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The Differential Effects of Disability and Sex on Job Sample Task Performance

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THE DIFFERENTIAL EFFECTS OF DISABILITY AND SEX
ON
JOB SAMPLE TASK PERFORMANCE

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VITA

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CHAPTER I

INTRODUCTION

The initial step in the vocational rehabilitation process is that of vocational evaluation, that is, the assessment of the client's work-related abilities, vocational interests, and work habits. The goal of this evaluation is the determination of a vocational objective, which may be either immediately obtainable or would require preliminary training.

There are three methods used for the evaluation of the vocationally handicapped. The first is the use of standardized, psychological aptitude tests which are usually of the paper-and-pencil variety but which also include certain simple apparatus tests. The problem here is that although the results are quantifiable, elements of the testing are often included which may be extraneous to particular jobs. For instance, a paper-and-pencil test of mechanical ability may require that the subject has attained a relatively high level of reading ability, whereas there exist certain types of mechanical jobs which do not require literacy. Moreover, the lack of formal education in some individuals may interfere with the accurate assessment of the true abilities (see Mitchell, 1968). Another problem with this method is that the tests often lack face-validity. Although the Purdue Pegboard is probably a valid measure of a certain type of manual dexterity, many clients do not see the relationship between the performance on this test and their ability to do any type of job. This lack of face-validity, at least from the client's point of view, may affect his test results and the validity of the tests (see Wright and Trotter, 1968, p. 187).

Job-tryout is a second method of vocational evaluation, whereby the client is placed to work on an actual job. While this type of evaluation is relevant to the actual job, it lacks the objectivity of the psychometric tests. It is also very time consuming since it may take a week or more to evaluate a client in a single job. Summarily then, the methods of psychometric testing and job-tryout used independently for vocational evaluation pose a number of limitations on an accurate assessment of individual potential. On the other hand a third method, job sample testing combines the objectivity of the standarized testing with the job relevancy of the job tryout and essentially reduces the margin for inaccurate appraisal.

There is no clear-cut differentiation between job sample tests and certain apparatus tests which are commercially available from test publishers. Basically, job sample tests are a standardized element of a particular job or job family. One aspect of the job of addressograph operator for example is filing the typed plates in reverse alphabetical order. If a person is not sufficiently flexible to do this unusual method of filing, training as an addressograph operator probably is not feasible. Thus a job sample test has been developed for this task.

Job sample tests may vary on two important continuums. The first is that of complexity. These tests may be as simple as nailing brads in a piece of wood or as complex and involved as the "In-basket" technique (see Cambell et al., 1968; Bray & Grant, 1966). The second is that of abstractness. That is, the more a job sample task resembles a specific job the more concrete it is. Usually, if a job sample test is designed to be predictive of success for several types of jobs, it is more abstract than one developed for predicting success for a single job. It is this dimension of abstractness that allows for difficulty in differentiating between job sample tests and psycho-motor apparatus tests.

For the purpose of this study the distinction is purely one of tests origin. Those tests which are commercially available are considered to be standard psychological tests, while those developed by the author are termed "job sample tests".

Much of the work in developing job sample tests has been scattered throughout various rehabilitation facilities and has involved little if any comprehensive planning or research. Only two job sample testing systems have been designed for use with the vocationally handicapped.

The TOWER system was developed in the late 1930's by the Institute for the Crippled and Disabled (1959) in New York City. This system was developed primarily for the cerebral palsied but is now used to evaluate people with all types of disabilities both in New York and throughout the country.

The second evaluation system evolved in 1967 at Goodwill Industries of Chicago and Cook County, Illinois (see Hester, 1967). The purpose of this system is two-fold: it was devised to provide a practical system for vocational evaluation of the vocationally handicapped, as well as to provide a frame-work for research into the taxonomy of work.

The lack of sufficient research into the nature of jobs and the basic dimensions of work aptitudes has been emphasized by Smith and Cranny in the 1968 Annual Review of Psychology (p. 490).

> "This review seems to us to support the view that many major problems are receiving little or no attention from industrial psychologist. Much of the present research is trivial, and irrelevant to the major problems of our industrial society. Urgent problems remain unanswered, such as those concerning the relative importance of different task characteristics for workers being retrained or even a general taxonomy of tasks".

Indeed, the only major program for the analysis of the underlying dimensionality of task performance is that of the American Institutes for Research in Washington, D.C. under the direction of Edwin A. Fleishman, Ph.D. However, the research at AIR is supported by the Armed Forces, primarily the U.S.A.F., and thus is mainly concerned with such jobs as airplane and helicopter piloting. Although they are making significant contributions to the knowledge of human abilities, there is obviously a need for research into the nature of non-defense jobs.

Goodwill Industries of Chicago and Cook County, Illinois provides an ideal climate for the study of task performance dimensionality. First, there are a large number of potential subjects. Approximately 400 clients per year enter Goodwill for six-weeks of vocational evaluation; about 300 plant workers are also available to serve as subjects when the need arises. Secondly, there are about 125 different jobs at Chicago Goodwill which can be related to the various task factors. These jobs range in difficulty from sorting, dishwashing, and porter work to steampressing, multilith operation and clerical work. Finally, sixty percent of the clients are physically disabled, the remaining forty percent have mental, psychiatric, or social disabilities. The accessibility of physically and non-physically handicapped groups may allow for a more simple analysis of specific abilities involved in various tasks. That is, if a particular task requires two-handed finger dexterity this may be more easily determined using a population in which it is assumed that this ability is more widely varied than in the normal population.

However, certain problems will be introduced if the physically disabled differ significantly in terms of test performance. The purpose, then, of this study is to determine if those individuals with a particular type of disability, in this case upper extremity disabilities, perform differently on certain job sample tests than those without this disability. Stated in terms of the null hypotheses: there is no significant difference between the job sample task performance of subjects with upper extremity disabilities and those with other physical disabilities.

Another variable which may enter into the performance of job sample tests is the sex of the subject. Again, stated in terms of the null hypothesis: there is no significant difference in the job sample task performance of male and female subjects.

It is further hypothesized that if differences occur in regard to the two disability groups they should be more pronounced in the tests which require the greatest amount of manual dexterity.

Finally by the inclusion of certain standard psychological tests of sensory-motor ability, it can be determined if they are as equally predictable of task performance for clients having upper extremity as for those with other physical disabilities.

CHAPTER II

RELATED LITERATURE

JOB SAMPLE TEST DEVELOPMENT

The concept of job sample testing stretches back in history to at least ancient Greece. Plato referred to it in The Republic as a Method of determining the type of work for which a child should be trained.

At the end of the 19th century Galton, Cattell, Munsterburg, Jastrow, and Kreaplin were using simple apparatus tests to study individual differences and "mental" ability.

Later, there was a temporary loss of interest in psychomotor skills due to the early enthusiasm over intelligence testing. Seashore appears to have been primarily responsible for renewing interest with his development of the Stanford Motor Skills Unit (1928).

The underlying assumption of job sample testing is that by the use of such tests, predictions of success in complex jobs can be made. However, the research has been somewhat inconsistent in supporting this assumption.

Seashore (1931) studied the validity of job sample tests for predicting success of winding machine apprentices in a knitting mill. The results of Seashore's study were discouraging as were also the results of Walker and Adams (1934) in attempting to predict typewriter proficiency. However, other studies are reported by Tiffin (1947) and Super (1949) which show a validity of manual dexterity tests for watchmaking, electrical fixture and radio assemblers, coil winders, packers and wrappers, and various machine operators.

Since the Second World War, more complex tests of motor skills have been developed primarily in the Air Force research program. A leading figure in this development is Fleishman (1953) who presents an excellent summary of the research on job sample tests employed by the Air Force. He believes that apparatus tests are more useful than printed tests whenever the primary interest is in the motor aspect of the subject's responses in such areas as perceptual-motor coordination, smoothness of control movement, and speed of discriminative reactions.

