WORK/ABILITIES: AN INTEGRATIVE APPROACH TO VOCATIONAL EVALUATION

Don W. Awtrey
Harold D. Converse
Janet B. Thompson

Abstract

Work/Abilities evaluation is a holistic approach to vocational evaluation which assesses the physical, intellectual, emotional and neuropsychological functioning of adults with severe physical or neurological disabilities. Strong emphasis is placed on the relationship of the individual's physical ability to neurological and cognitive abilities. The evaluation outcome is an integrated profile of the individual's capacity for productive employment, with specific recommendations made for placement possibilities, training options, engineering modifications or assistive devices.

Since 1972, the employment of individuals with severe physical disabilities has been a major focus of Cerebral Palsy Research Foundation of Kansas, Inc. (CPRFK). To achieve this goal, rehabilitation engineers of CPRFK have worked to design or modify tools, equipment and work place environments for workers with severe disabilities. In response to a need of business and industry for a method of defining appropriate task modifications for persons with specific handicapping conditions, the Rehabilitation Engineering Center at Wichita State University developed the Available Motions Inventory (AMI) to evaluate the aptitudes for performance of workers with physical disabilities. (Malzahn, 1984). The AMI also provided an objective basis for the development of adaptive equipment and machine modification to enhance the individual's productivity.

Over time, it was determined that assessing just the physical functioning of the severely disabled individual was not sufficient. Physical performance is one dimension of the individual's employability. Other factors, such as intelligence, cognition, motivation, personality and neuropsychological functioning all contribute to the individual's ability to become employed and maintain that employment. Understanding only one part of the individual's functioning was to ignore the whole.

The Work/Abilities Evaluation Program was developed by CPRFK in 1984 to provide a holistic evaluation of the severely disabled individual's potential for employment. Thus, the Work/Abilities evaluation assesses the individual's overall physical, cognitive, and neuropsychological functioning and the interaction of these elements. The emphasis of the evaluation is on the relative strengths of the severely disabled individual, rather than the specific deficits.

Physical Abilities Evaluation Component

The physical abilities evaluation component seeks to incorporate information gained through a complete physical therapy assessment, the Available Motions Inventory, and an engineering/assistive device assessment (as necessary).

Physical Therapy Evaluation

A measurement of the individual's range of motion, general motor functioning, and mobility is the outcome of the physical therapy evaluation. This evalua-

tion is typically administered prior to the AMI and possible contraindications as they relate to the individual's efforts on the AMI are provided. Ambulation and/or alternate mobility means and adaptive seating are also areas of assessment, as applicable. Recommendations for possible exercise programs for the individual, as appropriate, and indicated adaptive equipment requirements in the vocational setting are summarized in a report following the evaluation.

Available Motions Inventory

The core of each physical ability evaluation, the AMI provides an assessment of the upper extremity capability of individuals with neuromuscular impairments to perform industrial related jobs involving light bench work, light assembly, machine control and manual operations (Leslie, 1976; Malzahn, 1979). It is a system that falls between pure anthropometric assessments and work samples (Malzahn, 1984) to produce a detailed knowledge of an individual's functional abilities, rather than the individual's disabilities. Such detailed information is essential, quantitatively, for the determination of job placement and/or the design or modification of machine and work environments by rehabilitation engineers.

It is common practice to use broad classifications established by medical diagnoses as qualitative descriptors of the physical impairment. Use of such categories as indicators of physical status are, however, inherently limited in describing functional abilities. Similarly, traditional work sample evaluation methods tend to provide ample information about specific deficits, but very little about relative strengths. Insofar as most vocational evaluations provide a measurement of job skills (Botterbusch, 1976, 1977), the AMI was designed to measure abilities that are the precursors to such job skill development. What is measured is specific functional motion and control, by whatever means the person is capable of producing (Malzahn, 1984).

The AMI Evaluation System The AMI samples these capabilities through 71 separate evaluation items for each hand, a total of 142 measures. An adjustable test frame resembling a console-type work station is used to mount 12" square subtest panels in various locations to the individual seated in front of the console (see Figure 1).

Six (6) categorical subtests are designed to simulate components of industrial jobs evaluated with respect to strength, accuracy, or rate of performance. The subtests involve various switches (for accuracy and rate of performance), settings (for accuracy and rate of performance), rate (for gross rate of performance using larger muscle groups), strength (pinch, grip, applied torque and applied force), assembly (for fine motor control, accuracy and rate of performance), and reach-reaction (for rate of performance in response to a stimulus).

