type of economy to the measurement of job variables have dealt with the basic problem of quantification in one of two general ways. The first follows Viteles' method of identifying the abilities or characteristics required of people in the job. The second is characterized by a checklist of operations performed in the job. These checklists are usually limited to the occupation under investigation, and consist of statements such as "adjusts auto carburetors." Generally, an analyst or the incumbent indicates whether the activity <u>is</u> or <u>is not</u> performed in the job in question although in many cases additional information about the activities is gathered. It should be noted that these approaches are not always separate and distinct, and some researchers have utilized a combination of the two.

Worker Characteristics Approach

Jaspen (1949) utilized The Worker Characteristics Form, consisting of 45 traits, to rate 275 jobs representative of the classification structure of the DOT. Because of the infrequent applicability of many of these traits,

only 20 were included in the analysis. These were subjected to a factor analysis, and six interpretable factors emerged. These were:

1. Strength
2. Intelligence
3. Inspection
4. Unpleasant Working Conditions
5. Dexterity
6. Mechanical Information

A series of studies by McCormick and his associates (McCormick, Finn & Scheips, 1957; Finn, 1954; Scheips, 1954) shed additional light upon these dimensions. These studies included a factor analysis of 44 worker variables that were developed by the USES (Studdiford, 1953). The analysis yielded six factors:

1. Mental and educational development vs. adaptability to routine
2. Adaptability to precision operations
3. Body agility
4. Artistic ability and esthetic appreciation
5. Manual art ability
6. Supervisory ability vs. adaptability to routine
7. Clerical ability vs. heavy manual work

It can be seen that although there are some elements of similarity between these factors and those reported by Jaspen, a great deal of dissimilarity is also evident, most likely arising from differences in both the jobs studied and the variables employed.

Still another factorial study of worker characteristics (Norris, 1957) employed 179 variables which formed 11 factors and 7 unique items. Some of these, such as "manipulative ability" and "clerical perception" are similar to the factors mentioned earlier, but this study also adds a number of "new" factors such as "induction," "fluency of expression" and "emotional control." Thus, it seems that although some core of dimensionality may be developing from these studies, the specific factor structures seem to be a function of the various inputs.

Data on worker characteristics have also been applied to the problem of forming job groups or families. Studies by Coombs and Satter (1949), Scheips (1954), and Orr (1960) are examples of this type of application. In these studies various techniques were employed in developing the groupings, namely, Q factor analysis, R factor analysis and cluster analysis.

Checklist of Functions Approach

A great deal of effort has been concentrated on the analysis of jobs utilizing a checklist of functions that the incumbent may perform. Thomas (1952) applied a cluster analysis technique to data on office jobs obtained in with an appropriate checklist. The resulting clusters concerned activities such as typing, listing and compilation, and communication. Chalupsky (1962) also worked with clerical jobs, and a factor analysis of a functions

and a knowledge checklist yielded factors such as inventory and stockkeeping, supervision, and computation and bookkeeping.

Similar studies have been undertaken in other occupational areas, such as motor vehicle maintenance (Johnson, 1957) and metalworking (Dunlap, 1954). However, while the factors or clusters emerging from these studies may be quite useful for many purposes within the occupational area in question, the very nature of the checklists used, and the factors extracted precludes the widespread application of the results.

There have been some recent attempts to develop a more generalized checklist approach in an effort to broaden the scope of investigation. Hemphill (1959) developed an extensive set of checklists for the measurement of executive positions in general. A factor analysis of data gathered with these checklists from a varied sample of executive positions yielded 10 "dimensions" which are broad in scope, not limited to specific jobs or organizations. Examples of these dimensions are:

1. Providing a staff service in nonoperational areas
2. Supervision of work
3. Internal business control
4. Human, community and social affairs

However, though these dimensions may be applicable to a large class of jobs, they are still not applicable to jobs in general. It is possible that when one passes from manual jobs, through the skill levels, on up to higher level supervisory jobs, the underlying dimensions may be quite different. Another possible hypothesis, hinted at by Jaspen (1949), is that the factor structure varies as a function of the "intensity of measurement" at different levels. That is, there may be a single set of fairly gross dimensions for jobs in general, but if measurement is concentrated at one level (e.g., executive), additional, more specific factors may emerge.

Another study, which applied a generalized checklist to a wider range of jobs, is presented by Palmer and McCormick (1961). The job sample ranged from unskilled to fairly high level supervisory jobs in the steel industry. The 177-item checklist was organized generally along lines suggested by information theory, such as input, decision, storage and output. A series of factor analyses were conducted, the end product being four distinct factors:

1. General decision making and mental activity
2. Sedentary vs. physical work activity
3. Communications in business management vs. information in routine physical work
4. Knowledge of tools vs. mathematics

It can be seen that these factors, while broadly applicable, are at quite a gross level. However, these were the highest order factors emerging from the analyses; other, lower order factors such as "communications from signals vs. personal contact" were more specific in nature. Thus, this approach yielded very generalized dimensions, applicable across a wide range of jobs, but also more specific dimensions which may be of use in investigating a narrower sample of jobs.

In reviewing these studies dealing with the description of job dimensions, it becomes evident that the end results are widely varied. It would seem that at least some of the factors contributing to this variation are: the types of variables (requirements, activities, etc.) used to analyze the jobs; the "level" (very gross to very specific) at which these variables are measured; and the sample of jobs to which the variables are applied. In view of these results, it is evident that an approach to the measurement of the "basic" dimensions of worker-oriented variables will be meaningful only to the extent that the job variables used in the analysis faithfully represent the population of worker-oriented activities. Also, the job sample should be one that contains an accurate representation of these variables as they exist in the population of jobs.

In the study by Palmer and McCormick the authors utilized a generalized checklist to measure worker-oriented functions, stating that this checklist "was viewed as a 'first approximation' toward the development of what might ultimately be a much more refined device." The present study is concerned with the development of what might be viewed as a more "refined device," for the reasons discussed in the previous paragraph. For similar reasons, it was intended that this device be applied to a wide sample of jobs representing different industries, locales and job levels. As a step toward achieving a more precise measuring instrument, a number of psychological scaling techniques were applied to the measurement of job variables. In addition, it is the intent of the present study to couch this measurement wherever possible in a framework of worker-oriented activities, thus developing the basis for the identification of basic worker-oriented job variables.

In summary, the present study is designed to:

1. Develop a system of job analysis which would provide for the identification of "worker-oriented job elements."
2. Test the feasibility of applying some of the techniques of psychological scaling to the measurement of these elements.
3. Analyze the data developed through these procedures in such a way that the "basic dimensions" of worker-oriented activities could be explored.

PROCEDURE

Format Development

A great deal of the effort expended in this study was devoted to the development of a format for the measurement of worker-oriented variables. This aspect was considered crucial in light of previous studies which demonstrated that the job dimensions obtained are largely a function of the characteristics of the variables measured. The development of this format was divided into three steps: the identification of broad behavioral categories, the identification of activities included within these areas, and the translation of these activities into items for inclusion in the measuring instrument. It should be noted at this point that for ease of communication, all category headings along with the elements included within the categories will be referred to as "behaviors" or "activities", even though it will be shown that a number of these elements are not truly activities.

The first two steps of this process were accomplished through a review of the literature and a number of "brainstorming" sessions. Primary sources for the identification of behavioral categories and individual activities were the USES Training and Reference Manual for Job Analysis (1944), the Occupational Research Center Job Activity Checklist (undated), the USES Work Performed Manual (1954), the USES Worker Trait Requirements for 4,000 jobs (undated), Primoff (1953; 1955), Palmer (1958), Norris (1957), Jaspen (1949), and Mosel, Fine and Boling (1960). Behavioral categories were extracted, and activities listed within them. These preliminary formulations were then discussed in graduate classes in industrial psychology and job analysis, and students were encouraged to add any activities which they thought should be included. With the comprehensive list of activities thus developed, activity titles were then translated into items to be included in a measuring instrument.