Melton (1947) has provided a detailed description of the various apparatus tests developed in the Air Force classification program and he has summarized some of the problems attendant upon the use of apparatus tests. First, apparatus tests are generally expensive to build, maintain, and administer because they can be given to only a small group of subjects at a time. Secondly, the problem of maintaining uniform testing conditions with apparatus tests is greater than with paper-and-pencil tests. Part this lack of uniformity of testing conditions he feels rests upon variations in the test adminstrators. However, Cousins (1965) has shown that there are no significant differences in testing grip strength due to the amount of training the tester has received.

Harrell (1940) alludes to another problem in psychomotor testing which is that many of the tests are seen as childish by certain subjects. He observed that this was more likely with older than the younger subjects. The youths seemed to be "more impressed with the entire testing program and could not be dissuaded from believing that their responsiveness would influence their future chances of promotion." This observation may justify the use of more sophisticated equipment, not so much for the more refined measurements involved, but rather for the fact that it is impressive to the subject and consequently may increase his motivation to do well on the tests.

Thorndike (1949) reports still another difficulty found in using apparatus tests which is that because of the time required for the actual testing, the assembly of sufficient data for validity studies may often be accomplished too late to be pertinent.

It is possible that some aspects of personality enter into psychomotor performance as discovered by Cattell (1965). He found that perceptual motor rigidity, the ratio of accuracy to speed, and two-hand coordination are significantly related to his personality factor U.I. 23. (High mobilization - vs - Regressive debility). This finding could have important consequences in theoretical work but would probably be relatively unimportant for the evaluation of the vocational potential of individual clients.

A criticism which has been unjustly leveled at job sample testing is that the results are highly dependent upon the amount of specific training the subject has had in this type of skill. Seashore (1940) considered this problem and found that rather than obliterating the differences between subjects on specific tests, training actually increases the magnitude of these differences. Likewise, the correlations between initial and final scores on the learning curves of motor skills are reasonably high. This does not, however, obviate the fact that the amount of prior training of subjects should be taken into account in the interpretation of the job sample tests results.

An overview of the above discussion of apparatus testing seems to indicate that in spite of the associated problems and difficulty involved in validation, apparatus tests provide information about the client which would be virtually impossible to obtain in any other way.

FACTOR ANALYTIC STUDIES OF PERCEPTUAL MOTOR ABILITY

The initial factor analytic study of psychomotor abilities was performed by Farmer (1927).

Thurstone (1938) used sensory-motor tests in his factoral study of primary mental abilities. In this study he used a relatively small number of tests and as a result found only two related factors: spatial relations and perceptual speed.

At about the same time Buxton (1938) applied multiple factor analysis to the study of motor abilities with little success. He found six factors, all with such low loadings that he felt it would be improper to attempt to name them. Buxton suggested that future factor analytic studies of psychomotor abilities should use a more restricted group of tests so that fewer factors are involved. Also for each possible factor, more tests should be included so that the factors will be overdetermined.

Two years later Buxton did another study with Seashore and McCollom (1940). They again found six factors; however, this time most of them were sufficiently clear to be named. The factors found are as follows:

Factor I - "Speed of single reaction"

Factor II - "Finger, hand, and forearm speed in restricted oscillatory movement"

Factor III - "Forearm and hand speed in oscillatory movements of moderate extent" tapping on a single plate and with two or three plates is high on this factor.

Factor IV - This factor was not named but it appears to be related to steadiness or precision.

Factor V - "Skill in manipulating spatial relations"

Factor VI - Appears to be a residual for the battery of tests used.

Harrell (1940) factor analyzed various psychomotor and verbal tests and personal data. This analysis yeilded five factors. Factor I he found difficult to identify but it appears to be Thurstone's perception factor, even though none of Thurstone's tests were included in the analysis. Factor II is clearly verbal ability. The third factor he named "youth" since it is highly related to subject age and work experience. He felt that this factor represents a youthful willingness to follow instructions, particularly in view of the fact that two very monotonous tests were loaded on this factor. Factor IV appears to be clearly one involving manual dexterity. Tests high in IV are more routine than those in Factor I. The final Factor, V, is clearly spatial. Harell believes this study indicates that mechanical ability tests are composed principally of the perceptual and spatial factors and that the five factors found in here may be accurately measured by paper and pencil tests. However, it is not clear whether or not high loading of mechanical ability on the perceptual and spatial factors may be an artifact caused by the paper and pencil tests of mechanical ability used in this study.

In 1951 Takala (1951) factor analyzed a number of intelligence tests, cancellation tests, and manual skill tests. Six factors were identified relating to general intelligence, accuracy-speed factor of manual skill, and form factor and skill of fine motor performance. No intelligence tests showed significant loadings in manual skill factors.

Fleishman (1967) has conducted a series of factor analyses beginning with rather simple tests and continuing through some complex tasks associated with piloting an airplane. In his first study (1954) he used the scores of 400 subjects on 40 psychomotor tests variables. Ten relatively independent factors were identified: (1) Wrist-finger speed, (2) Finger dexterity, (3) Rate of arm movement, (4) Manual dexterity, (5) Steadiness, (6) Reaction time, (7) Aiming, (8) Psychomotor coordination, (9) Postural discrimination, and (10) Spatial relations. In addition two other factors appeard but there identification was uncertain.

In a second study Fleishman and Hempel (1954) factor analyzed 15 printed and apparatus dexterity tests. Five factors were identified: (1) Finger dexterity, (2) Manual dexterity, (3) Wrist-finger speed, (4) Aiming, (5) Positioning. The Purdue Pegboard had the highest loading in the first factor "finger dexterity." The second factor is best represented by the Minnesota Rate of Manipulation Test. The third factor "Wrist-finger speed" could also have been called "tapping". The fifth factor of "positioning" is best represented by the punch board test, Minnesota Rate of Maniputation Test's Placing Task, and the right hand task of the Purdue Pegboard.

Hempel and Fleishman (1955) used 46 tests of manipulative, paper and pencil, and physical performance to determine if performance on gross physical tasks is related to fine manipulative skill. The results indicate that these two types of ability are independent.

In 1956 Fleishman and Hempel began a series of studies into more complex types of task performance. In the first of these studies (1956) 23 test variables were factor analyzed. Nine factors, rotated to orthogonal simple structure, are as follows: (1) Psychomotor coordination I, (2) Psychomotor coordination II, (3) Spatial relations I, (4) Spatial relations II, (5) Integration, (6) Rate control, (7) Perceptual speed, (8) Manual dexterity, and (9) Visualization. Psychomotor coordination I requires fine, sensitive, highly-controlled adjustments in movements quite restricted in score whereas Psychomotor coordination II is grosser. It involves coordination between muscle groups since the four tests having the highest loadings in this factor require hand-leg coordination. Spatial relations I involves stimulus interpretation while spatial relations II is response oriented. An important finding in this study was that while paper and pencil tests can measure some dimension, other important factors cannot be so measured.

More recent studies of helicopter pilot performance (see Zabala, A et al., 1965 and Locke, E.A. et al., 1965) indicate that these same factors appear in somewhat different complex tasks.

Other studies of job sample tasks have been concerned with various different aspects of the problem. For instance, Kottenhoff (1961) found a general factor of spatial intelligence in two groups of neurotics in regard to simple and 3-choice reaction time and steering skill measures.

Bonnardel (1955) analyzed manipulative tests used as a preliminary orientation of unspecialized workers in a large industrial center. Three principle factors appeared: (1) intelligence of adaptability, (2) motivation level, and (3) precision and care. He also found that physical condition did not seem to exert any influence on test results.

An on-the-job analysis by Kirk and Feinstein (1967) in the worsted wool industry produced the conclusion that inspection and repair performance are unrelated. They suggested that the perceptual part (inspection) and the motor part (repair) might profitably be separated and carried out by different people.