Subtest	Position* CLH	SLH	CLV	CUV	SUV	Description
Switch Activation						
Push Button	X	X	X	X		27–¾" square detent push buttons–activate 9
Toggle Footswitch	X		X	X	X	27–3 position toggle switches–activate 18 Industrial tredle footswitch–rate of activation
Settings						
Finger Knob	X		X	X	X	10–¾" dia. knobs with pointer–setting at 36° intervals
Detent Knob	X		X	X	X	10–¾" dia. knobs with pointer–detent at 36°intervals
Handknob	X	X	X	X	X	2–½" dia. scalloped handknobs with settings at 2.1° intervals
Slide	X	X	X	X		3 horizontal & vertical linear slide switches–settings at ½" increments
Balanced Crank	X	X	X	X		1–½" radius crank, settings at 2.1° intervals
Crank	X		X	X	X	3–½" radius cranks, settings at 2.1° intervals
Reach-Reaction						
Lateral Reach	X					Time required to move hand from a point in front of body 12" to the side
Transverse Reach	X					Time required to move hand from a point in front of body 12" to a more distant point in front
Lateral Move	X					Time required to move hand from a point 12" to the side to directly in front of the body
Transverse Move	X					Time required to move hand from distant point in front of body 12" to a point in front of the body
Reaction Time	X					The time required to respond to an auditory stimulus

*Positions
CLH (Center Lower Horizontal) –Horizontal work surface at seated elbow height with center of area 75% of reach
SLH (Side Lower Horizontal) –Horizontal work surface at seated elbow height with center 20" lateral to the CLH position
CLV (Center Lower Vertical) –Vertical work surface at 90% of reach and 6" above seated elbow height
CUV (Center Upper Vertical) –Vertical work surface at 90% of reach and 18" above seated elbow height
SUV (Side Upper Vertical) –Vertical work surface at 45° to the frontal plane and 20" lateral to the CUV position

Figure 1. A sample of subtests and positions on the Available Motions Inventory.

All tests are administered with the individual seated in a wheelchair, or industrial type seating, and positioned for optimal functional reach to the left and right, and from table height to shoulder height. The test frame can be adjusted vertically, as necessary, so that all horizontal panel surfaces are 1" above the seated individual's elbow height, as measured from the floor.

The administration of the test and data collected follows an established program sequence to ensure a standardized procedure. Each subtest is given for the left hand, then the right, and subtest raw scores are calculated and recorded in units of pounds/inch-pounds for strength items, and correct actuations per unit of time for timed tests.

Raw data scores are translated into "ability scores" and into "motion-class scores".

Ability scores. The ability scores provide for intra-individual ability comparisons, e.g., whether an individual is

more capable of using a hand knob for initiating or controlling an activity than by using switches, for example, and which is the best position for any particular activity. The ability scores also furnish inter-individual ability comparisons to determine how capabilities compare with other persons within the same target group.

For comparison, a normalized ability scale was established based on the mean dominant hand performance of the AMI evaluation sequence by 80 able-bodied individuals (43 males, 37 females, 18 to 55 years of age), with the zero point indicating the mean performance of the standard population. The 71 separate ability scores are finally consolidated into 14 motion-class scores.

Motion-class scores. Motion-class scores are based upon motion-order and the quality of motion. A factor analysis of the relevant components of the upper extremity dexterity yielded two factors to be useful for defining motion-order: (1) the body member primarily involved, and (2) the degree of control involved (Malzahn, 1984). Motions can be defined along a continuum from fine (finger) to gross (whole arm) movements and the dominant body member involved in controlling the movement determines four motion-order groups, and are thus classified as: (1-) fingers-knuckles; (2-) hand-wrist; (3-) forearm-elbow; and (4-) arm-shoulder.

Quality of motion is measured in degrees of freedom which defines the complexity of the motion to accomplish a subtest (Rahimi and Malzahn, 1984). Degrees of freedom are described as: (-1) one dimensional (linear) movements, as in moving a lever; (-2) two dimensional (planar, or surface) movements, such as positioning an object on a flat surface by sliding; (-3) three dimensional (spatial) movements, as in reaching out to shake a hand, or to operate a lamp switch; and (-R) rotational movements not correlated with other tasks, such as rolling up a car window, turning a channel selector, using a door knob, etc.

Motion-class scores combine the motion-order (fingers, hand, forearm, whole arm) and the degrees of freedom classification (1, 2, 3, R) systems to comprise 14 motion classes. A motion-class profile (see Figure II) is generated which provides a graphic display of an individual's upper extremity relative ability by body member.

A review of client C's performance, as displayed in Figure II, shows that the right hand (light shaded) is predominantly superior to the left hand (dark shaded) in all motion-classes.

