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ABSTRACT

In the past two decades, significant advances have been made in understanding the vocational potential of severely physically impaired adults. However, instruments to evaluate the vocational ability of these persons have been scarce or unsuitable, and attempts to adapt existing instruments or to develop new methods of evaluating these persons have been fragmentary. In this report, a researcher from England, unfettered by the constraints of particular United States schools of thought, summarizes current thinking in the field of vocational evaluation of severely physically handicapped adults. The report summarizes traditional do's and don'ts that will be helpful to the beginning rehabilitation professional, while also including complex procedures which are new or those which vocational evaluators have tended not to adopt because of their complexity. Topics covered in the publication include (1) types of vocational evaluation, including pre-vocational evaluation, prescriptive evaluation, and predictive evaluation; (2) modifications to vocational evaluation tools, including discussion of psychometric tests, work samples and manual dexterity tests, and situational assessment and job tryouts; and (3) special techniques such as rehabilitation engineering, use of micro-motor analysis to establish motion times, and the Available Motions Inventory. A bibliography is included in the report. (KC)

VOCATIONAL EVALUATION OF SEVERELY PHYSICALLY IMPAIRED INDIVIDUALS:

Considerations and Techniques

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PREFACE

Traditionally, vocational evaluation has been a field that is pragmatic. It focuses upon what the individual could do in a given vocational setting. It has never been dogmatic by insisting that rigid procedures must be adhered to for the conduct of a "proper" vocational evaluation. Yet, certain expectations have been built up over the years concerning evaluation of the severely physically impaired. The rehabilitation system and vocational evaluation proponents have tended to screen out the severely physically impaired because of the seemingly impossible task of finding suitable employment. To a certain extent, the nature of employment in the private sector and lack of real technology for enhanced interface between severely physically impaired individuals and their environment have reinforced the negative perception of their vocational potential.

The times are changing and there is increased optimism among rehabilitation professionals, the private employment sector, and severely physically impaired individuals about vocational opportunities. More and more evaluators are being asked to assess the vocational potential of severely physically impaired individuals. Further, the private sector is moving rapidly in the area of higher technology and automation which opens up new doors for severely physically impaired individuals. The emergirg field of rehabilitation engineering and the spin-off application of space and military high technology in decreasing the dependency of the severely physically handicapped individual has provided further impetus for this optimism. There is, however, a noticeable gap between the changing vocational world and the ability of rehabilitation professionals to take full advantage of these changes.

The Research and Training Center at the University of Wisconsin-Stout has been one of those traditional proponents of vocational evaluation, but also a proponent which attempts to provide innovation and stimulation to the field. The opportunity arose to engage in a project which could provide for information and thought to stimulate innovation in the vocational assessment of the severely physically impaired individual. Also provided was a view of this problem from not only someone who was not a vocational evaluator, per se, but also not locked into the United States' view of provision of services.

The R&T Center, in cooperation with the University Center for International Rehabilitation and the Rehabilitation Counselor Education Program at Michigan State University, provided the opportunity for the author, Laurence A. Bates, to study in the United States and to specifically examine the problem of evaluating the severely physically impaired. Mr. Bates, who is currently completing his doctorate at Manchester University in England, completed this comprehensive report concerning considerations and techniques in evaluating severely physically impaired individuals.

I think that the reader will find that it provides a summary of current thinking in approaching the task from an open mind not constrained by the lexicon of our own rehabilitation system. In certain parts, the report summarizes traditional do's and don'ts which will be helpful to the beginning rehabilitation professional. In other sections, such as in "Specialized Techniques," complex procedures which are new or those which, by and large, vocational evaluators have tended not to adopt because of their complexity, will be found.

I would hope that, whether you are a vocational evaluator, rehabilitation counselor, professional in physical medicine and rehabilitation, administrator of various rehabilitation programs, or other concerned rehabilitation professional or consumer, you will find this report useful. The most important aspect of this report, however, is to focus attention upon the problems and prospects of those individuals with severe physical impairments and to heighten the need for enhancing techniques and procedures for evaluating their vocational potential.

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INTRODUCTION

In the past two decades, significant advances have been made in our understanding of the vocational potential of severely physically impaired adults. A number of studies have convincingly demonstrated that such people frequently have considerable rehabilitation potential (Geisler, et al., 1966; Rusk, 1963; Siegel, 1969; Mallik, 1979; Alfred, 1979). This fact, combined with the Rehabilitation Act of 1973 (PL 93-112 as amended by Pl 93-516) and recent technological advances in the fields of medicine, rehabilitation engineering, prosthetics, orthotics, placement techniques, etc., has led to a rapid increase in the number of severely physically impaired clients being referred for vocational evaluation.

The influx of more severely impaired clients to vocational evaluation centers has compelled many evaluators to apply considerable ingenuity in modifying their existing assessment techniques and devising adaptations for their work samples, etc. Unfortunately, as a recent preliminary survey* indicated, much of this work has been limited to individual centers and little has been achieved in the way of coordinating such efforts.

A follow-up survey conducted by the present author in conjunction with the University of Wisconsin-Stout, Research and Training Center, fully endorsed this view. It also indicated that vocational evaluators considered severely physically impaired clients to be the most difficult

*Peckham Vocational Industries, Lansing, Michigan.

group to evaluate and that evaluators were less satisfied with the evaluation tools for this group than for any other client category, except the visually impaired. In fact, approximately one third of the evaluation centers that responded indicated that they would like to be able to evaluate the vocational potential of severely physically impaired people but lack what they consider to be the necessary evaluation tools.

In addition, there is a growing feeling that the currently prevalent assessment techniques employed to evaluate the vocational potential of severely physically impaired clients tend to underestimate their abilities and emphasize their limitations (Rusalem, 1976; Schneck, 1976).

For example, as far as work samples are concerned, Schneck considers that, "We have completely disregarded the reason for success or failure by the individual--their individual functioning characteristics--which are of vital importance to providing additional services and allowing the clients' knowledge, skills and abilities to be more accurately paired with feasible employment opportunities. We eliminate possible opportunities for vocational choice by and for clients, based on misleading and incomplete information. We have not really assessed their strengths and weaknesses, but merely their weaknesses, if lack of exposure, training and practice can be classified as such." (p. 25)

Given the rapid expansion of evaluation services to severely physically impaired people, it might be expected that more appropriate vocational evaluation tools will soon be developed to meet the above mentioned needs as has happened with other disability groups, for example the mentally handicapped. Unfortunately, there is reason to believe that this will not be the case since the evaluation problem is inherently related to the

heterogeneous nature of the severely physically impaired population. In the past, vocational evaluators could usually rely upon standardized assessment tools that were developed for a fairly homogeneous group of clients and which required little, if any, modification to meet individual needs. This being the case, a particular client's performance in a certain area could be assessed and compared with an appropriate norm group to provide an estimate of relative ability. With severely physically impaired clients, however, modification of tests tends to be the norm rather than the exception. Furthermore, the adaptations required are of such a specific nature that it would be virtually impossible to construct a set of valid norms against which to compare a client's ability.