One important question to be answered is whether the factor structure of task performance can be affected by such variables as fatigue. A partial affirmative answer may have been provided by Bujas et al. (1960). They applied a battery of twelve intellectual tests to a group of subjects with fatigue and to a comparable group without fatigue. While the tests in the non-fatigue group formed the normal factoral structure, in the fatigued group the logic of the structure was completely deranged. The results appeared to support the hypothesis that under fatigue there is a certain disintegration of the normal functions and that they seem to achieve a new integration on a different level. However, Parker (1967) in his analysis of the problem of assessing the performance capabilities of the on-orbit astronaut found that the relatively mild stressors of sleep loss and heat did not result in significant alterations of performance on these tasks.

Another aspect of ability related to the determination of a general taxonomy of work-related abilities is that of gross physical ability. Fleishman's (1963, 1964) Cousins' (1955) and Cumbee's (1954) research have yielded similar results. Fleishman terms the factors Extent flexibility, Dynamic Flexibility, Static strength, Dynamic strength, Explosive strength, Trunk strength, Gross body coordination, Gross body equilibrium, and Stamina.

A different method was employed by Highmore and Jones (1959) who factor analyzed eight tests of athletic ability. They found a basic factor for athletic ability and three group factors related to running, jumping, and throwing.

Humphreys (1962) calls attention to what he feels is an unfortunate tendency in recent work on human abilities, namely, the proliferation of factors. He feels that in general broad tests, high in the factor hierachy, are more useful than the narrow, specific test.

JOB DESCRIPTION ANALYSIS

A second possible approach to the development of a classification system for jobs is through the factor analysis of job descriptions. This approach attempts to determine the basic structure of jobs as they exist independent of the consideration of the abilities involved. For instance, Chalupsky (1962), factor analyzed a sample of 192 office jobs. Four basic factors emerged: (1) Inventory and Stockkeeping, (2) Supervision, (3) Computation and Bookkeeping, and (4) Communication and Public Relations.

Likewise Baehr (1967) factor analyzed 122 job elements rated according to their relevance to non-occupational classifications which aranged from first-line foreman to executives. Twelve factors emerged which were subsequently classified into four groups. Organization, Leadership, Personnel, and Community.

A slightly different method was utilized by Secadas (1958). Instead of relying on job descriptions, he analyzed the content of shop courses in mechanics, metalworking, carpentry, electronics, and graphic arts. Factoring tasks in these courses yielded metalworking, mechanical, electronics-printing, and bookbinding-carpentry factors. Tests given the students yield mechanical, quantitative-graphic, manipulative, and plastic-artistic factors.

CHAPTER III

PROCEDURE

SUBJECTS

The 60 subjects were selected by disability and sex from the incoming vocational diagnostic clients at Goodwill Industries of Chicago. After sufficient subjects were obtained for a particular group, the selection for that group was stopped.

The 60 subjects were divided into four groups of 15 clients each as follows:

1. Male - Orthopedic
   These male subjects have a diagnosed orthopedic disability involving one or both upper extremeties.

2. Female - Orthopedic
   These female subjects have a diagnosed orthopedic disability involving one or both upper extremeties.

3. Male - other physical
   These male subjects have a diagnosed physical disability other than of an orthopedic nature; such disabilities included: deafness, respiratory or cardiac.

4. Female - other physical
   These female subjects have a physical disability other than of an orthopedic nature.

The subjects ranged in age from 16 to 59 years with an average age of 33.5 years. Table 1. shows the average age and standard deviation for each group. There is no significant difference between the groups in regard to age.

Table 1

Age Distribution of Subjects by Groups

Group	Mean	Standard Deviation
Male - Orthopedic	37.6	13.1
Female - Orthopedic	29.8	13.1
Male - Other Physical	35.7	10.4
Female - Other Physical	30.7	13.0

The average number of years of education for the total number of subjects is 10.2 years. Table 2 shows the average number of years of education for each group. There is no significant difference between the groups.

Table 2

Years of Education of Subjects by Groups

Group	Mean	Standard Deviation
Male - Orthopedic	10.2	3.0
Female - Orthopedic	10.6	1.4
Male - Other Physical	10.1	1.7
Female - Other Physical	9.7	1.4

TESTS

The choice of tests to be employed was based upon the review of the factor analytic studies presented in the previous chapter. Tests were picked primarily from four dimensions: Finger dexterity, Manual dexterity, Wrist-finger speed, and perceptual speed.

The ten job sample tests administered to each of the 60 subjects were:

Nailing Brads. The client's performance is measured according to the amount of time which it takes him to nail 32 ½ inch brads into a pine board.

SCORES: Time in minutes
Number of errors — NO TIME LIMIT: About 15 Min.

Nut and Washer Assembly. This test measures the speed at which the client can make a number of simple assemblies consisting of putting six washers and seven nuts on a bolt.

SCORES: Number of assemblies — TIME LIMIT: 1 Hour

Electronic Connecting Block Assembly. Using the standard connecting tool, the client connects wires to the terminals of a 25-pair connecting block. In making the connections he must follow written instructions which state the color code of the wire and the position of the terminal to which it is to be connected.

SCORES: Time in minutes
Number of errors — NO TIME LIMIT: About 1 Hour

Packaging Small Parts. The client packages wood jointers, rivits, nails, and washers in small envelopes which he then closes with a paper clip. The client is scores not only on the number of envelopes packaged during the time limit but also on the accuracy of packing.

SCORE: Number of packages TIME LIMIT: 30 Minutes

Weight Recording. The client is seated at a table upon which there is a scale and 18 filled bags each identified by a number. The client weighs each bag and records the weight to the nearest quarter of a pound on the answer sheet next to the bag's identification number.

SCORE: Time in minutes NO TIME LIMIT: About 20 Min.
Number of errors

Sorting File Signals. The client sorts a box of file signals according to color.

SCORE: Time in minutes NO TIME LIMIT: About 5 Min.

Coin Sort Test - I. This test measures the client's ability to do fine inspection. The client sorts pennies according to whether or not a mint mark appears under the date on the face of the coin.

SCORE: Time in minutes NO TIME LIMIT: About 30 Min.

Coin Sort Test - II. This test measures the client's ability to do gross inspection. The client sorts pennies according to the type of impression on the reverse side of the coin. Those which depict the Lincoln Monument are sorted out from those which do not.

SCORE: Time in minutes NO TIME LIMIT: About 20 Min.

Sorting Nails. The client sorts a box of nails according to the length.

SCORE: Time in minutes NO TIME LIMIT: About 10 Min.

Stamping Machine Feeding. This test measures the client's ability in machine feeding by use of an electric time stamping machine.

SCORE: Time in minutes NO TIME LIMIT: About 45 Min.

Since the tasks entitled "nailing brads", "electronic connecting block assembly", and "weight recording" are scored for both speed and accuracy, the ten tests yield 13 scores.

In addition each subject was also given the following standard psychological tests:

Raven Progressive Matrices - 1938. This is an untimed non-verbal test of abstract reasoning ability.

SCORE: Number correct NO TIME LIMIT: About 1 Hour

Purdue Pegboard - Right. With his right hand the client placed small metal pegs one at a time into small holes.

SCORE: Number placed TIME LIMIT: 30 Sec.

Purdue Pegboard - Left. This is the same as the preceeding test except that the client uses his left hand instead of his right.

SCORE: Number of pins placed TIME LIMIT: 30 Sec.

Purdue Pegboard - Both. The subject picks up one pin in each hand and simultaneously placed each in a hole opposite the hand.

SCORE: Number of pairs of pins placed TIME LIMIT: 30 Sec.

Purdue Pegobard - RLB. This is not a separate test but is the summation of the scores received for the right, left and both tests.

Purdue Pegboard - Assembly. The subject assembles simple objects by placing a pin in a hole with his right hand, then placing a washer over it with his left hand, a collar on top of the washer with his right hand, and finally a washer on top with his left hand.