Item Development

In the item-writing stage, an attempt was made to have each item express a human behavior with which an incumbent's behavior could be compared. For example, instead of an item dealing with the human ability of finger dexterity, the item would be defined in terms of the activity of finger manipulation, with a number of examples of activities involving different degrees of finger manipulation being presented (table 1). An exploratory study in this area by Peters (1961) indicated that scales constructed with task activity or job title benchmarks yield reliabilities superior to those involving only numerical anchors. Thus it was decided that, wherever it seemed reasonable, an item would be presented in the form of a continuum along which reference points would be defined in terms of task activities or job titles.

Table 1

Example of a Continuous Item Included
in the Worker Activity Profile

Finger Manipulation - Check the activity below which involves about as much finger manipulation as the incumbent employs in this job.

7 ____ performs surgical operations on human beings

6 ____ cuts ornamental designs in jewelry

5 ____ tunes auto engines

4 ____ adjusts camera settings for taking commercial pictures

3 ____ packs cakes of soap in cardboard boxes

2 ____ pulls weeds by hand

1 ____ carries pieces of furniture

0 ____ Incumbent's activities involve no finger manipulation.

It should be noted that although the dimension being measured is a worker-oriented one, the benchmark items are, to a large extent, job-oriented. Table 1 presents an example of this type of construction. It was believed that by using, as benchmarks in the scales, tasks or jobs that are generally familiar to most people, from which the relevant worker behaviors are easily inferred, the job of the analyst would be simplified considerably.

It will be noted that the term "wherever it seemed reasonable" is used to describe the development of continuous items. In many cases, items could be stretched out along a continuum, but it was anticipated that the occurrence of the activity would be so infrequent that a simple dichotomous response would furnish sufficient information. Items of this type include "Tactual discrimination," "Taste discrimination" and "Negotiating."

Generally, the construction of items was approached in one of four ways. Specifically:

1. The adaptation of data or items obtained from existing studies
2. The use of some method of psychological scaling
3. A combination of the above two approaches
4. The direct writing of items with the use of examples drawn from the literature or from the present author's experience

The last approach was confined mainly to those items which were to be presented in the form of two or three categories, rather than along an extended scale.

In developing a scaled continuous item through one of the psychological scaling methods, the first step was to define the activity in operational terms. Next, a number of tasks statements that might represent various degrees of that activity were written. The statements were then scaled by one or more of the following methods:

1. Method of Equal Appearing Intervals
2. Method of Successive Categories
3. Method of Rank Order
4. Method of Paired Comparisons

The choice of a method depended mostly upon such factors as the number and type of subjects available, the "spread" of the activity which might be expected in existing jobs, and the subjects' familiarity with the activity. It might be noted here that the limited numbers of subjects used in the scalings (approximately 25-50) and the complex nature of the stimuli would preclude placing a great deal of confidence in the interval properties of the scales. However, the primary objective of the scaling was not to achieve interval scale values of exacting precision, but rather to construct items which would add significantly to the accuracy of measuring certain job variables. Later analysis showed that this objective was fairly well met.

In some instances, certain data or existing scales were available which simplified the process of developing a scale. One example of this mode of development is the scale on occupational prestige. Occupations which gave equal differences between average scores were extracted from the North-Hatt Scale as reported in Shartle (1959). These occupations were subjected to a series of rankings by different groups of subjects until a list of occupations was developed which had very few reversals in the scaling process.

Other items developed by this approach are the intelligence scale (constructed from data presented by Tyler [1947, p. 316] on mean IQ scores

for various occupational groups) and the noise scale (constructed from data presented mainly by McCormick [1957] and Bonvallet [1952] on sound levels in different environments). Other scales were supplied by Peters (1961) who had constructed them in a pilot study of scaling procedures. These scales were later modified in the light of reliability data obtained on them.

This, briefly, is an outline of how the format was developed. A number of items in the format were of either the dichotomous or three category type. An attempt was made to construct continuous scales to represent a variety of activities, but because of the nature of many of these activities it seemed unreasonable to apply this approach to the majority of the items. At this point, The Worker Activity Profile, (WAP), as the format was titled, consisted of 167 items, broken down into two main sections (Activities and Situational Variables) and nine sub-classifications:

I Discrimination Activities
II Mental Activities
III Body and Limb Activities
IV Supervisory Activities
V Communications and Interpersonal Relations
VI Rhythm of Work Activities
VII General Characteristics of the Job Activities
VIII Physical Environment
IX Psychological and Social Aspects of the Job

Initial Reliability Study

The previous work of developing the WAP had shown that it was possible to construct items that represented rather basic worker activities. The question still remaining was whether or not these items could be applied in describing jobs with an acceptable degree of "accuracy." The word accuracy implies both validity and reliability. In job analysis, validity might be defined as the ability of the analysis to accurately represent all the elements of the job. Operationally, in the area of job analysis, validity is often equated with inter-rater reliability. That is, the extent to which two people describe a job in the same way is taken to be a measure of the accuracy with which the system can be used to describe the job, the assumption being that if two raters agree upon the existence of an element in a job, the element must indeed exist.

Thus, the first step in evaluating the entire system of analysis through worker-oriented job elements was to determine the reliability, and by inference, the validity, of the items developed for this purpose.

In this phase of the study, six analysts each rated twenty jobs using job descriptions as the information input. The analysts were all graduate students in industrial psychology who were familiar with the procedures involved in ratings and rating scales.

To determine the inter-rater reliability of each item, correlations were computed between each pair of raters on each item across all 20 jobs.

A mean reliability was then computed for each item by taking the average of the 15 inter-rater reliability coefficients. The mean reliability for all items for which there was sufficient variance for the computation of a reliability coefficient was .56. The mean reliability of just the scaled items was .74 as compared to a mean reliability of .52 for all other items. These correlations represent the average of averages, and since the number of effective observations upon which these are based is well up in the thousands, a statistical test on the difference between them would be superfluous. Thus it would seem that building psychological scales to measure work activities may be well worth the effort expended.

Generally the results of this phase of the study were encouraging. The majority of items were utilized with a fair degree of consistency, even in the face of extremely scanty job information in many cases. Also, it should be remembered that these reliabilities are for single items. It is possible that if, in future applications, item groups are taken as the basis of measurement, reliability might be boosted considerably, specifically, to the extent that the items are homogeneous within groups.

The initial reliability study also served as a basis for item by item evaluation of the format. In addition to the reliability data, write-in comments were solicited from all persons who had used the form concerning any problems encountered in the analyses or suggestions for improvement of the items. Utilizing these sources of information, the form was then screened item by item and revisions made wherever needed. The list of items included in the final revised format is presented in Appendix A.

Final Application

The final application of the WAP in this study was designed to serve three major purposes. First was the gathering of additional reliability information for each of the items in the form. Second, the data that were collected were subjected to a factor analysis in an attempt to probe the dimensions of worker-oriented job activities. The third purpose was the investigation of the structure of some of the possible specific domains of activity. In this connection, items in the format were placed in a context which follows somewhat along the lines of an information theory model. Acting upon a suggestion by Faverge (1953), Palmer (1958) suggests the following relationships between the language of communications and work activities:

> "The worker receives information through the senses, such as vision, hearing, touch, and others. This information is combined with his knowledge, skills, and purposes to make some decision, judgment, or plan and results in some form of work activity. Work activity calls upon the knowledge and skills which, in the view of information theory, is 'stored' in the worker. Conversely, the work activities produce changes in the worker's knowledge and skills which modify prior 'storage' and which affect future decisions" (p. 12).

In this study, the information model is revised to include the following elements:

1. Activities associated with inputs
2. Activities associated with the mediating processes (evaluation, decision making)
3. Activities associated with outputs
   a. Physical activities
   b. Communications activities

Two other categories which do not consist of activities, but rather deal with conditions that may affect the activities, are also considered. These are: Situational Factors and Environmental Effects.