Given that evaluators cannot look forward to the widespread development of standardized tests for use with particular categories of physically impaired clients, it appears likely that they will be forced to continue modifying their tests on a local basis and then interpreting the results as best they can. Some sharing of information will, no doubt, become possible as modifications become more established at the local level. In general though, the author's recently conducted survey appears to indicate that evaluators are either unwilling to share their test modifications or, more likely, have not been able to devote sufficient time to develop them into a format that can be more widely communicated. This area, undoubtedly, deserves further research but at the moment it appears that the greatest need is to inform vocational evaluators about the potential effects of any modifications that they introduce into the presently available standardized tests. Otherwise, there is a fairly high risk of arriving at completely erroneous conclusions on the basis of the

results from modified tests. Vocational evaluation will probably always retain something of an art-like character, but there is no justification for not providing evaluators with the most up-to-date knowledge that is available about their evaluation tools. This is particularly the case in an age of accountability, where evaluators are increasingly being called upon to justify their findings and recommendations in court (Sink, 1980).

OBJECTIVES

Given the above mentioned needs relating to the vocational evaluation of severely physically impaired individuals, this document is intended to instruct evaluators about the various principles that should be considered when assessment tools are either modified or used for a purpose outside of their original intent. In addition, an attempt has been made to identify the occasions when modification to existing tests becomes more of a hindrance than an asset. In such cases, alternative assessment techniques have been suggested wherever possible. It should be remembered, however, that these are subject to confirmation and that much latitude exists for personal creativity and inventiveness.

INITIAL CONSIDERATIONS

The overall goals of vocational evaluation remain the same regardless of the particular type of client that is being evaluated. It seems reasonable to presume that virtually everyone who presents themselves for vocational evaluation desires to find a job that is optimally interesting and remunerative and which can be completed to the satisfaction of his or her employers. Traditionally in vocational evaluation, the accomplishment of this goal has involved a stepwise progression from initially examining a wide range of options to a focusing in on what is hoped will prove to be an optimal vocational choice. During this process, early decisions made on the basis of the client's interests, rule out the majority of possible career choices. The remaining options are then examined in the light of his or her particular abilities. Such a process is ideal if the client has a wide range of potentially successful options from which to choose. With many severely physically impaired people, however, this is not the case and evaluators should attempt to preserve options throughout the evaluation process regardless of whether they fall in widely dissimilar interest categories. One possible means of accomplishing this is to evaluate the client's abilities in each of the worker-trait factors used in the Dictionary of Occupational Titles (DOT), i.e., the ability to manipulate verbal and numerical data, the ability to communicate and interact with people and the ability to manipulate physical objects, including machinery. These abilities may be determined by means of traditional vocational tools and allow the evaluator to use the DOT to

identify job categories that the client may be able to succeed in. Interest still remains an important consideration, of course, but sorting on the basis of ability first, allows for the possibility of interest developing in areas which might not otherwise have been considered.

Another advantage of determining a severely physically impaired client's abilities in the above mentioned areas (i.e., data/people/things) is that it highlights whether or not the client has the ability to succeed in jobs which are heavily loaded on data manipulation skills. Research has demonstrated that such jobs tend to emphasize many severely physically impaired client's abilities rather than their limitations. For example, Knorr, et al., (1975) placed a number of severely physically impaired clients into data processing jobs and concluded that, "Since computer programming is primarily an intellectual exercise requiring manual effort only to read requirements, look up references, make notes, and record results, it was an obvious candidate as a vocation for physically disabled people." (p. 77) Mallik (1979) similarly placed 79 physically impaired clients in selected categories of jobs emphasizing data manipulation abilities. The fact that they earned a total of over $500,000 during their first year of employment, is a good indication of the lucrative nature of such jobs. In addition, recent advances in rehabilitation engineering technology have made computer use possible for even the most severely physically impaired person, including those that are homebound, as long as they are able to accomplish the intellectual requirements of the job. It seems reasonable, therefore, to give this vocational area special consideration for the more intelligent severely physically impaired clients, especially if they are young enough to benefit from a period of academic training.

The possibility of using rehabilitation engineering technology to modify jobs for severely physically impaired people introduces a further consideration that evaluators should be aware of. In the early days of vocational evaluation, the job requirements were relatively inflexible and clients were recommended for such jobs on the basis of them either having such abilities or being able to acquire them. The amended version of the 1973 Rehabilitation Act, however, requires that employers with federal contracts worth more than $2,500 per year, provide handicapped job applicants with "reasonable modification" to enable them to fulfill the job requirements, Evaluators, therefore, needs to be fully aware of the types of skills that can be readily compensated for by rehabilitation engineering techniques. This will radically expand the employment prospects of their severely physically impaired clients, especially where the use of machinery or small hand tools is concerned, since these can frequently be adapted to the abilities of the user (see later section for further details). Again, it is helpful if the evaluator has begun to think in terms of the client's ability to deal with data, people and things since rehabilitation engineering techniques have their greatest impact in the latter area.

TYPES OF VOCATIONAL EVALUATION

Before examining the principles involved in modifying vocational evaluation tools, it is useful to briefly consider the type of evaluation in which the tools are being used. Indeed, modification of such tools should never be considered out of context of the particular purpose for which they will be used. Certain modifications to a work sample, for example, may not significantly affect its use as an indicator of a client's general ability in a certain area, but at the same time, might completely invalidate the use of any norms associated with the work sample.

Vocational evaluation may be conveniently separated into the following three categories:

Pre-vocational Evaluation

In this type of evaluation, the primary goal is to establish the physical, emotional or psychological problems that need to be dealt with before the client's vocational potential can be accurately and reliably assessed. Zelle (1976) considered that the goals of pre-vocational evaluation are to gain preliminary insight into the client's vocational interest, general intelligence, physical capacity, special aptitudes and psychological adjustment, in order that his or her counselor can more accurately determine an optimal rehabilitation plan for them. In practice, this phase of the evaluation process may run concurrently with the next stage (Prescriptive Evaluation) until it has been established that a realistic assessment of the severely physically

impaired client's vocational potential, is not possible until certain specific physical, emotional and/or psychological adjustment problems have been dealt with. When this is the case, then the evaluaiton may be temporarily suspended and the client referred to another, more appropriate agency for counseling or further training, etc.

Prescriptive Evaluation

In this stage of the evaluation process, there is no fixed job opportunity for which the client is being assessed. One of the primary goals during this phase is to enable the client to make an optimal occupational choice which takes into account his or her interests, abilities, and functional limitations as well as local and national trends in the job market. Another important goal would be to provide the client's counselor with adequate information about aspects of the work environment that would either enhance or reduce the client's chances of success in a particular employment position. Ideally, this phase ought to begin before the client enters the evaluation facility. This would enable the resourceful evaluation center to accommodate itself to the client's unique characteristics. In this respect, White (1978) considers that, "When an applicant has identified him or herself as handicapped, the examining office should contact that person by phone or letter to determine what modifications, if any, may be required. Additional information, such as what modifications the client has used in previous testing situations and what modifications are available for the examination, can be exchanged at this time. Any reasonable request the applicant may have should be accommodated, if possible."