SCORE: Number of assemblies TIME LIMIT: 1 Min.

Crawford Small Parts Dexterity Test - Pins. The subject uses a tweezer, held in the dominant hand, to place a pin in a hole and then to place a collar over it. This done for 50 pins.

SCORE: Time in seconds NO TIME LIMIT: about 2 Min.

Crawford Small Parts Dexterity Test - Screws. Fifty screws are driven into holes with a small screw driver.

SCORE: Time in seconds NO TIME LIMIT: About 2 Min.

Tapping I - Right. The subject taps a single metal plate with a stylus as rapidly as possible for 30 seconds. The number of taps are recorded on an electrical digital counter.

SCORE: Number of taps TIME LIMIT: 30 Sec.

Tapping I - Left. This test is the same as the previous one except that the client uses his left hand.

SCORE: Number of taps TIME LIMIT: 30 Sec.

Tapping II - Right. With a metal stylus held in his right hand the subject taps in rapid succession two metal plates located 3 inches apart. The recording of the scores is the same as in Tapping I.

SCORE: Number of taps TIME LIMIT: 30 Sec.

Tapping II - Left. This test is the same as the above except that the client uses his left hand.

SCORE: Number of taps TIME LIMIT: 30 Sec.

Minnesota Clerical Test - Numbers. The subject compares sets of numbers to determine if they are identical.

SCORE: Right minus wrongs TIME LIMIT: 8 Min.

Minnesota Clerical Test - Names. The subject compares sets of names to determine if they are identical.

SCORE: Right minus wrongs TIME LIMIT: 7 Min.

METHOD

The subjects were given the preceeding tests as part of their vocational evaluation. They were tested individually and the testing normally required a six-hour day.

The subjects were divided into four groups of 15 subjects each as stated previously:

1. Male - Orthopedic
2. Female - Orthopedic
3. Male - other physical
4. Female - other physical

After the subjects were divided into the above groups, they were compared interms of age and education. At first it was though that these two factors might contaminate the research results, but it was latter discovered that there was no significant difference between any of the four groups on these two parameters.

In order to test the hypothesis that disability or sex, singly or together, might significantly affect test results, a two-way analysis of variances was used.

The data for each test was arranged as shown in Table 3.

Table 3

Two-way Analysis of Variance Model

	Male	Female	
Orthopedic Disability	N=15	N=15	30
Other Physical Disability	N=15	N=15	30
	30	30	60

The analysis of variance for each of the 27 test results were computed at Loyola University on an IBM 1401 using the TWO program. Subsequently, the means for each test by disability group and by sex were hand computed.

In order to verify the hypothesis concerning the interrelationship of the tests for the two groups, the intercorrelations for the 27 variables were computed separately for the orthopedic group and the other physical disability group. The matrices were generated at Northwestern University on a Control Data 3400 using the BIMD 29 program. The multiple correlation and data transformation sections of the program were not used.

CHAPTER IV

RESULTS

The complete listing of the F ratios for each of the 27 variables in is presented in Appendix A.

Table 4 lists the means on each of the job sample task results for the two disability groups, as well as the pertinant F ratio. It will be noted that only four tasks indicate significantly better performance by the "other physical" disability group.

Table 4

Comparison of Disability Groups on Job Sample Tasks
Means and F Ratios

Test Variable	Means: Orthopedic	Means: Other physical	F Ratio	Significance Level
Nailing Brads-Time	21.3	14.4*	4.246	.05
Nailing Brads-Errors	6.6	2.7*	4.357	.05
Nut&Washer Assembly	14.7	23.0	16.788	.001
Connecting Block-Time	90.6	66.4*	6.912	.05
Connecting Block-Err.	13.8	0.4*	1.287	
Packing	79.5	118.0	0.620	
Weight-Time	18.8	18.4*	0.039	
Weight-Errors	9.0	8.1*	0.424	
File Signals	6.4	5.5*	1.728'	
Coin I	26.2	22.2*	1.499	
Nail Sorting	8.6	7.2*	1.561	
Stamping Machine	29.8	22.8	3.192	
Coin II	15.1	13.0*	1.695	

* on these variables a low score indicates better performance

The means and F ratios for the males and females are given in Table 5.

Table 5

Comparison of Sex Groups on Job Sample Tasks
Means and F Ratios

Test Variable	Means Male	Means Female	F Ratio	Significance Level
Nailing Brads-Time	19.2	16.4*	0.638	
Nailing Brads-Errors	4.6	0.5*	0.005	
Nut&Washer Assembly	19.7	17.8	0.949	
Connecting Block-Time	80.5	73.7	1.149	
Connecting Block-Err.	13.6	10.7*	0.876	
Packing	87.9	98.5	43.879	.001
Weight-Time	20.9	15.9*	2.221	
Weight-Errors	8.4	8.7*	0.070	
File Signals	6.5	5.4*	3.011	
Coin I	26.5	22.5*	0.975	
Nail Sorting	8.8	7.1*	2.415	
Stamping Machine	27.8	23.8*	1.564	
Coin II	15.3	12.8*	2.276	

* on these variables a low score indicates better performance

Table 6 lists the means and F ratios for the two disability groups on each of the standard psychological tests.

Table 6

Comparison of Disability Groups on Standard Tests
Means and F Ratios

Tests	Means		F Ratio	Significance Level
	Orthopedic	Other Physical		
Raven Progressive M.	25.9	28.3	0.500	
Purdue Pegboard - R	10.1	15.1	18.442	.001
Purdue Pegboard - L	9.3	14.0	16.522	.001
Purdue Pegboard - B	5.6	12.1	37.518	.001
Purdue Pegboard-RLB	24.0	40.6	40.995	.001
Purdue Pegboard-Assm.	17.1	27.6	30.640	.001
Crawford Pins	10.6	6.6*	12.905	.001
Crawford Screws	19.4	10.5*	20.206	.001
Tapping I - R	134.0	157.6	3.387	
Tapping I - L	125.5	154.0	5.491	.05
Tapping II - R	96.0	110.0	2.498	
Tapping II - L	82.1	104.2	7.633	.01
MCT - Numbers	67.4	74.6	1.293	
MCT - Names	66.4	68.0	0.075	

* on these two tests, a low score indicates better performance

The other physical group did significantly better than the orthopedic group on nine of the above tests.

The means and F ratios for the male and females are given in Table 7.

Table 7

Comparison of Sex Groups on Standard Tests
Means and F Ratios

Tests	Means: Male	Means: Female	F Ratio	Significance Level
Raven Progressive M.	25.2	28.6	0.907	
Purdue Pegboard - R	11.3	13.2	1.045	
Purdue Pegboard - L	11.9	11.4	0.187	
Purdue Pegboard - B	8.5	8.6	0.003	
Purdue Pegboard-RLB	31.9	32.8	0.110	
Purdue Pegboard-Assm.	21.6	23.1	0.594	
Crawford Pins	9.3	8.0*	1.386	
Crawford Screws	16.0	14.2*	0.511	
Tapping I - R	153.9	137.3	1.710	
Tapping I - L	159.3	120.4	10.733	.01
Tapping II - R	;00.0	103.2	0.492	
Tapping II - L	103.2	83.1	6.235	.05
MCT - Numbers	59.7	82.6	12.056	.001
MCT - Names	57.1	77.6	7.602	.01

* on these two tests, a low score indicates better performance

The information provided by Table 7 indicates that the females did significantly better than the males on two of the fourteen tests. On two tests, left hand tapping I and II, the males performed better than the females.

The results of the job sample task intercorrelation for the orthopedic disability group is presented in Table 8. Those for the "other physical" disability group are shown in Table 9. All information is combined in Table 10 to better illustrate the differential patterning of the significant intercorrelations between the two disability groups. Instead of showing the intercorrelation values, a "1" indicates that the two job sample tasks are significantly (at the .05 level) related for the orthopedic disability group. A "2" refers to a significant correlation in the "other physical" disability group.