Organization of activities in the above manner may have some advantages in terms of ultimately "bridging" the gap between work activities and the abilities or traits required to perform these activities. That is, there may be a direct connection between the category in which an activity falls, and the type of skill that is required to perform the activity. For example, it might not be unreasonable to expect that input activities require sensory abilities, mediational activities require intellectual abilities, physical output activities require strength and motor skills, and communication activities require verbal abilities. Thus, in order to provide some guidelines for future research in this area, the specific domains of activities and related conditions as outlined above were subjected to separate factor analyses.

Job Sample

If an attempt is made to investigate the basic dimensions of worker activities, it is necessary that a fairly wide sample of jobs, representative of as many facets of work activities and environments as possible, be employed. Also, the results may be more definitive if the total sample of jobs reflects the numbers and types of jobs as they exist in the "real world." In order to approach these objectives, it was decided to use the DOT as the basis for the job sample, and also to include at least a few hundred jobs in order to obtain some variance on as many of the activities as possible.

With these objectives and procedures established, the decision was again made to employ job descriptions, rather than to have analysts observe jobs directly. However, it was deemed necessary to obtain complete job analysis schedules to work from instead of brief job summaries. Cooperation in this matter was enlisted from the United States Employment Service and their complete file of job analyses were put at the authors' disposal. That organization has done a great deal of work in the field of occupational analysis, including one study (USES, undated) conducted on a sample of 4,000 jobs representative of job codes in the DOT. The study includes a great deal of information on individual traits required in each of these jobs. With the possibility in mind that this information might ultimately be matched with the activity data which would emerge from the present study, the sampling of jobs was conducted within these 4,000.

A sample of 400 jobs was chosen which accurately reflected the percent of coded jobs in the DOT which are found within each of the major occupational areas. The characteristics of this sample are presented in Table 2.

Table 2

Percent and Number of Jobs in the Final Sample
Under Each of the Major Occupational Groups
of The Dictionary of Occupational Titles
N=400

Code	Occupational Group	Number of jobs in the sample	Percent of jobs in the sample
0	Professional and Managerial	40	10
1	Clerical and Sales	20	5
2	Service	12	3
3	Agricultural, Fishery, Forestry and Kindred	8	2
4,5	Skilled	62	15
6,7	Semiskilled	150	38
8,9	Unskilled	108	27

Analysts

The analysts employed in this phase of the study were the same as those participating earlier; thus each was quite familiar with the task before him. Each rater was paid for his participation in the study, either as a regular research assistant or on an hourly basis. The number of jobs rated per analyst ranged from 35 to 140. Responses to the checklist were recorded by circling appropriate numbers on a two-page answer sheet. It took approximately 20 minutes to complete the rating of a job. The great amount of time spent by most raters in performing this task might have induced something of a "rater fatigue," causing a reduction in the preciseness of the ratings over time.

It was deemed advisable to get a further reliability estimate on the items in the revised format, since many had undergone extensive change since the previous estimate was established. In order to develop this estimate, the 400 jobs were divided into two samples of equal size, which for convenience shall be referred to as samples I and II. One hundred jobs were chosen randomly from the total sample. Since all the sample information had previously been placed on IBM cards, these 100 cards were

reproduced so as to provide two cards for every job in what will be referred to as the reliability sample. The original 100 reliability cards were replaced in their previous positions in samples I and II, while the duplicate cards were placed in the opposite samples. Thus if a job originally appeared in sample I, its duplicate would appear in sample II. This procedure resulted in the formation of two samples with 100 jobs common to both.

The six raters were then divided into two groups of three each. The first group was provided with an IBM printout of only those jobs in sample I while the other group was provided with the same materials for sample II. Each group was then treated as a single rater, and the ratings of group I were correlated with the ratings of group II across the 100 overlapping jobs, again yeilding an inter-rater reliability coefficient for each item.

Results

In this final application of the WAP, a total of 398 jobs were analyzed, two job descriptions containing insufficient information for rating purposes. In examining the results of these ratings it was found that a number of items were used too infrequently for the computation of meaningful correlation coefficients. In such cases items were either combined or eliminated. As a result of these actions, a total of 137 items were analyzed in terms of their reliability. Table 3 presents a frequency distribution of reliability coefficients for these 137 items.

The correlations presented in Table 3 are of the same general magnitude as those found in the previous reliability study. It should be noted that with an N of 100 (jobs) a correlation of .26 or higher is significant at the .01 level. In addition to those items eliminated earlier, it was decided to drop all items with a reliability of less than .26 from further analysis. This meant eliminating 18 more items, leaving a total of 119.

It should be noted that the reliability coefficients were computed between groups of raters across 100 jobs. Since this added another source of between-rater error to the total variance, the resulting coefficients must be considered as underestimates of the actual reliabilities. In effect, they are underestimates to the extent that different raters within a group had different rating "sets."

One other point might be made at this time. Table 3 indicates that the reliability of all items (for which coefficients were computed) was .52. It can be added that the reliability of the 26 scaled item (omitting item 108 because of a lack of sufficient responses) was .64 as compared with a reliability of .49 for all other items. Again, the large number of effective observations makes these average reliabilities quite stable. Thus, the superiority of the scaled items has been demonstrated in this second, independent situation.

Table 3

Frequency Distribution of Reliabilities
of Items in the Final Format
N=137

Correlation	Frequency	Proportion	Cumulative Proportion
.96 - 1.00	1	.007	.999
.91 - .95	0	.000	.992
.86 - .90	6	.044	.992
.81 - .85	4	.029	.948
.76 - .80	9	.066	.919
.71 - .75	11	.080	.853
.66 - .70	12	.088	.773
.61 - .65	8	.058	.685
.56 - .60	11	.080	.627
.51 - .55	10	.073	.547
.46 - .50	15	.109	.474
.41 - .45	12	.088	.365
.36 - .40	9	.066	.277
.31 - .35	9	.066	.211
.26 - .30	2	.015	.145
.21 - .25	2	.015	.130
.16 - .20	5	.036	.115
.11 - .15	5	.036	.079
.06 - .10	1	.007	.043
.01 - .05	1	.007	.036
-.05 - .00	4	.029	.029

$\bar{X}$ = .52

FACTOR ANALYSES

Factor Analysis of the 119 Variables

Pearson Product-Movement correlations were computed among the 119 variables. All of the factor analysis computations were done on an IBM 7090 using a program developed by John B. Carroll, Harvard University. Communalities were estimated by the image-covariance method which is closely related to the square of a multiple correlation coefficient between each variable and all the remaining variables. Twenty-five factors were extracted by the principle components method. While this is admittedly an over-factorization, the time and money expended in obtaining the superfluous factors was negligible for the assurance of extracting sufficient factors.

Latent roots were plotted for the results of the analysis and the results are presented graphically in Figure 1. The point of inflection of a smooth curve plotted through the points seems to be between the sixth and seventh factors, and the decision was made to rotate seven factors.

The Carroll biquartimin method (Harmon, 1960, pp. 324-334) was used to perform this and all subsequent rotations. Although this is an oblique rotation, the method represents somewhat of a compromise between an oblique and an orthogonal rotation, tending to keep the correlations between factors fairly low. From the results of these rotations, items were rank ordered by factor loadings within each factor.

Description of the Factors

The first factor to emerge from the rotation seems to be heavily loaded with activities of a mental nature. Interspersed are a number of variables relating to repetitive physical labor which load negatively on the factor. A number of items dealing with communications also load positively, but generally smaller in magnitude than the mental activities. These relationships seem to indicate a bipolar factor of Varied Intellectual vs. Physical Activities. The items with loadings of .30 or above on this factor are presented in Table 4. It appears that this factor is closely related to the mediating processes category that was discussed earlier in this report.

Factor II (Table 5) seems to be heavily weighted with various types of executive activities. Although many of the communications activites load on this factor, they seem to compliment and add to the planning and decision making activities rather than define a distinct communications factor. It should be noted that a correlation of .54 between Factors I and II indicates that there is a substantial relationship between them. But while Factor I seems to concern various types of intellectual tasks, Factor II is more associated with the planning, decision making and communicating activities of management personnel. Thus Factor II has been named Decision Making and Communicating Activities.