After considering the potential problems that the client might encounter in the evaluation setting, the vocational evaluation may begin to follow a more familiar pattern. Accurate information about the client's interests, abilities, and limitations then becomes the key to helping them make optimal vocational choices.

Predictive Evaluation

In this case, a specific job direction is under consideration. The evaluators primary goal is to provide both the client and his or her counselor with an estimated probability of job success. In addition, the evaluator may be able to recommend modifications or adaptations to the client's potential work environment, which would improve his or her chances of success.

If the severely physically impaired client is a new referral to the evaluation center, then the assessment is likely to involve many of the areas normally covered in the prescriptive evaluation. Should these already have been covered, however, then the procedure is considerably simplified. In either case, it will be necessary to obtain a comprehensive job analysis and an environmental condition and accessability report about the possible employment opportunity. Care should be taken that these include not only the general requirements but also the special conditions which occur less frequently such as a dusty atmosphere on Friday when the machines are being cleaned. These job requirements may not necessarily be inflexible, but they do provide a reasonable guideline against which to match the client's vocational abilities.

MODIFICATIONS TO VOCATIONAL EVALUATION TOOLS

Any discussion about possible modifications to vocational evaluation tools necessarily involves a trade-off between brevity and simplicity of application. For example, one possible option would be to list all of the more commonly used tools, along with possible modifications and their anticipated effect. Such an approach would certainly have some value but it would be extremely repetitive and may tend to stifle some of the more creative uses of the underlying principles to meet new situations as they arise. The following discussion will, therefore, be centered around groups of tests for which the same types of modification principles apply.

Psychometric Tests

Tests in this category are largely of the paper and pencil variety and include interest tests, intelligence tests, achievement tests and some aptitude tests. Each of them is intended to measure a particular aspect of a person's ability, but when they are applied to severely physically impaired people there are several ways in which they can inadvertently measure unrelated disability rather than relevant ability.

According to White (1978), "There are three major areas of concern regarding the (psychometric) testing of motor handicapped persons: (a) psychological factors related to the limited opportunity for social interaction frequently imposed by a handicap, (b) physical factors which must be considered when selecting test material and (c) changes in the psychometric properties of standardized tests which are modified

in some way to accommodate a handicap." This framework is so useful that it will be used to outline the important consideration for the selection and possible modification of psychometric tests.

Psychological Factors. One of the major psychological factors that should be considered when using psychometric tests to evaluate severely physically impaired clients, is test anxiety. A certain amount of anxiety is almost always associated with taking such tests, but this is likely to be much greater for this type of client. If the impairment is congenital or of long standing, then the client's opportunity for social interaction may have been severely restricted (Schlenoff, 1974). If this is the case, then the testing environment itself is likely to be anxiety provoking, especially during the first few days of evaluation (Anastasi, 1976; Reynell, 1970). On the other hand, if the impairment is the result of a fairly recent traumatic event, then the client's background level of anxiety will probably be high, even before the evaluation process begins (Gray, 1980). A small amount of anxiety may actually increase test scores. As this anxiety increases, however, it becomes a progressively greater distraction and will produce lower test scores (Schroder, 1967; Russell et al., 1975; Thomas, 1980). If it becomes apparent that the client is overly anxious before or during the test, then the evaluator should attempt to find methods of reducing this anxiety. In some cases, a short break may be sufficient. At other times, some counseling intervention may be necessary, and in extreme cases, relaxation techniques may need to be resorted to. Whatever the degree of anxiety, the evaluator should ensure that his relationship with the client is as supportive and accepting as possible.

Another psychological factor which should not be overlooked is motivation. Most timed psychometric tests assume that the client is motivated to complete the test items as soon as possible. This assumption is somewhat problematic with any rehabilitation client but especially so with severely physically impaired people. It should be remembered that they have very many concerns and succeeding at a vocational evaluation test or even getting a job may not be their highest priority. If this appears to be the case, then some of the competing concerns may need to be dealt with before evaluation can proceed.

Similarly, the evaluator should be concerned about the client's level of expectation about whether or not they will ever obtain a job. If this is very low then it might be worthwhile to provide them with information about research studies into job possibilities for severely physically impaired people (Alfred, 1979; Mallik, 1978; 1979). Seeing what is possible despite functional limitations might even be a useful means of motivating some clients.

A somewhat related problem is when clients appear to have a highly unrealistic job preference. They may be willing to modify this when they begin to consider a range of other options but if this is not the case, then it may be advisable to gain the assistance of someone who is familiar with the stages that many severely physically impaired clients pass through in adjusting to their disability. Otherwise, the evaluator may unknowingly do substantial psychological damage to some clients by forcing them to accept the reality of their situation before they have developed the necessary coping mechanisms required for satisfactory adjustment (See Shontz, 1975 for further information).

Physical Factors. Most psychometric tests make the assumption that the potential user is able to quickly record his or her answers to the various test items. With severely physically impaired clients, however, this is frequently not the case and special provisions must be made for this if their final results are to reflect their ability rather than disability. For example, if the client is to write his or her answers to test items, then the testing surface should be adjusted so that it is as comfortable as possible for them. It should also be fairly stable and have a high coefficient of friction so that the answer paper does not slide during the writing process. In addition, many tests employ computer read coding sheets which have tiny spaces in which to record answers. If this proves to be a problem for the client, then his or her answers can be recorded on a larger sheet (or set of sheets) and later transcribed onto the computer coding sheet by someone else. Ballpoint and felt-tip pens may be easier to write with and should be provided in addition to pencils. A typewriter or other writing aid should be considered if necessary (White, 1978). Another alternative, which some clients may prefer, is for a third person to do the answer recording in response to the client's verbal or other easily distinguished cue.

The client's reading ability should also be taken into consideration, since most psychometric tests require at least a fifth grade reading level. If this is not the case, then auditory presentation of the test may be considered or selection of another type of test (See Botterbusch, 1975; 1978 for details of the reading age required for selected psychometric tests). If the client has impaired vision, intensified lighting, magnification or a large print version of the test may be useful. Auditory

impairment is somewhat more difficult to accommodate for and if the evaluator is not confident about the client's level of comprehension, the use of a translator may be a possible option.

It should be remembered, of course, that altering the method of test presentation or answer recording will probably increase the time necessary to complete it. Depending upon the client's ability to concentrate for prolonged periods and/or susceptability to fatigue, it may be beneficial to allow them frequent, short rest periods. This will not present any undue problems if the test is not timed, but if it is, further complications arise. A decision must be made about whether the time restrictions may be waved without seriously effecting the implications of the overall test results. In this respect, White (1978) makes the point that, "the ability to perform certain tasks usually associated with test behaviors, especially with paper and pencil tests, is affected by the motor handicapped person's strength, coordination and stamina. The most apparent effects for the majority of motor handicapped persons are on speed of performance and susceptability to fatigue and, consequently, the use of tests which require timed, continuous adminstration to obtain meaningful results is almost categorically opposed (Allen, 1958; Allen and Collins, 1955; Anastasi, 1976; etc.)." If this is the case, then some means must be developed to distinguish between those tests which still remain valid after the timing limitations have been relaxed and those which do not.