The intercorrelation matrices of the standard psychological tests for the two disability groups are given in Table 11 and 12. The significantly (at the .05 level) intercorrelated tests for the two disability groups are provided in Table 13.

Tables 14 and 15 show the correlations of the standard psychological tests and the job sample tasks for each of the two disability groups.

The significant (at the .05 level) correlations for each group are presented in Table 16.

Table 8

Job Sample Task Intercorrelations

Orthopedic Disability Group*

	Nailing			Con. Block			Weight		File	Coin	Nail		Coin
	T.	Acc	Nut	T.	Acc	Pack	T.	Acc	Sig	I	Sort	Stamp	II
Nailing Time	-	.82	.48	.16	.16	.35	.04	.41	.35	.17	.44	.11	.30
Nailing Acc.	.82	-	.45	.15	-.08	.28	-.05	.46	.16	.07	.42	.01	.26
Nut and Washer	.48	.45	-	.12	-.11	.56	-.01	.23	.41	-.07	.27	.27	.22
Con Block Time	.16	.15	.12	-	.41	.49	.11	.38	.40	.29	.62	-.08	.41
Con Block Acc	.16	-.08	-.11	.41	-	.17	.17	.16	.29	.16	.35	-.02	.16
Packing	.35	.28	.56	.49	.17	-	.17	.59	.64	.21	.65	.42	.42
Weighing Time	.04	-.05	-.01	.11	.17	.17	-	.18	.27	.00	.38	-.01	.16
Weighing Acc	.41	.46	.23	.38	.16	.59	.18	-	.40	.29	.60	.15	.64
File Sig	.35	.16	.41	.40	.29	.64	.27	.40	-	.51	.57	.49	.44
Coin I	.17	.07	-.07	.29	.16	.21	.00	.29	.51	-	.29	.23	.34
Sort Nail	.44	.42	.27	.62	.35	.65	.38	.60	.57	.29	-	.09	.58
Stamping Machine	.11	.01	.27	-.08	-.02	.42	-.01	.15	.49	.23	.09	-	.32
Coin II	.30	.26	.22	.41	.16	.42	.16	.64	.44	.34	.58	.32	-

* Correlations equal to, or greater than, .35 are significant at the .05 level and correlations of .45 are significant at the .01 level.

Table 9

Job Sample Task Intercorrelations

Other Physical Disability Group *

	Nailing T.	Nailing Acc	Nut	Con. Block T.	Con. Block Acc	Pack	Weight T.	Weight Acc	File Sig	Coin I	Nail Sort	Stamp	Coin II
Nailing Time	-	.50	.36	.18	.27	.37	.15	.01	.09	.33	.26	.18	.36
Nailing Acc	.50	-	.38	.23	.30	.31	-.02	.55	.20	.47	.52	-.13	.35
Nut and Washer	.36	.38	-	.13	.26	.46	.07	.35	.11	.38	.31	.23	.36
Con Block Time	.18	.23	.13	-	.22	.28	.37	-.02	.66	.57	.52	.14	.46
Con Block Acc	.27	.30	.26	.22	-	.35	.07	.37	.24	.29	.35	-.03	.16
Packing	.37	.31	.46	.28	.35	-	.14	.11	.09	.41	.47	-.10	.31
Weighing Time	.15	-.02	.07	.37	.07	.14	-	-.07	.19	.41	116	.15	.29
Weighing Acc	.01	.55	.35	-.02	.37	.11	-.07	-	-.03	-.21	.14	-.15	.14
File Sig	.09	.20	.11	.66	.24	.09	.19	-.03	-	.49	.63	.32	.61
Coin I	.33	.47	.38	.57	.29	.41	.41	.21	.49	-	.59	.35	.34
Sort Nail	.26	.52	.31	.52	.35	.47	.16	.14	.63	.59	-	.03	.47
Stamping Machine	.18	-.13	.23	.14	-.03	-.10	.15	-.15	.32	.35	.03	-	.29
Coin II	.36	.35	.36	.46	.16	.31	.29	.14	.61	.34	.47	.29	-

* Correlations equal to, or greater than, .35 are significant at the .05 level and correlations of .45 are significant at the .01 level.

Table 10

Locations of Significant (at .05 Level) Job Sample Task

Intercorrelations for the Two Disability Groups*

	Nailing T.	Nailing Err	Nut	Con. Block T.	Con. Block Err	Pack	Weight T	Weight Err	File Sig	Coin I	Nail Sort	Stamp	Coin II
Nailing Time	-	1,2	1,2			1,2		1	1		1		2
Nailing Errors	1,2	-	1,2					1,2		2	1,2		2
Nut and Washer	1,2	1,2	-			1,2		2	1	2			2
Con Block Time				-	1	1	2	1	1,2	2	1,2		1,2
Con Block Errors				1	-	2		2			1,2	1	
Packing	1,2		1,2	1	2	-		1	1	2	1,2		1
Weighing Time				2			-			2	1		
Weighing Errors	1	1,2	2	1	2	1		-	1		1		1
File Sig	1		1	1,2		1		1	-	1,2	1,2	1	1,2
Coin I		2	2	2		2	2		1,2	-	2	2	
Sort Nail	1	1,2		1,2	1,2	1,2	1	1	1,2	2	-		1,2
Stamping Machine						1			1	2		-	
Coin II	2	2	2	1,2		1		1	1,2	1	1,2		-

* "1" indicates a significant correlation for the orthopedic disability group
"2" indicates a significant correlation for the other physical dis. group

Table 11

Test Intercorrelations

Orthopedic Disability Group*

	Raven	Purdue					Crawford		Tap I		Tap II		MCT	
		R	L	B	RLB	A	P	S	R	L	R	L	Nu	Na
Raven	–	.42	-.12	.12	.15	.37	.20	.16	.39	-.06	.49	-.03	.57	.56
Purd R	.42	–	-.33	.46	.48	.59	.14	.33	.50	-.43	.60	-.39	.46	.37
Purd L	-.12	-.33	–	.55	.62	.27	.22	.22	.03	.71	-.31	.61	-.29	-.28
Purd B	.12	.46	.55	–	.94	.67	.13	.36	.36	.35	.11	.28	.11	.12
Purd RLB	.15	.48	.62	.94	–	.71	.24	.37	.37	.33	.15	.24	.11	.08
Purd A	.37	.59	.27	.67	.71	–	.38	.52	.41	.03	.40	.01	.29	.31
Crfd P	.20	.14	.22	.13	.24	.38	.–	.62	.16	.07	.15	.00	.08	.02
Crfd S	.16	.33	.22	.36	.37	.52	.62	–	.35	-.01	.37	.04	-.01	-.06
Tap I R	.39	.50	.03	.36	.37	.41	.16	.35	–	.17	.84	.30	.32	.20
Tap I L	-.06	-.43	.71	.35	.33	.03	.07	-.01	.17	–	-.18	.90	-.35	-.32
Tap II R	.49	.60	-.31	.11	.15	.40	.15	.37	.84	-.18	–	.04	.39	.23
Tap II L	-.03	-.39	.61	.28	.24	.01	.00	.04	.30	.90	.04	–	-.32	-.35
MCT Nu	.57	.46	-.29	.11	.11	.29	.08	-.01	.32	-.35	.39	-.32	–	.83
MCT Na	.56	.37	-.28	.12	.08	.31	.02	-.06	.20	-.32	.23	-.35	.83	–

* Correlations equal to, or greater tham, .35 are significant at the .05 level and correlations of .45 are significant at the .01 level.