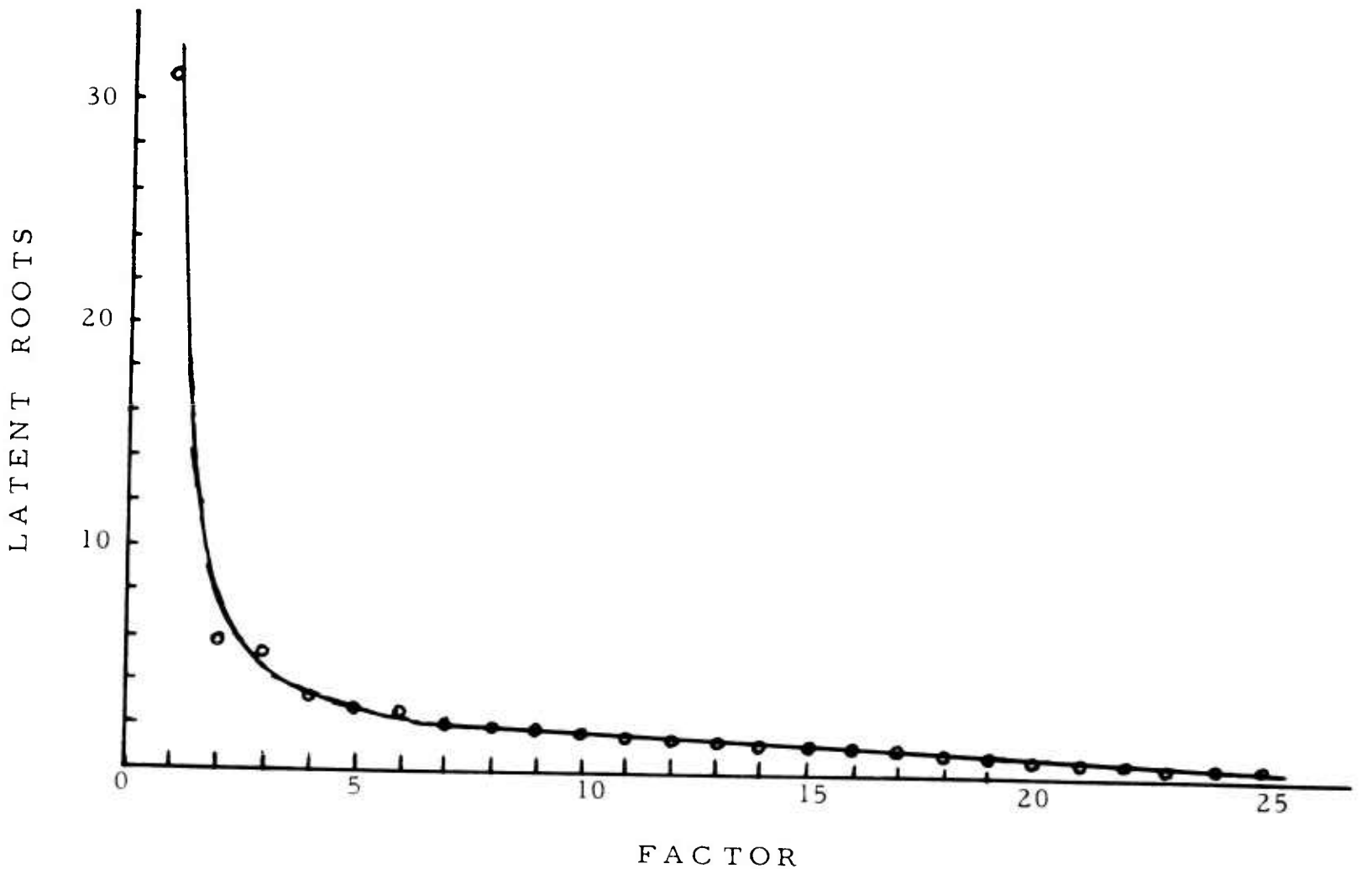

Figure 1. Latent roots for 25 factors prior to rotation.

Table 4

Factor I Varied Intellectual vs. Physical Activities

Item No.	Factor Loading	Name of Item
42	.51	Clerical tasks - files
130	.51	Activity domain - data
29	.49	Skepticism
149	.46	Type of pay - regular salary basis
27	.46	Intelligence
28	.45	Curiosity
30	.45	Interpretation of information
31	.44	Usage of mathematics
111	.43	Reporting
43+	.40	Clerical tasks - typing; shorthand; calculating, adding or bookkeeping machine operation
88	.37	Information giving and receiving (giving)
147	.37	Job security
103	.34	Written communications
146	.34	Occupation prestige
93	.34	Interchange information with salesmen
26	.33	Time span of decisions
89	.33	Interchange information with members of management
1	.31	Near visual discrimination
104	.31	Verbal communications
25	.30	Uniqueness of decisions
158	.30	Unpleasant or frustrating experiences
92	.30	Interchange information with clerical workers
36	-.30	Manual force
37	-.33	General force
128	-.35	Repetitiveness (highly repetitive)
131	-.40	Activity domain - things
64	-.41	Moving objects by hand
161	-.42	Amount of job structure (highly structured)
148	-.46	Type of pay - hourly basis

Table 5

Factor II Decision Making and Communications Activities

Item No.	Factor Loading	Name of Item
23	.74	Planning activities - develops budgets
109	.67	Persuading
68+	.66	Supervises upper level management, middle management, first line management, professional personnel
105	.62	Verbal presentations
117	.60	Social obligations
96	.51	Interchange information with "the public"
21	.50	Planning activities - forecasts needs in terms of personnel, material and/or money
163	.48	Variety of communications
97+	.48	Interchange information with "important persons," investors, suppliers
94	.46	Interchange information with semi-professional and professional personnel
110	.46	Negotiating
107	.44	Advising
87	.43	Personnel decisions - other punitive actions
142	.43	Distractions - telephone calls
103	.42	Written communications
80+	.41	Personnel decisions - promotions, demotions, transfers, raises, salary cuts
83+	.41	Personnel decisions - dismissals, hiring
112	.40	Publicizing
119	.40	Dress - tie and jacket or other public presentable clothing
98+	.38	Interchanges information with prospective employees, students or trainees
65	.36	Supervision given (general)
155	.36	Traveling
26	.35	Time span of decisions
111	.34	Reporting
25	.32	Uniqueness of decisions
146	.32	Occupation prestige
102	.31	Coordination of activities

Factor III (Table 6) seems to deal with physical activities involving some degree of skill. A number of the items with lower loadings seem to suggest that this factor would be prevalant in jobs such as automobile mechanic and plumber. An appropriate name for this factor might be Skilled Physical Activities.

Table 6

Factor III Skilled Physical Activities

Item No.	Factor Loading	Name of Item
50	.67	Skill of hand tool usage
51	.60	Number of hand tools used
32	.43	Finger manipulation
34	.43	Arm-hand steadiness
9	.42	Estimation of size
48	.39	Assembling
63	.38	Climbing
3	.35	Depth discrimination
17	.33	Adjustments to the vertical
144	.31	Work space (cramped)
55	.30	Kneeling

Factor IV is also a factor which is composed of a number of items dealing with the management of personnel. However, these activities are of a different order than those in Factor II. The present factor deals with direct supervision of individuals who are not fulfilling a supervisory role. The dominant majority of activities are those that would usually be performed by foremen and other first line supervisors. However, other jobs such as those of a doctor or a schoolteacher could be closely associated with a number of these items. In these cases, the interpersonal relationships are not necessarily supervisory, but do have definite hierarchical connotations. Thus the factor has been titled Hierarchical Person to Person Interaction (Table 7). In viewing the supervisory aspects of this factor, it would seem that as we pass from first line supervision to higher levels of management, the nature of the activities changes substantially. Information of this type may have far-reaching implications in terms of training and promotion of supervisors.