After a review of the relevant research literature, White (1978) concludes that the results of power tests are not significantly effected when timing restrictions have been waved (Birch, et al., 1977), however, those of speed tests are completely invalidated. She defines the two types of tests in the following way:

> "A power test is designed to measure an individual's level of ability in relation to some mental factor such as reading comprehension, reasoning, or mathematical ability. The items assembled for such a test will range in difficulty so that some will be answered correctly by most of the applicants used and others may be solved by less than a third of them. (Some power tests may have all items at the same difficulty level). Time limits are usually set so that about 90% of the applicants have time to attempt each item. . .A speed test is made up of items which are so easy that, given enough time, 95% or more of the applicants would answer all of them correctly (Nunnally, 1967). Time limits for these tests are usually set so that only 50% of the applicants are able to attempt every item."

If a psychometric test normally has a timing restriction, then the evaluator must decide to what extent the client's score will be a reflection of his or her physical limitations rather than their mental ability. If this is more than just minimal and the test being considered is a speed test, then it should be dropped in favor of a more appropriate power test.

It should be noted that adaptations made to any type of test should be included in the client's final report. The evaluator may be held legally responsible for misleading presentations of test scores (Sink, 1980).

Psychometric Factors. Two interdependent sets of psychometric considerations need to be taken into account when using this type of test with severely physically impaired clients. The first is related to the inferences that can be made from the results if the test is not modified and the second to those that can be made if it is modified. In other words, against which set of norms should I compare the client's results if the test either is or is not modified? This can best be answered by first considering the case of vocational evaluation tests in

general. As far as these are concerned, Schneck (1976) asks the question "Should one client's performance be compared with other client's performance, actual worker's performance, or should it be compared at all during the vocational evaluation process?. . .If we are comparing an evaluation client's performance with other client's performance, does this mean that they will only have to compete with this group for jobs, or that we expect all persons with similar physical, mental, emotional, and socio-economic disadvantaged conditions to perform at the same level? This philosophy appears to meet the criterion of the 'self-fulfilling prophecy'. . ."Likewise, if we should try to compare an evaluation client's performance against the performance of an experienced, trained, and practiced worker, will we be depriving that individual of an option for choice in vocation, based on a lack of necessary training, experience, or work-site adjustment? Without allowing the client to develop knowledges, skills and abilities necessary for job success, along with provision of job restructuring and work simplification procedures where needed, we are also providing the simplest of answers to the 'self-fulfilling prophecy'."

In general, therefore, norms based upon other clients or upon industrial standards are not likely to be appropriate. Ideally, such norms ought to be based upon the people with whom the client is likely to be competing for a particular job. Unfortunately, such norms are seldom available for the majority of vocational evaluation tests so that the evaluator must learn to glean whatever information that he or she can from the available psychometric test norms.

Unfortunately, the question about the norms appropriate for modified psychometric tests is even more complex and depends largely upon the purpose of the test and whether this is in any way altered by the modification. White (1978) considers that the research literature on the topic, "tends to support the assertion that, to the extent that an instrument is a power test, minor adjustments in examining procedures will not significantly alter the psychometric properties of the instrument." In other words, as long as the modifications do not alter what the test is intended to measure, then they shouldn't significantly affect the test results. In fact, it is likely that not modifying a test for a person whose functional limitations will bias the results, will lead to greater error than modifying it. For example, White (1978) considers that, "It is evident that the administration of an ability test to a motor handicapped individual under timed conditions or without other modifications needed by that individual will certainly reflect the interference of the motor handicap, thus altering the factor composition of the score. Although some modifications of examining procedures affect to a certain extent the factor composition of test scores, there can be little doubt that without such modifications, when they are necessary, no fair assessment of a motor handicapped person's mental abilities can occur." Modifications to psychometric tests, therefore, may be essential when they are used with severely physically impaired clients, in order for the tests to fulfill their intended functions. Any modification, however, should be very critically examined to ensure that they do not alter the test's factor composition. For example, if a client is very unfamiliar with psychometric tests in general, then he or she is at a disadvantage when

their results are compared with the normal population. It would obviously be inappropriate, though, to coach the client or let him or her practice on the test items since this would introduce a learning factor into the final test results. It might be possible, however, to let the client practice on a different type of test in order to gain the baseline experience that other nondisabled test-takers have accumulated over a period of time.

Another psychometric consideration of vital importance is the need to ensure that the client fully understands what is expected of them before they undertake a particular test. Ideally, such tests should be done on a one-to-one basis with clients so that freqeunt checks can be made on whether they understand the instructions. This will also allow the evaluator or someone else, to be present when a pencil is dropped or some other minor crisis occurs which could invalidate the time scores if not dealt with fairly promptly.

Work Samples and Manual Dexterity Tests

Work samples are exactly what their name implies. They are samples of work which closely resemble actual operations performed in industrial or other vocational settings. As such, they test a wide range of different abilities, some of which are very similar to those evaluated using certain psychometric tests. For example, the Valpar 'Clerical Comprehension and Aptitude Test' is concerned with both mental and practical ability. To the extent that it evaluates mental ability, many of the considerations relating to psychometric tests will apply and will, therefore, not be reiterated in this section. Evaluators interested in modifying such work samples are recommended to apply the same principles that are outlined

in the section on modifying psychometric tests. This section is more concerned with those work samples or aspects of work samples which primarily measure manual ability. As such, its considerations will also apply to manual dexterity tests.

Evaluating a severely physically impaired client's manual ability by means of work samples or manual dexterity tests is one of the areas in which evaluators experience considerable difficulty. Virtually all of the modifications reported by evaluators in the previously mentioned survey, fall into this category. This is hardly surprising considering the fact that, even at the theoretical level, there are a wide range of issues that have not yet been adequately resolved. For example, which norms should be used or should any be used at all? Should the client be allowed to practice on the work sample or manual dexterity test in order to compensate for their limited industrial experience? If so, how much practice is necessary? What do we do if the client's functional limitations preclude the use of virtually all the major work samples? Should the work samples be modified or should the client be allowed to use adaptive devices? If so, to what extent? (Remembering that it is conceivable for a whole automobile assembly plant to be operated by the single touch of a button).

Some of these difficulties, although by no means all, can be resolved by choosing the correct type of vocational evaluation task to measure the client's object-manipulation ability. For example, if a client can accomplish every aspect of a work sample except the parts requiring very fine eye-hand coordination, does that mean that he or she is incapable of doing that type of job? What about all the other abilities that enabled the client to complete the rest of the work sample? Should one functional limitation be allowed to nullify all their positive poten-

tial? Certainly not, but what if the client could only accomplish half of the work sample or manual dexterity test? The point being made is that any test which involves a large number of actions has the potential to magnify a client's disabilities rather than measure their abilities. For some severely physically impaired clients, it will, therefore, be completely inappropriate to present them with work samples that require a particular ability that they don't possess.