Table 12

Test Intercorrelations

Other Physical Disability Group*

	Raven	Purdue R	Purdue L	Purdue B	Purdue RLB	Purdue A	Crawford P	Crawford S	Tap I R	Tap I L	Tap II R	Tap II L	MCT Nu	MCT Na
Raven	-	-.11	-.02	.11	-.09	.09	-.06	-.09	-.07	-.01	.23	.17	.46	.42
Purd R	-.11	-	.65	.50	.78	.39	.40	.19	.10	-.10	.36	.14	.33	.30
Purd L	-.02	.65	-	.52	.82	.50	.36	.48	.14	.02	.19	.24	.32	.27
Purd B	.11	.50	.52	-	.82	.26	.60	.47	.15	.06	.32	.26	.73	.71
Purd RLB	-.09	.78	.82	.82	-	.45	.52	.42	.16	.02	.33	.25	.51	.41
Purd A	.09	.39	.50	.26	.45	-	.19	.29	-.28	-.07	-.31	-.15	.19	.17
Crfd P	-.06	.40	.36	.60	.52	.19	-	.45	.37	.28	.42	.42	.57	.46
Crfd S	-.09	.19	.48	.47	.42	.29	.45	-	.33	.43	.23	.50	.32	.32
Tap I R	-.07	.10	.14	.15	.16	-.28	.37	.33	-	.64	.56	.62	.03	.09
Tap I L	-.01	-.10	.02	.06	.02	-.07	.28	.43	.64	-	.44	.57	.12	.05
Tap II R	.23	.36	.19	.32	.33	-.31	.42	.23	.56	.44	-	.79	.42	.28
Tap II L	.17	.14	.24	.26	.25	-.15	.42	.50	.62	.57	.79	-	.22	.14
MCT Nu	.46	.33	.32	.73	.51	.19	.57	.32	.03	.12	.42	.22	-	.86
MCT Na	.42	.30	.27	.71	.41	.17	.46	.32	.09	.05	.28	.14	.86	-

* Correlations equal to, or greater tham, .35 are significant at the .05 level and correlations of .45 are significant at the .01 level.

Table 13

Locations of Significant (at .05 level) Test Intercorrelations

For the Two Disability Groups*

		Purdue					Crawford		Tap I		Tap II		MCT	
	Raven	R	L	B	RLB	A	P	S	R	L	R	L	Nu	Na
Raven	-	1				1			1		1		1,2	1,2
Purd R	1	-	2	1,2	1,2	1,2	2		1	1**	1,2	1**	1	1
Purd L		2	-	1,2	1,2	2	2	2		1		1		
Purd B		1,2	1,2	-	1,2	1	2	1,2	1	1			2	2
Pur RLB		1,2	1,2	1,2	-	1,2	2	1,2	1				2	2
Purd A	1	1,2	2	1	1,2	-	1	1	1		1			
Crfd P		2	2	2	2	1	-	1,2	2		2		2	2
Crfd S			2	1,2	1,2	1	1,2	-	1	2	1	2		
Tap IL	1	1		1	1	1	2	1	-	2	1,2	2		
Tap IL		1**	1	1				2	2	-	2	1,2	1**	
TapIIR	1	1,2			1		1,2	1	2	2	-	2	1,2	
TapII L		1**	1				2	2	2	1,2	2	-		1**
MCT Nu	1,2	1		2	2		2			1**	1,2		-	1,2
MCT Na	1,2	1		2	2		2						1,2	-

* "1" indicates a significant correlation for the orthopedic disability gp
"2" indicates a significant correlation for the other physical dis. gp.
** The significant correlation is in the negative direction

Table 14

Correlations between Job Sample Tasks and Tests

Orthopedic Disability Group*

	Nailing T	Nailing Acc	Nut	Con. Block T	Con. Block Acc	Pack	Weight T	Weight Acc	File Sig	Coin I	Sort Nail	Stamp	Coin II
Raven	.36	.29	-.03	.34	.21	.34	.22	.47	.39	.24	.50	.12	.24
PurdR	.40	.35	.40	.20	-.02	.57	.16	.41	.41	.15	.44	.35	.32
PurdL	.14	.22	.31	.04	.02	.21	.01	.03	.03	-.08	.09	.06	-.09
Purd B	.32	.37	.67	.21	-.13	.62	.00	.37	.30	-.01	.30	.20	.22
PurRB	.38	.45	.64	.20	-.08	.65	.06	.35	.33	.01	.42	.25	.19
PurdA	.52	.43	.54	.15	-.08	.65	.22	.61	.48	.07	.51	.45	.41
Crfd P	.58	.34	.22	-.11	.03	.30	-.10	.16	.37	.36	.15	.53	.24
CrfdS	.64	.29	.47	.05	.13	.44	.07	.22	.55	.37	.31	.52	.35
TapIR	.48	.55	.46	.39	-.07	.58	.10	.36	.43	.21	.54	.13	.19
TapI L	.12	.23	.23	.05	-.20	.02	-.19	-.20	-.14	-.21	-.14	-.20	-.35
TapIIR	.45	.40	.29	.37	.03	.46	.21	.35	.45	.27	.60	.20	.27
TapIIL	.11	.20	.15	.14	-.16	-.01	-.05	-.17	-.12	-.09	-.04	-.25	-.30
MCT Nu	.15	.10	.09	.41	.30	.51	.42	.67	.51	.31	.51	.20	.46
MCT Na	.08	.08	.08	.42	.18	.55	.23	.68	.43	.26	.42	.13	.45

* Correlations equal to, or greater than, .35 are significant at the .05 level and correlations .45 are significant at the .01 level.

Table 15

Correlations Between Job Sample Tasks and Tests

Other Physical Disability Group*

	Nailing		Nut	Con. Block		Pack	Weight		File	Coin	Sort	Stamp	Coin
	T	Acc		T	Acc		T	Acc	Sig	I	Nail		II
Raven	-.11	-.02	-.08	.46	.13	-.09	.49	.08	.13	.01	.09	-.09	.15
Purd R	.54	.44	.35	.26	.17	.50	.26	.02	.15	.37	.34	.16	.35
Purd L	.45	.55	.50	.48	.33	.31	.25	.28	.43	.60	.41	.21	.34
Purd B	.48	.33	.33	.38	.06	.60	.25	-.15	.25	.35	.37	.12	.41
Pur RLB	.52	.46	.48	.38	.21	.57	.23	.06	.29	.50	.41	.19	.41
Purd A	.31	.23	.31	.27	-.04	.22	.31	.15	.16	.23	.13	-.07	.46
Crfd P	.62	.39	.50	.25	.30	.47	.03	.06	.42	.41	.45	.34	.55
Crfd S	.34	.60	.28	.36	.11	.36	.14	.24	.37	.60	.50	-.07	.49
Tap IR	.14	.25	.35	.09	.39	.25	-.04	.22	.24	.40	.24	.15	.13
Tap IL	.19	.12	.14	.18	.24	.07	.14	.22	.22	.41	.22	.11	.26
Tap IIR	.22	.26	.08	.30	.36	.27	.16	.17	.21	.40	.38	.26	.24
Tap IIL	.30	.46	.15	.24	.33	.15	.07	.39	.27	.48	.39	.21	.38
MCT Nu	.42	.14	.13	.52	.12	.35	.48	-.28	.41	.31	.40	.28	.53
MCT Na	.32	.16	.02	.40	.07	.35	.53	-.32	.36	.30	.32	.20	.41

* Correlations equal to, or greater than, .35 are significant at the .05 level and correlations of .45 are significant at the .01 level.