Two items seem to dominate Factor V (Table 8). Both of these items deal with control activities in a man-machine system. Other items, with substantially lower loadings, seem to fill out the picture of an interaction between man and the machine which he controls. This factor has been named Man-Machine Control Activities. It might be noted here that in the study by Norris (1957), cited earlier, a strong unique item which emerged was titled "Actuating Fixed Position Controls." There is some relationship between that item and the present factor, although in this latter

case the factor is much broader in scope. However, it is interesting to note that control operations seem to have a great deal of uniqueness in jobs, and may even define something of a job "type."

Table 7

Factor IV Hierarchical Person to Person Interaction

Item No.	Factor Loading	Name of Item
71+	.74	Supervises non-supervisory employees, students or trainees, patients
75	.64	Number of people supervised
106	.62	Instructing
79	.56	Issuing directives
83+	.54	Personnel decisions - dismissals hiring
65	.52	Supervision given (general)
22	.51	Planning activities - schedules work of others
67	.48	Supervises fellow workers
80+	.48	Personnel decisions - promotions, demotions, transfers, raises, salary cuts
102	.42	Coordination of activities
87	.42	Personnel decisions - other punitive actions
98+	.42	Interchange information with prospective employees, students or trainees
88	.39	Information giving and receiving (giving)
129	.39	Activity domain - people
104	.38	Verbal communications
76	.38	Delegating authority
20	.36	Planning activities - develop methods for effective utilization of resources under his control
66	.34	Supervises assistants
143	.30	Distractions - people seeking or giving information

Table 8

Factor V Man-Machine Control Activities

Item No.	Factor Loading	Name of Item
40	.73	Control operations (motor aspects)
41	.70	Control operations (mental aspects)
47	.36	Monitors a work process
30	.35	Interpretation of information
77	.34	Responsibility for physical assets
140	.31	Noise

The next factor (Table 9) to emerge in the rotation seems to have one loading which is more dominant than the rest, and this item may aid in its interpretation. With regard to item 120 (Dress - specific uniform), analysts were instructed to check this item when the incumbent was required to waar a uniform so that the general public could identify him. In this type of situation the uniform generally signifies that the incumbent is in a service occupation. This interpretation of the meaning of Factor VI would also fit well with item 150+ (paid tips or commission). However, the items do not seem to have a sufficiently strong dimension running through them, and it is felt that for present purposes this factor will remain uninterpreted.

Table 9

Factor VI Unnamed

Item No.	Factor Loading	Name of Item
120	.54	Dress - specific uniform
54	.38	Standing
125	.37	Regularity of work flow
2	.33	Far visual discrimination
58	.32	Walking
150+	.32	Type of pay - commission or tips
53	-.30	Sitting

Factor VII (Table 10) which is correlated .48 with Factor VI, seems to deal mainly with the physical conditions under which people work. The presence of a high negative loading suggests that this factor should be interpreted as bipolar in nature. In view of these facts it has been named Pleasant vs. Unpleasant Working Conditions.

Table 10

Factor VII Pleasant vs. Unpleasant Working Conditions

Item No.	Factor Loading	Name of Item
121	.78	Dress - wears special work clothes
137	.47	Uncomfortable atmosphere
138	.45	Cleanliness of environment (unclean)
145	.36	Physical hazards
32	.31	Finger manipulation
118	-.66	Dress - left to incumbent's discretion

Factor Analyses of Individual Areas

The factors that have emerged from the analysis of the overall format represent the dimensions underlying those worker activities which were measured. As indicated earlier, these dimensions might be viewed as "basic" to the extent that the sample of activities measured is representative of the population of worker-oriented activities. It can be seen that the factors are fairly wide in scope, representing broad bands of activities. For some purposes a more specific type of measurement would be desirable. For this reason items in the form were divided in terms of an information theory model, and analyzed separately by areas.

In order to proceed with the analyses, a separation was made between those items which were essentially activities from those which could better be characterized as situational or environmental aspects of jobs. Working only with the activities, seven raters who had previously analyzed jobs with the WAP were requested to place each item in one of four categories: (1) Input, (2) Mediation, (3) Physical Output and (4) Communications. Where the raters were in strong agreement (at least five out of seven), the item was placed in the dominant category. Seventeen items did not meet this criterion. In these cases the item in question was either placed in the two dominant categories or the author placed it in a single appropriate category, taking into consideration the distribution of judgments as well as the nature of the item. Seven items which represented some general characteristics of jobs (e.g., amount of structure, occupational prestige, "thinking" vs. "doing") were also analyzed with each of the activity categories. Only seven items were placed in the Input section, and since it was believed that the number and nature of the items

did not lend themselves to a meaningful analysis, the category was not analyzed independently. Analyses were conducted within three activity areas, as well as two non-activity areas (situational and environmental aspects).

Analyses were conducted using the same factor analysis and rotation techniques described previously. In each case, latent roots of the unrotated factors were plotted, and a point of inflection was determined by inspection.

In the Environmental area three factors were rotated while in the other four areas five factors were rotated. It should be mentioned that in the Mediation, Situational and Output areas there seemed to be secondary points of inflection: seven in the case of the first two areas and eight in the case of the last. Rotations were also performed with the greater number of factors, but in each case the five factor rotations produced more meaningful results.

In the presentation to follow, each factor will be described in terms of those items which had loadings of .30 or above. In a few instances, items with loadings below .30 will be presented in order to make the interpretation of the factor clearer. The reader himself may decide how heavily he will weigh these smaller loadings.

Mediation Activities (Table 11)

The mediation activities seem to splinter into two distinct groups. The first, represented by the dominant first factor, seems to be indicative of varied intellectual functions, as opposed to repetitiveness and structure of the activities. This factor has been named Varied Intellectual Activities vs. Structured, Repetitive Activities and is closely related to the first factor extracted in the overall analysis. The remaining factors in this section seem to be oriented more toward business and supervisory decisions than the purely intellectual functions. Factors M4 and M5 were perfectly correlated, so that Factor M5 will be disregarded. Factor M2 seems to involve direct face to face supervision as did Factor IV in the overall analysis. In this case, the pattern seems to be more clearly supervisory than merely indicating hierarchical interaction. Thus this factor has been named Direct Supervisory Activities. Factor M3 also implies supervisory activities, but is heavily loaded with those decisions which have a direct effect upon people. The factor is also characterized by the fact that those items having the dominant loadings are responsibilities rather than activities in the strict sense. In view of these considerations the factor has been named Decisions Directly Affecting People. Factor M4 seems related to Factor II in the overall analysis in that it deals with the decisions made by management personnel, and is therefore titled Management Decisions.

Most of the intercorrelations between the factors in the Mediation section are in the .30's and .40's. It seems logical that decision making activities should be related to intellectual activities rather than, say, routine physical activities. One surprising result was the emergence of Factor M3, Decisions Directly Affecting People. This factor seems to indicate that these activities form a distinct cluster within the domain of decision making activities. It will be interesting to note whether this factor will emerge in future analyses as a stable dimension.