The above mentioned problem with work samples and manual dexterity tests, may be resolved in several different ways, depending upon whether the tools are being used in the prescriptive or predictive phase of vocational evaluation. In the latter case, the number of work samples being considered is fairly limited since, by definition, a possible job area has already been selected. It may be appropriate, therefore, to use some form of task analysis to identify the particular aspects of the work sample that the severely physically impaired client experiences difficulty with. This information can then be discussed with a rehabilitation engineer or job modification specialist if necessary.

Task analysis is ideally suited to situations where there are a limited number of job options under consideration. If this is not the case, however, then task analysis becomes a somewhat cumbersome tool which presents the evaluator with a large amount of information that is difficult to relate together or to reduce down to a manageable size. In a prescriptive evaluation, it may be more useful, therefore, to combine the use of work samples with a system which identifies and categorizes the particular elemental notions which the client finds difficult to accomplish. Both M.T.M. and M.O.D.A.P.T.S. have been used to accomplish

this (Todd, et al., 1975; Hume, 1973; Drewes, 1961; Paulhe, 1965; Thompson, et al., 1963). These techniques are fairly time consuming and should not be used with all clients, but they are especially useful for severely physically impaired people who experience difficulty with complex work samples. The vocational evaluator, therefore, ought to be capable of using a range of techniques to measure a severely physically impaired client's ability to manipulate objects. These techniques will be discussed under the headings, Work Samples, Macro-Motor analysis, and Micro-Motor analysis.

Work Samples. For some severely physically impaired clients, work samples will not present any undue problem. Their physical limitations are such that they can accomplish all aspects of a task, although possibly at a slower rate than the industrial standard. Other clients may be able to attempt the work sample as long as a particular prosthetic, orthotic or other adaptive aid is available. In each of these cases, it does not appear to be unreasonable to judge the client's performance by the accepted normative standards as long as the content of the work sample is not altered. Employers are legally mandated to allow severely impaired people to use "reasonable accommodation" in order to perform their job satisfactorily, so that their use of prosthetic devices, etc., when completing work samples, should not present any methodological problems. It is strongly recommended, however, that the vocational evaluator record the use of such adaptive devices alongside the work sample performance scores in the client's final report.

As indicated earlier, a problem may arise when we begin to consider the complexity of adaptive devices that the severely physically impaired person may use when completing a work sample. The solution, unfortunately,

will vary from situation to situation and depends largely upon what the client's future employer will accept as a "reasonable accommodation." On a theoretical level, this problem is a somewhat intractable one but the solution is likely to be fairly evident in practice.

Another equally intractable problem is related to the work sample norms which severely physically impaired clients should be rated against. For reasons mentioned earlier in the section on psychometric tests, neither the industrial norms nor those based upon other rehabilitation clients are appropriate (Schneck, 1976). Ideally, the client's performance should be matched with normative scores based upon the population with whom he or she will be in competition with in the job market. Unfortunately, as mentioned earlier, such norms are virtually impossible to obtain. Neither is it possible to develop such norms based upon elemental motion analysis such as M.T.M. or M.O.D.A.P.T.S. Chaffin (1966) demonstrated that the difference between initial performance scores and the industrial standard, as computed using M.T.M. depends upon the complexity of the job and is not possible to predict with any acceptable degree of accuracy. It should be noted, however, that this particular problem is not unique to the vocational evaluation of severely physically impaired clients, but is common to virtually all other rehabilitation clients also. One theoretical solution to the problem is to allow the client to practice completing the work sample before his or her final score is recorded and compared with the standard industrial norms. Unfortunately, however, research strongly suggests that the amount of practice required is greatly in excess of that allowable in the standard vocational evaluation program (Dunn, 1976). Evaluators are, therefore, highly recommended to exercise great

caution when interpreting work sample scores, whether for severely physically impaired clients or, indeed, any other rehabilitation client.

Despite the norming problem, work samples do have considerable value, especially if the evaluator is able to closely supervise the client's performance. A considerable amount can be learned from the types of errors that the client makes and the work attitude that he or she displays while completing the task. It should also be possible to determine whether the work sample should be modified or whether macro or micro-motor analysis would be more appropriate.

There are essentially two aspects of a work sample that may be modified. These can be separated along the lines of the client's input and output (Thomas, 1980). The input category includes all the instructions given to the client which direct what he or she actually does, or in other words, their output. It is essential to conceptually separate these aspects of the work sample since output is usually regarded as a measure of ability but is, nevertheless, heavily dependent upon input. If the client does not understand the instructions adequately, then their performance is not a valid measure of their object manipulation ability.

One of the values of separating work sample modifications into the broad categories of input and output is that it can generally be assumed that input modifications do not invalidate the use of the standardized work sample norms. The effects of output modification, however, are somewhat less predictable in this respect. The criterion for input modification should be the client's understanding of what he or she is being asked to do. This can be checked by either direct observation or

by asking the client to briefly outline what they think they should be doing. If the client's understanding is adequate, then his performance can be expected to be an indication of his or her ability and may be rated against whichever norms are considered to be appropriate. As a safeguard against misunderstandings, though, even input modifications should be indicated in the client's final report.

Output modifications range from simple rearrangement of the work sample, to completely altering the tools of construction method used. Such modifications clearly invalidate the use of the original work sample norms. Moreover, since such adaptations are likely to be constructed on an individual basis, then re-norming is neither possible nor desirable (Dunn, 1976). In such cases, the use of macro or micro-motor analysis may be a more preferable option. It may, on occasion, however, be possible to modify a work sample such that a wide range of clients, or potential clients would benefit. It would still be impractical to re-norm the modified work sample, but the effects of the modification may be assessed by allowing a number of people (at least twenty and preferably considerably more) to complete both the original and modified work samples. (NOTE: The order of presentation should be randomized so that half complete the original work sample first and the other half the modified work sample). A comparison of the results for both work samples should provide a reasonable indication about how the standardized norms are effected by the modifications.

One important modification that doesn't fall conveniently into either the input or output category, is time. If the work sample is timed, should the client be allowed to continue beyond the time limits? It would appear that the best solution to this is to stop the client after

the time limit and record his or her progress (Thomas, 1980). They can then be left to continue so that two sets of data are obtained from the one work sample.

Macro-Motor Analysis. Macro-motor analysis is a means of evaluating the severely physically impaired client's physical capacity. It includes muscle strength, manual and finger dexterity, perceptual-motor coordination and range of motion, etc. The value of clearly defining a rehabilitation client's physical capacity has long been recognized (Cranfield, 1947), and various attempts have been made to match this information to the demands of a potential job. This has led to the development of a whole range of checklists and test batteries which tend to have either a medical or vocational orientation. Those in the first category are outside the scope of this document, but the reader is referred to a very recent state-of-the-art review in the area of functional limitations conducted by Indices, Inc. (1980). In addition, the works of Sokolov, et al., (1966), Walls, et al., (1979a, 1979b), and Westerway, et al., (1977) are particularly recommended in this area.