Table 16

Locations of Significant (at .05 Level) Correlations Between the Job Sample Tasks and the Psychological Tests for the Two Disability Groups*

	Nailing T	Nailing Err	Nut	Con. Block T	Con. Block Err	Pack	Weight T	Weight Err	File Sig	Coin I	Sort Nail	Stamp	Coin II
Raven	1			2			2	1	1		1		
Purd R	1,2	1,2	1,2			1,2		1	1	2	1	1	2
Purd L	2	2	2	2					2	2	2		
Purd B	2	1	1	2		1,2		1		2	2		2
PurHB	1,2	1,2	1,2	2		1,2		1		2	1,2		2
Purd A	1	1	1			1		1	1		1	1	1,2
Crf P	1,2	2	2			2			1,2	1,2	2	1	2
Crf S	1	2	1	2		1,2			1,2	1,2	2	1	1,2
Tap IR	1	1	1,2	1	2	1		1	1	2	1		
Tap IL										2			1**
Tap IIR	1	1		1	2	1		1	1	2	1,2		
Tap IIL		2						2		2	2		2
MCT Nu	2			1,2		1,2	1,2	1	1,2		1,2		1,2
MCT Na				1,2		1,2	2	1	1,2		1		1,2

* "1" indicates a significant correlation for the orthpedic disability grp.
"2" indicates a significant correlation for the other physical disab. grp.

** The significant correlation is in the negative direction

CHAPTER V

DISCUSSION

PERFORMANCE DIFFERENCES

The first major null hypothesis, that there is no significant difference for the two disability groups on job sample task performance, may be rejected at the .05 level of confidence, or better, for four variables. These variables are: nailing brads-time, nailing brads-errors, nut and washer assembly, and connecting block-time. On these four variables the "other physical" disability group did better than the upper-extremity (orthopedic) disability group. These tasks require greater two-hand coordination than the remaining tasks. The only other task definitely requiring both hands is the packing task. However, involvement of the non-dominant hand extends only to holding the small envelope to be filled. Virtually all of the orthopedic group subjects had at least this amount of dexterity in their disabled hands. The stamping machine task requires two-hand coordination for optimum operation speed; nevertheless, it can be done with only one hand.

There was far greater involvement of upper extremity disability in the performance of the standard tests of manual dexterity. All of the Purdue Pegboard subtests and the Crawford Small Parts Dexterity test, both pins and screws, were significantly different at the .001 level of confidence. The left hand tapping tests are significantly different for the groups at least at the .05 level of confidence.

The fact that the standard manual dexterity tests are more sensitive to upper extremity disability than the job sample tasks does not seem to indicate that the job sample tasks require less in terms of manual dexterity. For instance, the file signals to be sorted are more difficult to pick up than the pins of the Purdue Pegboard, although the file signals are just dropped into the appropriate box rather than placed into tightly fitting holes as is the case with the Purdue Pegboard. Indeed, the difference appears to be more related to the length of the job sample tasks. The time limit for the Purdue Pegboard subtests Right, Left, and Both is 30 seconds for each. The Assembly subtest allows one minute. On the other hand the mean average time for the file signal sorting task is about five minutes. This possibly means that, given an average amount of dexterity in one hand, motivation becomes far more important a variable in file signals sorting than it does the Purdue Pegboard subtests. This hypothesis receives some support from the fact that the file signal sorting test is significantly correlated to the right hand test of the Purdue Pegboard and the right hand tapping tests only for the orthopedic group, but not for the group with other than orthopedic disabilities. This phenomenon could occur because the range of the one-hand manual dexterity is wider than that for the "other physical" group. This would tend to support the contention that, provided the dexterity is more average than below average, manual dexterity in longer tasks loses its importance in favor of motivation. Also the Crawford subtests, which average eight to fifteen minutes to do, are significantly correlated with the file signal sorting test for both groups, even though a motion study reveals that file signal sorting is far more related to the right hand test of the Purdue Pegboard than to either of the Crawford Small Parts Dexterity Tests.

The second major null hypothesis, that there would be no significant differences between the task scores due to the sex of the subjects, can be rejected in the case of only one task. The difference between the two groups' performances on the packaging task is at .001 level of confidence. The females performed better than the males.

On the psychological tests the males did significantly better on the two left-hand tapping tests at the..05 level of confidence or better. On the other hand the females did significantly better at the .01 level of confidence or better, on the two subtests of the Minnesota Clerical Test.

It is rather surprising that the females did not do significantly better than the males on the various tests of the Purdue Pegboard since such was found in the normative studies performed with the Purdue.

As can be seen in Appendix A there were no significant differences due to the interaction of disability and sex.

INTERCORRELATION MATRICES

It seems that one way of determining the existing relationships between the correlation matrices is to examine Tables 10, 13, and 16 in order to observe any differences in the patterning of the significant correlations for different variables. For instance, Coin sorting I seems to be related to the other sample tasks only for the "other physical" group. This task is significantly related to eight other job sample tasks for the "other physical" group, but to only two for the orthopedically disabled group.

Sorting file signals is the only task for which both groups show a significant correlation. Coin I and Coin II are significantly related only for the orthopedic group. This is interesting in view of the fact that the only difference in the demands of the two tasks is the size of the item to be inspected. In the case of the Coin I task the sorting is to be done on the basis of the presence or absence of a very small, less than one millimeter, mint mark on a penny. The difference used as a basis for sorting in the Coin II task is the entire design on the reverse side of a penny 18 millimeters in diameter. It would appear that Coin I, therefore, should be more related to the Minnesota Clerical Tests than Coin II. This is not the finding, however. Coin I is not significantly related to the Minnesota Clerical Test for either disability group while Coin II is significantly correlated with the MCT for both groups. Also Coin I is significantly related to the manual dexterity tests in general only for the "other physical" disability group. An attempted explanation of these unexpected results at this time would be premature.

The operation of the stamping machine is related to the other job sample tasks and the psychological tests only for the orthopedically disabled group. For the "other physical" group the stamping machine tasks do not seem to be related to the other tests. As with the file signal sorting tasks, the manual dexterity factor may be important in the performance of the stamping machine task only within a group of subjects where the range of dexterity is far greater than normal.

Likewise, the weighing task appears to be rather independent of the other tasks and tests in the battery for the "other Physical" disability group, but not for those orthopedically disabled.

As has been implied in much of the above discussion, the relationship of the subtests of the Purdue Pegboard to the other tasks and tests varies considerably between the two sample groups. For instance, the assembly test is related to the job sample tasks only for the orthopedic group, with the sole exception of Coin II for the "other physical" group. The left hand task of the Purdue Pegboard, on the contrary, is related significantly to the job sample tasks only for the "other physical" group. This latter finding is interesting in view of Fleishman's results as reported eirlier, that the left hand task was the one most highly loaded on manual dexterity. No doubt the disabilities of the orthopedic group interfered with this normally-found relationship. Moreover, in the same study Fleishman determined that the tapping factor is relatively distinct from manual dexterity, as measured by the Purdue Pegboard, for normal groups. In this study,however, there were were found to be significant correlations between the Purdue Pegboard and the Tapping tests for the orthopedic disability groups.

CHAPTER VI

SUMMARY

This research was indertaken in order to determine if there are significant differences in the performance of certain job sample tasks which are attributable to either the subjects physical disability or sex, the disabilities in this case being upper-extremity orthopedic disability and other physical disabilities.

The second purpose of the study was to determine, as far as possible from correlation matrices, if it appeared that the underlying factor structure of the measured abilities is similar.

The 60 subjects were divided into four groups of 15 subjects each as follows:

Male - Orthopedic disability

Female - Orthopedic disability

Male - Other physical disability

Female - Other physical disability

The subjects were given 10 sample tests which primarily involved either manual dexterity and/or perceptual speed; these 10 tasks yielded 13 variables since three of the tasks are scored for both speed and accuracy. They were also given five standard psychological tests, i. e., the Raven Progressive Matrices, the Purdue Pegboard, The Crawford Small Parts Dexterity Test, Tapping test, and the Minnesota Clerical Test. These five tests yield 14 variables.

The resulting scores for the individual job sample tasks and the tests were compared by the using of a two-way analysis of variances. The resulting F-ratios are shown in Appendix A. The inter-row differences are related to the sex of the subject. The intercorrelations for all 27 variables were computed for each of the two disabilities groups.