Table 11

Mediation Activities

Item No.	Factor Loading	Name of Item
		Factor M1 Varied Intellectual Activities vs. Structured, Repetitive Activities
30	.70	Interpretation of information
27	.68	Intelligence
31	.67	Usage of mathematics
28	.59	Curiosity
130	.59	Activity domain - data
146	.55	Occupation prestige
26	.53	Time span of decisions
29	.52	Skepticism
132	.46	"Thinking" vs. "Doing" (thinking)
25	.44	Uniqueness of decisions
24	.41	Initiating action
77	.36	Responsibility for physical assets
41	.34	Control operations (mental aspects)
20	.31	Develop methods for effective utilization of resources under his control
7	.30	Inspection tasks
131	-.38	Activity domain - things
128	-.57	Repetitiveness
161	-.60	Amount of job structure (highly structured)
		Factor M2 Direct Supervisory Activities
67	.65	Supervises fellow workers
71+	.60	Supervises non-supervisory employees, students or trainees, patients
79	.42	Issuing directives
22	.41	Schedules work of others
75	.41	Number of people supervised
102	.39	Coordination of activities
76	.39	Delegating authority
20	.31	Develops methods for effective utilization of resources under his control

(Table continued on next page)

Table 11 (continued)

Mediation Activities

Item No.	Factor Loading	Name of Item
		Factor M3 Decisions Directly Affecting People
80+	.69	Personnel decisions - promotions, demotions, transfers, raises, salary cuts
87	.66	Personnel decisions - other punitive actions
83+	.64	Personnel decisions - dismissals, hiring
65	.39	Supervision given
75	.33	Number of people supervised
129	.30	Activity domain - people
		Factor M4 Management Decisions
68+	.48	Supervises upper level management, middle management, first line management, professional personnel
66	.38	Supervises assistants
23	.31	Develops budgets
21	.23	Forecasts needs in terms of personnel, material and/or money
78	.23	Responsibility for health and welfare of others

Physical Output Activities (Table 12)

In this section, the five factors displayed consistently low intercorrelations and can be viewed as essentially orthogonal. A number of these factors resemble the factors obtained in the overall analysis, but in the present case the factors are generally more specific in nature.

Factor P1 is clearly bipolar in nature. The positive loadings refer to intellectual activities dealing with people and data, whereas the negative loadings refer to routine physical actions. Thus the factor has been titled Varied Intellectual vs. Routine Physical Activities. Factor P2 seems to point clearly toward precise, physical activities requiring some degree of skill. The factor has been titled Precise Physical Activities.

Factor P3 indicates a very different type of physical activity from Factor P2. Whereas the former was concerned with precise movements, the present factor seems related to gross movements and muscular activity.

The factor has thus been named Gross Muscular Activities. Factor P4 has been given the name Body Balancing Activities since the dominant loadings involve the whole body rather than specific muscle groups, and each of these items seems to indicate that the incumbent is in some way maintaining body balance. In contrast, Factor P5 also involves bodily activities, but here a single characteristic which runs through the items seems to be a bending at the knee. This factor has been named Knee Bending Activities.

Table 12

Physical Output Activities

Item No.	Factor Loading	Name of Item
Factor P1 Varied Intellectual vs. Routine Physical Activities		
132	.73	"Thinking" vs. "Doing" (thinking)
146	.73	Occupation prestige
24	.64	Initiating action
26	.63	Activity domain - people
27	.55	Activity domain - data
42	.35	Clerical tasks - files
43+	.33	Clerical tasks - typing; shorthand; calculating, adding, or bookkeeping machine operation
61	-.31	Reaching
36	-.38	Manual force
37	-.39	General force
64	-.48	Moving objects by hand
131	-.70	Activity domain - things
128	-.78	Repetitiveness (highly repetitive)
161	-.84	Amount of job structure (highly structured)
Factor P2 Precise Physical Activities		
50	.68	Skill of hand tool usage
32	.64	Finger manipulation
51	.60	Number of hand tools used
34	.55	Arm-hand steadiness
48	.48	Assembling
49	.37	Arranging or positioning
40	.30	Control operations (motor aspects)

(Table continued on next page)

Table 12 (continued)

Physical Output Activities

Item No.	Factor Loading	Name of Item
		Factor P3 Gross Muscular Activities
54	.73	Standing
37	.49	General force
36	.41	Manual force
58	.40	Walking
35	.37	General physical coordination
53	-.69	Sitting
		Factor P4 Body Balancing Activities
17	.64	Adjustments to the vertical
62	.62	Balancing
63	.51	Climbing
35	.32	General physical coordination
		Factor P5 Knee Bending Activities
57	.50	Crawling
55	.46	Kneeling
56	.22	Stooping

Communications Activities (Table 13)

The unrotated factor loadings of this area indicate the presence of an overall G factor. However, this does not preclude a rotation of the factors in order to determine what dimensions may exist if the area were to be viewed from a multidimensional rather than an essentially unidimensional frame of reference. Again in this case the point of inflection of a plot of the latent roots prompted a five-factor rotation. The correlations among the first four are fairly substantial factors, ranging from .43 to .63. However, these relationships are not so high as to make the factors identical. Rather, each factor should be interpreted within itself and also in relation to the other factors. The fifth factor is relatively independent of the others, but this independence seems to be at least in part due to the fact that the factor contains no strong loadings and is apparently vague and uninterpretable. Thus only the first four factors will be discussed below.

Table 13

Communications Activities

Item No.	Factor Loading	Name of Item
		Factor C1 Informative Communication Activities
79	.56	Issuing directives
88	.54	Information giving and receiving (giving)
106	.53	Instructing
104	.44	Verbal communications
129	.39	Activity domain - people
102	.36	Coordination of activities
132	.34	"Thinking" vs. "Doing" (thinking)
146	.30	Occupation prestige
161	-.51	Amount of job structure (highly structured)
128	-.51	Repetitiveness (highly repetitive)
		Factor C2 Persuasive Communication Activities
109	.58	Persuading
105	.51	Verbal presentations
110	.40	Negotiating
112	.40	Publicizing
96	.37	Interchange information with "the public"
		Factor C3 Varied Communication Activities
93	.55	Interchange information with salesmen
163	.41	Variety of communications
97+	.35	Interchange information with "important persons," investors, suppliers
92	.27	Interchange information with clerical workers
95	.27	Interchange information with customers, including clients, patients, etc.
		Factor C4 Communication of Data
130	.49	Activity domain - data
111	.37	Reporting
94	.31	Interchange information with semi-professional and professional personnel
103	.31	Written communications
131	-.40	Activity domain - things

Factor C1 appears to be related to those activities in which the incumbent initiates various types of communications. Inherent in these items seems to be an information giving dimension. Thus, the factor has been called Informative Communication Activities.

Factor C2, Persuasive Communication Activities, seems to have a number of elements of one individual attempting to influence others. Although the communications may be written or verbal, one gets a feeling of verbal persuasiveness through such items as "verbal presentations" and "negotiating."

The next factor is not very well defined, but seems to deal with communications of a varied nature. The items loading on this factor are mainly different groups of people with whom the incumbent communicates. Factor C3 has been named Varied Communication Activities.

Factor C4, the final interpretable factor, has been named Communication of Data. The type of people who are communicated with, the type of communications that are involved, and the high loading on the data item seem to point toward activities which involve the formal processes of communicating summary information.

It can be seen from the nature of the items in each factor that there is considerable overlap between the factors. However, each of these dimensions seems to have some unique property, and for this reason it may be valuable to consider the separate factors, rather than the communications section as a whole.

Situational Aspects (Table 14)

Factor S1, Public Contact, involves a number of aspects which are usually associated with high level occupations. However, sales occupations could conceivably also load heavily on this factor. The main dimension seems to be one of interacting with the public.

The second factor is bipolar with one pole associated with high status, secure positions while the other is associated with the type of activities whereby the incumbent's income is directly dependent upon his performance. This factor has been named Job Security vs. Performance-Dependent Income.

Factor S3 has two dominant loadings, both concerning pay. The factor has been named Salary vs. Hourly Pay. Although the pattern is not entirely clear, some of the minor loadings suggest that the factor may include some elements of the type of work done.

Factors S4 and S5 are concerned mainly with the incumbent's dress. Factor S4 was named simply Apparel: Specific Uniform. Factor S5 was named Apparel: Working Clothes vs. Apparel: Optional Clothing. It is interesting to note that the item on wearing a uniform forms a factor (S4) by itself rather than joining in with the other items on dress. It is also interesting to note that this factor has a substantial correlation (.35) with Factor S1, Public Contact. This relationship lends greater credence

to the hypothesis advanced previously that Factor VI in the overall analysis is connected with service activities.