Commercial attempts at macro-motor analysis tend to have a vocational orientation and include the Crawford Small Parts Test, the Hester Evaluation System, Bennett Hand-Tool Dexterity Test, Purdue Pegboard, Scales K. F. and M. of the General Aptitude Test Battery and many others. The techniques for using or modifying these tests for severely physically impaired clients are fairly similar to those presented in the work sample section. The primary difference is that these tests are usually somewhat less complex than most work samples and, therefore, there is less likelihood of magnifying the client's inabilities via the previously outlined process.

care should, nevertheless, be taken to evaluate the reasons for the severely physically impaired client's poor performance or failure on a particular test. Often, this yields a considerable amount of information about the client's functional limitation and may indicate that micro-motor analysis would be more suitable.

One of the more recent and, therefore, less well-known means of macro-motor analysis is the "Available Motions Inventory for Evaluation of Physical Capability (1980)." This allows measurement of the client's ability to manipulate a wide variety of switches, handwheels, levers, etc., in various spatial locations. It also includes objective measurement of his or her pinch, grip and arm strength plus range of motion determination in the horizontal and vertical plane. Since it is specifically designed for severely physically impaired clients, it requires little, if any, modification. (A more thorough analysis of this technique can be found in the special techniques section of the document.)

One of the major disadvantages of macro-motor analysis techniques is that it is virtually impossible to assess how much of a particular ability is required for a specified job or even range of jobs. The evaluator must utilize a considerable amount of personal knowledge and intuition about how various jobs are performed in industry. One way of overcoming this problem is to use micro-motor analysis, since many industrial jobs, particularly the simple, repetitive variety, have been analyzed using Methods-Time-Measurement (MTM) techniques.

Micro-Motor Analysis. Micro-motor analysis is a means of summarizing a person's object manipulation ability in terms of the elemental motions required to reach, grasp, move and position an object during a simple, repetitive work cycle. Various systems have developed in industry as a

means of establishing time standards for the completion of manual tasks. These include Methods-Time-Measurement (M.T.M.), Modular Arranged Predetermined Time Standards (MODAPTS), Master Standard Data, Basic Motion Time Study, Dimensional Motion Times, etc. Of these, MTM appears to be the most widely accepted, and is available in several different versions ranging from the fairly elaborate MTM (1) version to the much more condensed MTM (3). For the purpose of micro-motor analysis, MTM version two is most ideal in that it combines simplicity with the ability to distinguish between important work related motions. MTM (2) will be, therefore, referred to extensively throughout the discussion on micro-motor analysis. It is briefly defined as "a procedure which analyzes any manual operation or method into the basic motions required to perform it, and assigns to each motion a predetermined time standard whose duration stems from the nature of the motion and the conditions under which it is made" (Todd, et al., 1975).

Before embarking upon a study of micro-motor analysis, it should be realized that to the author's knowelidge, no comprehensive system for the vocational evaluation of severely physically impaired clients is, at present, commercially available. An examination of the research literature, however, reveals that during the 1960's several researchers demonstrated the value of such a system and began to make preliminary attempts to design one (Drewes, 1961; Paulhe, 1965; Thompson, et al., 1963). Unfortunately, these attempts were somewhat ahead of their time and apparently floundered through lack of financial support. At that time, very few severely physically impaired people were being seriously considered for open employment so that the research succeeded only in providing answers to questions that people were not yet ready to ask. Even more unfortunately,

now that legislation mandates consideration of the vocational potential of severely physically impaired adults, the above mentioned line of research has been virtually forgotten, at least as far as the USA is concerned. Other countries, including Australia, Japan and Sweden seem to have been more fortunate in their timing of sociological concerns and technological innovations and appear to be considerably more advanced in their use of systems for micro-motor analysis (Hasselquist, 1972; Hume, 1971; 1972; 1973;1980; Bootle, 1976).

Despite the disadvantage of not being able to purchase a ready-made, fully integrated system of micro-motor analysis, the advantages of using at least the elements of such a system are too extensive to be ignored, especially for those severely physically impaired clients who are forced to consider a manual job due to lack of expertise in other areas.

One particular advantage of micro-motor analysis systems such as MTM (2) is that they not only identify which element of a job a client is unable to accomplish, but unlike task analysis, they also categorize this information into a limited number of elements which are highly generalizable to other manual work. This is a particular benefit when a potential manual job has already been broken down into MTM (2) units, as is frequently the case. This not only allows the examiner to quickly determine where the potential problem areas are likely to occur, but it also communicates to employers exactly what the client's manual abilities are in terms that they are already familiar with.

A further advantage of MTM (2) is that there is reason to believe that the system provides valid and accurate norms. The problems inherent in either client-based or industrial norms, for work samples or macro-motor analysis, have already been outlined. For both of these types of tests, it is virtually impossible to obtain norms based upon the population with

whom the severely physically impaired client is in competition in the job market. Micro-motor analysis, however, offers evaluators a very close approximation to this ideal since individual MTM elements can be timed in job sequences that are so short that very little practice is required for the client to reach their optimal performance. These times can then be compared with the industrial standards. In addition, research suggests that the times taken to accomplish individual MTM (2) elements can be added together to provide an estimate of a person's final speed at a particular job, although the amount of practice required to accomplish this speed will increase in relationship to the number of different elements. (Chaffin, et al., 1966). (NOTE: Possible methods for determining a client's speed on individual MTM (2) elements are discussed in the special techniques section of this document.)

A further advantage of the use of MTM (2) is that it can be expected to promote valuable research. Very little research effort has been devoted to the vocational evaluation of severely physically impaired clients because it has been assumed that no single test could be used for such a wide variety of abilities and limitations. In reducing the measurement components down to very basic levels, however, micro-motor analysis offers the possibility of comparing test scores and subsequent vocational outcomes for a wide variety of clients. An empirical basis for decision-making in evaluation is long overdue and any means of establishing one should not be overlooked.

After noting the advantages of micro-motor anlaysis, it must be remembered that its use is not in any sense a panacea. The technique involves much more time and one-to-one involvement with clients than the

more traditional evaluation techniques. Its use can best be justified for a specific class of severely physically impaired clients for whom work sample and manual dexterity tests are not appropriate for reasons discussed earlier. It should also be remembered that micro-motor analysis is a highly specialized technique and if the client has above average ability to work with people or manipulate data, then such an exact analysis may not be necessary. It is particularly recommended, however, for the clients who are likely to find their optimal vocational choice amongst jobs which are highly loaded in the DOT "things" category.