The results of the analysis of variance indicates that four jobs sample tasks variables and nine of the test variables are significantly different for the two disability groups. The results were interpreted in terms of the length of the tasks rather than the dexterity required. It was felt that as the tests increased greatly in length, the degree to which motivation entered as a significant factor increased with the concomitant decrease in the importance of dexterity.

The females performed significantly better on one of the job sample tasks, i. e. packing, and the two parts of the Minnesota Clerical Test. The males did better than the females on the two left hand tapping tests. The fact that variances on the Purdue Pegboard were not significant was surprising.

A comparison of the two intercorrelation matrices revealed certain decided differences in the location of significant correlations. It is felt that future factor analysis of work-related abilities should be done separately for subjects with upper extremity disabilities rather than including these subjects with the physical disabled.

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APPENDIX A

1. Nailing Brads TIME

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	728.017	1	728.017	4.246
Between Columns	109.350	1	109.350	0.638
Interaction	0.416	1	0.416	0.002
Within Cells	9601.200	56	171.450	
Total	10438.983	59		

2. Nailing Brads ERRORS

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	224.267	1	224.267	4.357
Between Columns	0.267	1	0.267	0.005
Interaction	4.267	1	4.267	0.083
Within Cells	2882.533	56	51.474	
Total	3111.333	59		

3. Nut and Washer Assembly

Components	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	992.267	1	992.267	16.788
Between Columns	56.067	1	56.067	0.949
Interaction	3.267	1	3.267	0.055
Within Cells	3310.000	56	59.107	
Total	4361.600	59		

4. Electronic Connecting Block Assembly TIME

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	8143.350	1	8143.350	6.912
Between Columns	1353.750	1	1353.750	1.149
Interaction	126.150	1	126.150	0.107
Within Cells	65973.333	56	1178.095	
Total	75596.583	59		

5. Electronic Connecting Block Assembly ERRORS

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	176.817	1	176.817	1.287
Between Columns	120.417	1	120.417	0.876
Interaction	322.017	1	322.017	2.343
Within Cells	7696.400	56	137.436	
Total	8315.650	59		

6. Packaging Small Parts

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	29084.167	1	29084.167	0.620
Between Columns	2058312.800	1	2058312.800	43.879
Interaction	1509.933	1	1509.933	0.032
Within Cells	2626887.300	56	46908.702	
Total	471594.200	59		

7. Weight Recording TIME

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	7.350	1	7.350	0.039
Between Columns	421.350	1	421.350	2.221
Interaction	132.016	1	132.016	0.696
Within Cells	10622.267	56	189.683	
Total	11182.983	59		

8. Weight Recording ERRORS

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	12.150	1	12.150	0.424
Between Columns	2.017	1	2.017	0.070
Interaction	66.150	1	66.150	3.306
Within Cells	1606.533	56	28.688	
Total	1686.850	59		

9. Sorting File Signals

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	10.417	1	10.417	1.728
Between Columns	18.150	1	18.150	3.011
Interaction	20.417	1	20.417	3.387
Within Cells	337.600	56	6.029	
Total	386.583	59		

10. Coin Sort Test - I

Components	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	256.267	1	256.267	1.499
Between Columns	166.667	1	166.667	0.975
Interaction	326.667	1	326.667	1.911
Within Cells	9574.000	56	170.964	
Total	10323.600	59		

11. Sorting Nails

Components	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	28.017	1	28.017	1.561
Between Columns	43.350	1	43.350	2.415
Interaction	66.150	1	66.150	3.685
Within Cells	1005.333	56	17.952	
Total	1142.850	59		

12. Stamping Machine Feeding

Components	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	540.000	1	540.000	3.193
Between Columns	264.600	1	264.600	1.564
Interaction	26.666	1	26.666	0.158
Within Cells	9475.067	56	169.198	
Total	10306.333	59		

13. Coin Sort - II

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	66.150	1	66.150	1.695
Between Columns	88.817	1	88.817	2.276
Interaction	126.150	1	126.150	3.232
Within Cells	2185.467	56	39.023	
Total	2466.583	59		

14. Raven

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	79.350	1	79.350	0.500
Between Columns	144.140	1	144.140	0.907
Interaction	7.350	1	7.350	0.046
Within Cells	8896.000	56	158.857	
Total	9126.850	59		

15. Purdue Pegboard - R

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	360.150	1	360.150	18.442
Between Columns	20.417	1	20.417	1.045
Interaction	0.417	1	0.417	0.021
Within Cells	1093.600	56	19.529	
Total	1474.583	59		

16. Purdue Pegboard - L

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	331.350	1	331.350	16.522
Between Columns	3.750	1	3.750	0.187
Interaction	40.017	1	40.017	0.995
Within Cells	1123.067	56	20.055	
Total	1498.183	59		

17. Purdue Pegboard - B

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	735.000	1	735.000	37.518
Between Columns	0.067	1	0.067	0.003
Interaction	48.600	1	48.600	2.481
Within Cells	1097.067	56	19.590	
Total	1880.733	59		

18. Purdue Pegboard - RLB

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	4200.067	1	4200.067	40.995
Between Columns	11.267	1	11.267	0.110
Interaction	91.266	1	91.266	0.891
Within Cells	5737.333	56	102.452	
Total	10039.933	59		

19. Purdue Pegboard - A

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	1664.267	1	1664.267	30.640
Between Columns	32.267	1	32.267	0.594
Interaction	45.067	1	45.067	0.830
Within Cells	3041.733	56	54.317	
Total	4783.333	59		

20. Crawford Small Parts - Pins

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	236.017	1	236.017	12.905
Between Columns	25.350	1	25.350	1.386
Interaction	12.150	1	12.150	0.664
Within Cells	1024.133	56	18.288	
Total	1297.650	59		

21. Crawford Small Parts - Screws

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	1161.600	1	1161.600	20.206
Between Columns	29.400	1	29.400	0.511
Interaction	29.400	1	29.400	0.511
Within Cells	3219.333	56	57.488	
Total	4439.733	59		

22. Tapping I - R

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	8120.067	1	8120.067	3.387
Between Columns	4100.267	1	4100.267	1.710
Interaction	6201.667	1	6201.667	2.586
Within Cells	134274.400	56	2397.757	
Total	152696.400	59		

23. Tapping I - L

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	11592.600	1	11592.600	5.491
Between Columns	22659.267	1	22659.267	10.733
Interaction	308.263	1	308.263	0.146
Within Cells	118220.800	56	2111.086	
Total	152780.930	59		

24. Tapping II - R

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	2898.150	1	2898.150	2.498
Between Columns	570.417	1	570.417	0.492
Interaction	1188.149	1	1188.149	1.024
Within Cells	64974.867	56	1160.283	
Total	69632.583	59		

25. Tapping II - L

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	7370.417	1	7370.417	7.633
Between Columns	6020.017	1	6020.017	6.235
Interaction	770.417	1	770.417	0.798
Within Cells	54070.800	56	965.550	
Total	68231.650	59		

26. Minnesota Clerical Test - Numbers

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	843.750	1	843.750	1.293
Between Columns	7866.150	1	7866.150	12.056
Interaction	10.417	1	10.417	0.016
Within Cells	36537.333	56	652.452	
Total	45257.650	59		

27. Minnesota Clerical Test - Names

Components	Sums of Squares	Degrees of Freedom	Mean Squares	F Ratios
Between Rows	62.017	1	62.017	0.075
Between Columns	6303.750	1	6303.750	7.602
Interaction	1083.750	1	1083.750	1.307
Within Cells	46436.133	56	829.217	
Total	53885.650	59		

APPROVAL SHEET

The dissertation submitted by Edward J. Hester has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the dissertation is now given final approval with reference to content, form, and mechanical accuracy.

The dissertation is therefore accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

June 17/69
Date

Signature of Adviser