Table 14

Situational Aspects

Item No.	Factor Loading	Name of Item
		Factor S1 Public Contact
119	.84	Dress - tie and jacket or other public presentable clothing
117	.59	Social obligations
146	.42	Occupation prestige
158	.40	Unpleasant or frustrating experiences
155	.34	Traveling
160	-.31	Supervision received (immediate)
153	-.38	Overtime pay
		Factor S2 Job Security vs. Performance-Dependent Income
147	.44	Job security
146	.37	Occupation prestige
128	-.37	Repetitiveness (highly repetitive)
150+	-.46	Type of pay - commission or tips
		Factor S3 Salary vs. Hourly Pay
149	.79	Type of pay - regular salary basis
128	-.25	Repetitiveness (highly repetitive)
153	-.39	Overtime pay
148	-.78	Type of pay - hourly basis
		Factor S4 Apparel: Specific Uniform
120	.91	Dress - specific uniform
125	.31	Regularity of work flow
		Factor S5 Apparel: Working Clothes vs. Apparel: Optional Clothing
121	.94	Dress - special working clothes
118	-.90	Dress - left to incumbent's discretion

Environmental Aspects (Table 15)

Before discussing this section it should be noted that the intercorrelations between the 10 items in the section were extremely small, the sum of the communalities being only 1.6949 for 10 variables. Thus, one would not expect strong factors to emerge in this area. However, to see what affinities do exist, three of the extracted factors were rotated and are discussed below.

Table 15

Environmental Aspects

Item No.	Factor Loading	Name of Item
		Factor E1 Annoying Environment
140	.53	Noise
141	.34	Vibration
137	.27	Uncomfortable atmosphere
145	.21	Physical hazards
		Factor E2 Outdoor Work
136	.34	Indoor - outdoor work (outdoor)
141	-.22	Vibration
		Factor E3 Unpleasant Environment
138	.45	Cleanliness of environment (unclean)
145	.31	Physical hazards
137	.23	Uncomfortable atmosphere

Factor E1 seems to be composed of a number of different aspects of an Annoying Environment. The item on indoor-outdoor work appears only on Factor E2 which could be called Outdoor Work. Factor E3 seems to be similar to Factor E1, although the correlation between them is only .18. The distinguishing feature of Factor E3 seems to be unpleasantness rather than annoyance and this factor has been named Unpleasant Environment.

DISCUSSION

The results of a study of this kind are complex and difficult to assess. The end product is not merely the tagging of a probability statement onto a statistic, but rather a series of findings from which the experimenter must draw his conclusions in a somewhat subjective manner. The major objectives of the study were threefold (p. 5). The determination of how well each of these objectives were met may still leave some elements for individual interpretation.

The first objective was to develop a system for the measurement of worker-oriented job variables. However, the concept of "worker-oriented" variables has itself never been subject to vigorous experimental verification. Actually there is some peripheral evidence that the concept is at least a meaningful one (Gordon & McCormick, 1962), but it was still necessary to first make the assumption that these variables do exist. However, even though it has been assumed that these variables do exist, there is still no information available as to the characteristics of the population of these variables. Thus, a great deal of effort was expended in developing a comprehensive list of the variables, but there is little that can be done in comparing the properties of this sample to the population from which they are derived. This lack of knowledge concerning the population is probably the greatest single limiting factor in the study.

On the positive side, a wide variety of variables were developed, and seemed to be used with sufficient consistency so as to be useful in a number of situations. While this study may not have resulted in an ultimate measuring instrument, it has resulted in a system for the measurement of worker-oriented job variables which yields meaningful data.

The above point leads directly to the second objective, that of applying psychological scaling techniques to the measurement of job variables. It is felt that this objective has been met quite well. It will be remembered that the average reliability of the scaled items was distinctly higher than the average of all other items. This is an extremely encouraging result in view of the fact that a number of scales were constructed in complex, unstructured areas such as verbal communications and job structure.

One possible limitation of the scales should be pointed up. That is, these scales were developed with college student subjects. It is entirely possible that scale value may vary considerably as a function of the subject's familiarity with the activities being scaled. However, every effort was made to choose activity statements which would be quite familiar to any group of subjects. An example of such a statement is "rides bicycle to deliver messages and telegrams." If familiarity is fairly constant across subjects, then the use of these scales should be valid for job analysts in the field.

The third objective was, perhaps, the most unstructured of all-- that of exploring the dimensions of worker-oriented activities. It is the conviction of the present authors that these dimensions have indeed been probed. Whether the "basic" dimensions, or the dimensions at any specific level, have been determined is a more controversial matter. However, it is believed that the factors which have emerged at each phase of the study are quite meaningful in terms of affording one a way of viewing activities in an understandable number of dimensions.

It might be appropriate at this point to consider the nature of the factors that emerge from a study of this type. In a study of human abilities, it is often hypothesized that different abilities are correlated because of some underlying trait, and it is the possession of this trait in varying degrees which causes individuals to perform consistently on "related" tasks. In research with job activities, factors are formed solely by the coexistence of activities in jobs, and there is no necessity for these factors to have the same type of psychological meaning as factors of human abilities. Indeed, it is quite possible that a factor may define a dimension which is quite heterogeneous in terms of the human abilities required to perform the activities. It is this quality which sometimes makes activity factors seem internally inconsistent, whereas if they were viewed from the framework of coexistence, these seeming inconsistencies often disappear.

In viewing the results of each separate area analysis, a few points should be made clear. First, it must be remembered that a number of common items were included in each of the Mediation, Physical Output and Communications sections. Those items were considered to be more or less "general" characteristics of job activities, and it is interesting to note that they performed somewhat differently in each of the three analyses. In the Mediation section, almost without exception, the items loaded on the first factor, which seemed to be clearly related to Factor I in the overall analysis. But in the Communications section these items served to enhance other factors rather than predominate in a single factor. In the Physical Output section these items formed, almost by themselves, the positive pole of one of the factors (P1). This factor was closely related to Factor I in the overall analysis, but in this case it was the negative pole that was the more dominant.

It can be seen that these items played a significant role in defining the factor structures of the individual sections. Had the items not been included across the three analyses, it is possible that the structures might have been somewhat different, although where strong affinities exist between items, the introduction of additional variables should not weaken these affinities.

It should also be noted that while great care was taken in placing the items into the categories that were subjected to individual factor analyses, there were some cases where no clear-cut distinctions were possible. This was particularly true with the items dealing with supervision. From the judgments of all those who had categorized the items a choice had to be made as to whether these items would go into the Mediation section, the Communications section, or both. Since inclusion in both sections

would give more overlap than was desirable, a decision was finally made to include these items in the Mediation processes. The results of the analysis in this section indicated that the supervision items formed factors within themselves, whereas most of the other items appeared in a single factor.

It was regrettable that a number of items relating to perceptual tasks had to be eliminated from the factor analyses because of their low frequency of usage or unreliability. The section dealing with Input activities seems to warrant further work in order first to measure the significant inputs and second to analyze them.

There is at least one further perspective from which the results of the factor analyses should be viewed, and that is in the light of previous analyses. There are some factors which have emerged from this study which may not have had counterparts in previous work. However, the majority of the factors bear resemblance to those which have evolved from studies of worker traits, job requirements and job activities. For example, Factors I and III of the overall analysis are very closely related to the first two factors discussed by Finn (1954), while that author's third factor (Body Agility) is closely related to the fourth factor emerging in the Physical Output area (Body Balancing Activities). It should be noted that Finn analyzed worker characteristics, whereas the present study dealt with work activities. The factors are thus of a different nature, but each seems to be a counterpart of the other in its own specific domain.

The study by Palmer (1958) should provide a direct basis for comparison since he also dealt with worker activities. Again, there is correspondence between the studies. In a second order factor analysis, Palmer found a general decision making and mental activity factor, which is mirrored in Factors I and II of the present study. At a more specific level, Palmer describes a factor entitled Routine Work Decisions vs. Personnel Decisions. This factor seems to have a great deal of relationship to Factor M3, Decisions Directly Affecting People. These two illustrations are representative of a number of further relationships between the studies.