Situational Assessment and Job Tryouts

Situational assessment and job tryouts might, in some sense, be considered to be extremely complex examples of work samples. In this sense, some of the previous considerations will apply to those aspects of them that assess a person's mental and physical abilities. In addition, however, both situational assessment and job tryouts are excellent techniques for assessing a client's ability to work with other people and his or her attitude to work, supervision, time-keeping, etc. These aspects of the severely physically impaired client's abilities are extremely important since, according to Neff (1976), "It is probably not too much to say that many people leave their jobs or are fired, as often because they cannot behave to their colleagues in expected ways, as because they lack the requisite work skills, . . .it has been found that more jobs are lost because disabled (as well as other) people cannot behave as required while at work than because of skill or ability defects." All clients, therefore, ought to have their abilities evaluated in these critical areas, particularly those with severe physical impairment. Schlenoff (1977) has indicated that limitations in mobility often limit such peoples' opportunity for

social interaction, especially if the impairment is congenital or very long in duration. In addition, the different set of life experiences can tend to isolate a severly physically impaired person from his or her co-workers and result in varying degrees of alienation (Neff, 1976).

Despite the potential value of situational assessment and job tryouts, it is important to remember that they must be exteremely well planned and coordinated if they are to accomplish any of their objectives. This is especially the case where job tryouts are to be held in a setting that is unfamiliar to the client. Such situations are likely to cause considerable anxiety to many severely physically impaired people since they are unaware of what to expect and what resources are available to assist them should the need arise. One particularly important aspect of the planning, therefore, is that a resource person be located within the occupational setting, to whom the client can turn for advice or assistance. This person should also be informed about the need for reliable data collection during the client's stay, and how to best accomplish this. Job tryouts do not necessarily imply eventual employment for the client, but if they are well documented, then the time spent will not have been wasted.

In addition to collecting information about the client, both situational assessment and job tryouts can be especially valuable in providing severely physically impaired people with feedback about their abilities and in encouraging them to realize that they are able to play a productive part within society. These aspects are particularly important for recently injured clients who previously held fairly responsible positions in either industry or some other organization. Self confidence does not assure success, but lack of it can make a significant contribution to failure.

Another advantage of a job tryout is that it helps to provide the potential employer with a sense of security in knowing that there are resources that can be drawn upon if difficulties arise during the initial stages of employment. This is particularly valuable to the client's long term employment since many difficulties experienced at work are fairly simple to resolve given a certain amount of resourcefulness and tact. It is important to remember, though, that subjecting both the client and potential employer to lengthy job tryouts when there is low probability of job success, is both tiresome and counter-productive. An employer will eventually lose interest in employing a person with severe physical limitations if they are constantly presented with those who obviously do not meet the job criterion. Similarly, the client is less likely to be motivated in the future if his hopes of employment have been repeatedly raised and then thwarted.

SPECIAL TECHNIQUES

Rehabilitation Engineering

Throughout this document, reference has been made to the particular skills that a rehabilitation engineer can add to the vocational evaluation process of severely physically impaired clients or to the modification of their eventual job. A prolonged period of study is necessary in order to gain a thorough group of these skills. Nevertheless, the vocational evaluator will find it helpful to understand at least some of the basic contributions that such an engineer can make.

One of the skills that a rehabilitation engineer can be expected to possess is a thorough knowledge of environemntal changes that may need to be made to an occupational setting in order for a severely physically impaired worker to make optimal use of it. For example, Brolin, et al., (1978) asked, "Can the workplace be made accessible to the handicapped worker? Can special changes be made in the work environment in the areas of seating, lighting, sound and location which will accommodate the special disability of the worker? And, can these changes be made at a minimum cost to the employer while permitting the handicapped employee the opportunity to maintain competitive productivity?" (p. 8)

In addition to suggesting modifications to the client's potential job environment, the rehabilitation engineer will typically be able to offer suggestions about the physical layout of the job iteself or perhaps about the sequencing of its operations. Smith (1978) for example, was able to offer the following six principles of design for jobs involving disabled workers:

1. Keep the design simple.
2. Eliminate grasp wherever possible. Keep grasps that cannot be eliminated as simple as possible.
3. Use power or powers assist whenever reasonable.
4. Use holding features whenever possible.
5. Select tables and machinery for seated operation.
6. Cut materials handling to a minimum.

Similarly, rehabilitation engineers will usually be aware of modern technology in the form of prosthetics, or orthotics that can be provided to the severely physically handicapped person in order to increase their vocational potential. These include a variety of tools intended for mouthstick users, a range of wheelchairs to meet varying circumstances, and complete information about whatever supports and/or cushion the client may need to increase his or her stability at the workstation and reduce the incidence of tissue breakdown.

Brolin, et al., (1978) contends that the primary purpose of rehabilitation engineering is to, "decrease the list of 'cannots' which tend to severely restrict the number of vocational choices a handicapped person can make." They, therefore, suggest vocational evaluators consider the following list of questions when analyzing the performance of clients on particular tasks:

- "Can changes be made in the job which will make it more accessible to the worker?
- Can adjustments be made in seating, lighting, or work station which will allow the worker to increase productivity?
- Can the job be redesigned to meet the individual's needs?

- Can the job be restructured or broken down into smaller units? How much of the job can the person do?
- Can the individual do the task with other tools or machinery?
- Can the equipment be reengineered?
- What prosthetic devices can be used to help the individual accomplish the task?
- Can we realistically expect the potential employer to make accommodation for these modifications?" (p. 11)

Consideration of these questions will enable the vocational evaluator to determine whether the skills of a rehabilitation engineer would be helpful for a particular client.

Use of MTM (2) to Establish Elemental Motion Times

One of the initial steps in micro-motor analysis is the identification of which elemental motions the severely physically impaired client either cannot do or has difficulty with. For this purpose, almost any work sample can be used which has been broken down into MTM (2) components. It is preferable, however, to select a range of tasks which encompass as many as possible of the elemental motions. This can be done with the aid of an engineer who is qualified in MTM analysis, or an evaluator who has been on an approved MTM (2) course. Repeated observation of the client's performance should indicate the relevant areas of difficulty.

After establishing the client's particular configuration of ability and limitations with respect to object-manipulation, the next stage is quantification. MTM (2) motions are conveniently sectioned into the categories of: Reach; Grasp; Move; Turn and Apply Pressure; Position; Release; Disengage; Eye Travel; and Body, leg, and foot motions. These will be considered separately since somewhat different methods are used for quantification.

Reach. The MTM (2) category of reach is subdivided into separate time units depending on the length of reach, type and position of object reached to (five defined classes) and whether the hand was previously in motion. For the purposes of vocational evaluation, it is usually sufficient to establish the severely physically impaired client's limit of reach in both the horizontal and vertical planes, while seated at a bench. The Available Motions Inventory (AMI) method of establishing length of reach is to systematically map it out, for each arm, on boards set at varying angles in front of the client. This is more than adequate for the present purposes. Smith (1979) has developed a more elaborate method using the Range of Motions Sensor (ROMS) but since this involves the use of computer facilities, it is more useful as a research tool than an evaluation procedure.

It is also possible to quantify the client's speed of reaching to an object by using a reaction timing device with the switch positioned at different distances from the hand. The difference between the two average times is the amount of time it took the client to reach the extra distance. The switch can also be made very large or very small to assess the effect of reaching to objects in a general or specific location. Using this procedure, it should be possible to evaluate the client's efficiency of reaching as compared with the MTM (2) established norms. It must be remembered, however, that the industrial standard is generally 15% higher than the MTM time to allow for rest breaks, etc.

Move. The method for assessing the client's reaching ability could also be adapted to measure his or her ability to move different sized objects to various locations. In this case, the average time of movement from B to C could be computed by comparing the time it took to move an

object from A to C, with the time to pick up the same object at A and then simply drop it into a hole at B. Varying the distance moved and weight of object would enable comparisons between the client's performance and the MTM industrial standards.

Grasp. The MTM (2) category of grasp is divided into ten subsections, depending upon the size and location of the object to be grasped. The client's efficiency of grasp can be fairly easily established using a similar principle to that utilized in the "move" section. In this case, the client would pick up an object and move it perhaps eight inches. After establishing his average time to do this, he or she could be asked to move the same object sixteen inches (double the original length). Subtracting the difference in times from the original score (i.e., the 8 inch move) should give a reasonable indication of the client's time to grasp a particular type of object.

Turn and Apply Pressure. The client's ability to apply pressure is probably best measured via the pinch and grip tests utilized in the Available Motions Inventory. Time to turn objects of various weight could be established by a similar method to the one used in the "move" section.

Position. This category is certainly one of the more difficult to measure accurately. It requires having a range of symmetrical, partially symmetrical and non-symmetrical objects which fit into loose, close fit and exact fit holes. Drewes (1961) developed a modified version of the Purdue Pegboard (Purdue Elemental Motions Test) using various shaped pegs which fitted into holes of different shapes and sizes. He convincingly demonstrated the feasibility and usefulness of this approach, but, unfortunately, concentrated on pegs and holes that required fairly exact machinings. The

fact that this test has not subsequently been made commercially available (to the author's knoweldge), is probably an indication that the cost of production was too high. A more economical approach would be to use readily available 'pegs and sockets' of standard size. These could include hexagonal sockets, nuts, bolts, spacers, pipe and rod sections, beads, bobbins, flashlight batteries, marbles, childrens' peg-in-hole games, felt tip pen tops, golf tees, paper clips, small bayonet type bulbs and their sockets, etc. The list is virtually endless and theoretically at least, MTM (2) ought to be able to categorize each combination of object and socket into a particular class of symmetry and fit. Since there are only 18 different subsections within the "position" category, it should not be too difficult to find an easily replicable example of each category. After this had been achieved, measuring the client's ability to position objects and subsequently relating this to the MTM standard, would be a relatively simple and inexpensive procedure.

Eye travel time and eye focus. Provided that the client does not have substantial visual impairments, the standard MTM (2) method of computing this could be followed. Since this is related to the objects being focused upon rather than the person doing the focusing, comparison of these times would be meaningless.

Body, leg and foot motions. SPI clients are likely to have substantial impairment in their natural ability to perform these tasks. It is usually possible to either minimize these elements by job restructuring, or to increase the client's ability via the use of orthotics and/or prosthetics. In the latter case, these should be considered to be a functional part of the client and their use allowed in his or her vocational evaluation.

If the purpose of these motions is to enable mobility, Todd (1975) has outlined a method of assessing the client's mobility-efficiency relative to the MTM standard.

If the client can be evaluated on all of the major MTM (2) classifications, then, theoretically at least, it should be possible to estimate his or her ability to perform the physical demands of any job that has been analyzed using MTM (2). For those wishing to attempt this, Thompson (1963) has established an algebraic equation to use when combining the various scores. In practice, however, if the job is already known, then it may be more useful to develop a work sample or use situational assessment. The actual difficulties involved in performing the task can then be more readily identified, and dealt with whenever possible. Micro-motor analysis is more appropriate during the prescriptive phase of evaluation.

Available Motions Inventory

This instrument is designed by the Rehabilitation Engineering Center of Wichita, Kansas who issued an instruction manual for its use in 1980. This has been referred to extensively in the preparation of this brief review.

The Available Motions Inventory can best be considered as having three principle components. The first and most significant from the standpoint of this document is essentially a means of evaluating a severely physically impaired person's ability to operate the controls of a machine in an industrial setting. Its intent is to provide vocational evaluators with very specific information about their client's abilities in relationship to types of machine controls, their physical location and the adjustments they require.

The second component of the test is a selection of industrial-looking manual dexterity tests, similar in concept to the Purdue Pegboard, but involving a wider variety of motions. The last component is a means of measuring a person's reaction time and speed of reaching to fixed objects.

The first component of the Available Motions Inventory is a significant departure from the usual work sample or manual dexterity test approach, since it measures not only what a person can do and how fast they can do it, but also in which positions they can do it. This is achieved by means of a standard test frame which is capable of holding a variety of different component boards in different locations in relationship to the client's shoulder position. The developers say of this that it "consists of a framework of two horizontal rows of five square openings. The two modules at either end are placed 45% forward: This allows for the simulation of a console configuration where controls might be located to the side as well as directly in front of the worker. The table surface and supporting framework can be raised or lowered. Thus, the overall height of the entire table can be adjusted to a standard orientation to the client being tested. . . The typical position for the test client is sitting in a chair or wheelchair" (p. 3-4)

The component boards which fit into the test frame contain a variety of controls that might typically be found on a production line machine. They include slide switches, rotary switches, toggle switches and push button switches. In addition, modules have been constructed which measure the rate at which a severely physically impaired person is able to turn various handles, wheels and knobs as well as his or her ability to set them at predetermined positions. Several commercial strength measuring

instruments are featured in the test including pinch and grip gauges. Others have been especially constructed to measure a person's ability to apply force in any direction (up, down, sideways, and push-pull) including rotating around an axil (torque).

The Available Motions Inventory produces useful information during the prescriptive phase of evaluation, especially if a client is considering jobs that require extensive interaction with either machinery or electronic control panels. It not only demonstrates whether a severely physically impaired person can manipulate a machine's controls in a certain place, but also whether they can do it for prolonged periods without excessive fatigue. As with the micro-motor analysis, much of the information that the test provides is superfluous if the client already has a particular job or a particular type of machine to work with in mind. It would probably be much simpler in this case to use some form of work sample or situation assessment.

SUMMARY

Over the past decade, the demand for the vocational evaluation of severely physically impaired adults has expanded considerably faster than our technological capacity to perform them. The stage has been reached where simply adapting the traditional methods of evaluation may not be efficient or even possible. The current state-of-the-art as reflected by the research literature, does not provide us with custom-fit solutions, but it does contain a wealth of insights and partial solutions to the problem. This document has, therefore, attempted to summarize this information in a format that allows vocational evaluation to integrate new ideas into their current assessment technique. If it serves this purpose. then much will have been accomplished.

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