Thus it seems that a number of dimensions of job variables appear as consistent entities when different job samples are utilized and when measured through different approaches. This seeming consistency of dimensions may prove to be a savior to the applied psychologist in a world of constantly changing jobs.

SUMMARY AND CONCLUSIONS

This study represents an attempt to identify, measure and explore the dimensions of worker-oriented job variables. These variables are defined as those human behaviors which people perform in carrying out work as contrasted with a description of the job in terms of its end products or accomplishments.

A format was developed which consisted of items for the measurement of a number of work activities as well as some environmental and situational aspects of jobs. In developing this format, a number of psychological scaling techniques were applied to the measurement of worker activities. This format was tried out on a small sample of job descriptions and an item by item reliability analysis was made. In view of the information gained in this phase, the format was revised, and the revised format was applied to a sample of 398 jobs, representative of the percentages of jobs in the major occupational areas of the DOT. Duplicate ratings were made on 100 of these jobs in order to collect further reliability data. In light of the frequency of usage and the reliability data available, 119 items in the format were factor analyzed. The factors emerging at this stage are presented in Table 16.

Table 16

Factors Emerging from the Overall Analysis

Factor No.	Name of Factor
I	Varied Intellectual vs. Physical Activities
II	Decision Making and Communications Activities
III	Skilled Physical Activities
IV	Hierarchical Person to Person Interaction
V	Man-Machine Control Activities
VI	Unnamed - may be related to activities associated with service occupations
VII	Pleasant vs. Unpleasant Working Conditions

Prior to conducting this overall analysis, items were grouped somewhat along the lines of an information theory model. Subsequently, factor analyses were conducted within the following areas:

1. Activities associated with the mediating processes
2. Activities associated with physical outputs
3. Activities associated with communications
4. Environmental aspects
5. Situational aspects

The factors evolving from each of these areas are presented in Table 17.

Table 17

Factors Emerging from the Individual Area Analyses

Factor No.	Name of Factor
	Mediation Activities
M1	Varied Intellectual Activities vs. Structured, Repetitive Activities
M2	Direct Supervisory Activities
M3	Decisions Directly Affecting People
M4	Management Decisions
	Physical Output Activities
P1	Varied Intellectual vs. Routine Physical Activities
P2	Precise Physical Activities
P3	Gross Muscular Activities
P4	Body Balancing Activities
P5	Knee Bending Activities
	Communications Activities
C1	Informative Communication Activities
C2	Persuasive Communication Activities
C3	Varied Communication Activities
C4	Communication of Data
	Situational Aspects
S1	Public Contact
S2	Job Security vs. Performance-Dependent Income
S3	Salary vs. Hourly Pay
S4	Apparel: Specific Uniform
S5	Apparel: Working Clothes vs. Apparel: Optional Clothing
	Environmental Aspects
E1	Annoying Environment
E2	Outdoor Work
E3	Unpleasant Environment

Probably the most significant conclusion that can be drawn from this study is that jobs can be viewed from a framework of the activities that the incumbent performs, yet this framework need not be so specific that it cannot be generalized across different jobs, occupations, industries or geographical areas.

Secondly, the application of psychological scaling techniques to job variables has been quite successful, notwithstanding the amount of effort that must be spent in scale development. In view of the generality of the worker-oriented approach, the effort expended in developing and improving scales may well be worthwhile .

The final data gathered in this study represented a rather broad sample of jobs. Thus, the factors that have emerged from the study have a fairly sound foundation of jobs upon which they are based. This breadth should be valuable if the factors were to be applied to contexts such as selection, placement, job evaluation or training. It is hoped that in the future the experience gained through these factorial studies may serve not only to increase our knowledge of job interrelationships, but also to increase our ability to utilize this knowledge.

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APPENDIX A: ITEMS INCLUDED IN THE FINAL REVISION OF THE WORKER ACTIVITY PROFILE

1. Near visual discrimination
2. Far visual discrimination
3. Depth discrimination
4. Night vision
5. Estimation of speed
6. Estimation of quality or value
7. Inspection tasks
8. Estimation of quantity
9. Estimation of size
10. Sound discrimination
11. Difficulty of hearing
12. Identification of patterns and sequences of sounds
13. Taste discrimination
14. Odor discrimination
15. Tactual discrimination
16. Blind positioning
17. Adjustments to the vertical
18. Develops policies and objectives
19. Develops procedures to carry out policies
20. Develops methods for effective utilization of resources under his control
21. Forecasts needs in terms of personnel, material and/or money
22. Schedules work of others
23. Develops budgets
24. Initiating action
25. Uniqueness of decisions
26. Time span of decisions
27. Intelligence
28. Curiosity
29. Skepticism
30. Interpretation of information
31. Usage of mathematics
32. Finger manipulation
33. Gross arm-hand manipulation
34. Arm-hand steadiness
35. General physical coordination
36. Manual force
37. General force
38. Leg force
39. Operation of foot control devices
40. Control operations (motor aspects)
41. Control operations (mental aspects)
42. Clerical tasks - files

43+. Clerical tasks - typing; shorthand; calculating, adding or bookkeeping machine operation

47. Monitors a work process
48. Assembling
49. Arranging or positioning

50. Skill of hand tool usage
51. Number of hand tools used
52. Reclining
53. Sitting
54. Standing
55. Kneeling
56. Stooping
57. Crawling
58. Walking
59. Running
60. Jumping
61. Reaching
62. Balancing
63. Climbing
64. Moving objects by hand
65. Supervision given
66. Supervises assistants
67. Supervises fellow workers
68+. Supervises upper level management, middle management, first line management, professional personnel
71+. Supervises non-supervisory employees, students, trainees, or patients
75. Number of people supervised
76. Delegating authority
77. Responsibility for physical assets
78. Responsibility for health and welfare of others
79. Issuing directives
80+. Personnel decisions - promotions, demotions, transfers, raises, salary cuts
83+. Personnel decisions - dismissals, hiring
87. Personnel decisions - other punitive actions
88. Information giving and receiving
89. Interchange information with members of management
90. Interchange information with foremen and other first line supervisors
91. Interchange information with non-supervisory personnel
92. Interchange information with clerical workers
93. Interchange information with salesmen
94. Interchange information with semi-professional and professional personnel
95. Interchange information with customers, including clients, patients, etc.
96. Interchange information with "the public"
97+. Interchange information with "important persons," investors, suppliers
98+. Interchange information with prospective employees, students or trainees
102. Coordination of activities
103. Written communications
104. Verbal communications
105. Verbal presentations
106. Instructing
107. Advising
108. Counseling

109. Persuading
110. Negotiating
111. Reporting
112. Publicizing
113. Isolation
114. Attending or catering
115. Performs to amuse others
116. Conflicting directions
117. Social obligations
118. Dress - left to incumbent's discretion
119. Dress - tie and jacket or other publicly presentable clothing
120. Dress - specific uniform
121. Dress - special working clothes
122. Day-night work
123. Pattern of working hours
124. Seasonal regularity of the job
125. Regularity of work flow
126. "Rush jobs"
127. Continuous attention
128. Repetitiveness
129. Activity domain - people
130. Activity domain - data
131. Activity domain - things
132. "Thinking" vs. "Doing"
133. Temperature
134. Temperature fluctuation
135. Humidity
136. Indoor-outdoor work
137. Uncomfortable atmosphere
138. Cleanliness of environment
139. Illumination
140. Noise
141. Vibration
142. Distractions - telephone calls
143. Distractions - people seeking or giving information
144. Work space
145. Physical hazards
146. Occupational prestige
147. Job security
148. Pay - hourly basis
149. Pay - regular salary basis
150+. Pay - commission or tips
152. Self employed
153. Overtime pay
154. Personal sacrifices
155. Traveling
156. Separation from family
157. Family housing conditions
158. Unpleasant or frustrating experiences
159. Social value conflicts
160. Supervision received
161. Amount of job structure
162. Color discrimination
163. Variety of communications