The dominant hand is functioning at marginal performance levels in several motion-classes. This is indicated by scores at or above -3 in motion classes

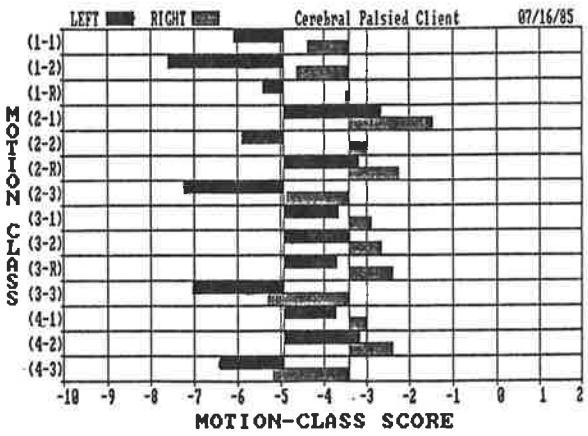

Figure II. AMI Motion-class performance scores for Client C. Body members are: 1 = fingers, 2 = hand, 3 = forearm, 4 = full arm. Motion classes are determined by body member and 1, 2, or 3 degrees of freedom plus rotation (R).

(2-1), (2-2), (2-R), (3-2), (3-R), (4-1), and (4-2). Performance is affected as the complexity of the motion increases for each body member, (2-1) better than (2-3), (3-1) better than (3-3), and (4-1) better than (4-3), with each member superior, overall, to the fingers in all levels of complexity. This is a fairly typical profile for persons with a neurological impairment.

The same kind of analysis can be performed for the subordinant left hand, which, in the illustrated case, is roughly equivalent to the right in ability, but is more severely limited.

Implications of the AMI Motion-Class Profile Each negative number along the scale to the left of zero (100% of standard) represents one unit of standard deviation. Data in this format allows for a measure of deviation of an individual's performance from able-bodied performance in each motion-class. Scores within -1.0 to +1.0 indicates an average range of abilities. Scores from -1.0 to -2.0 represent adequate performances for most physical activities, but may perform marginally for "competitive" standards. Scores in the -2.0 to -3.0 range are considered substandard performance, and modification of the work station may be desirable for the enhancement of performance. Scores in the -3.0 to -4.0 range represent a serious deficit in abilities; modification of the work site would be required to enable the client to perform at competitive levels. Scores below -4.0 are severely limited levels of performance. More extensive modifications would be required which, situationally, may or may not be performance and/or cost effective. The index of -10 is nonperformance (0% of standard).

Engineering Evaluation

The engineering evaluation presents the principles of rehabilitation engineering which are applicable to the individual's specific needs as determined by the physical therapy evaluation and the AMI to perform more competitively in a vocational setting. These techniques can also be extended to the independent living setting as well.

This evaluation relies heavily on the results of the physical therapy and AMI assessments to evaluate the individual's need for modifications and/or adaptive devices. An interview with the individual supplements information previously gathered and recommendations are made for modifications, as applicable, for possible vocational and/or independent living considerations. A report summarizes items of significance to vocational placement.

Neuropsychological Evaluation Component

The purpose of a neuropsychological evaluation is to look at the whole individual and assess the integrity of all brain systems: motor, tactile-kinesthetic, rhythm, receptive, associative and expressive speech functions, short term and long term memory capability, written language, numerical capacity, visual perception, and the integration of these systems.

Work behaviors of severely disabled individuals are determined by addressing one basic question: Is the brain intact enough to recognize, analyze, organize and direct thoughts or movements, and evaluate the outcome? This question is based on the premise that all purposeful behavior is brain induced and directed. The effect of lesions on any part of the brain may have far reaching consequences on the behavior of the individual. This is emphasized by Luria (1973) by describing a lesion of the right hemisphere of the brain, for example, which may result in the remarkable absence of perception by the individual of existing physical or personality deficits.

Because the functioning of the brain systems and their integration affects the cognitive and intellectual capability of the individual to function in competitive employment, the evaluation begins with a neuropsychological screening. The Reitan-Indiana Aphasia Screening Test and the Reitan-Klove Sensory Perceptual Examination are used because of their sensitivity to basic disorders of language function or sensory-perceptual deficits. This screening provides a quick preview of language and non-language functions, left and right brain comparisons, and both intra-individual and inter-individual differences. Deviation from the norm indicates further exploration which may include a comprehensive neuropsychological assessment, usually based on Luria's (1973) investigative techniques.

If an individual has had a traumatic closed head injury, a stroke, a tumor or a developmental disorder, the brain may have compensated for the resulting deficit in a functional capability through another sensory modality. Thus, the visual-motor modality, for example, may become the major communication content area if language is lost.

Personal-Career Evaluation Component

To facilitate the investigation of the brain's systems, the Work/Abilities evaluation includes an assessment of the individual's cognitive abilities through the Structure of Intellect (SOI) test. Based on Guilford's (1967) research that 120 different patterns of intellectual abilities are required for different educational and vocational outcomes, Meeker and Meeker established the Structure of Intellect Institute in 1980. Twenty-four specific cognitive abilities were extrapolated from Guilford's model which are especially predictive of success in education and a broad range of vocations and careers (Meeker, 1969).

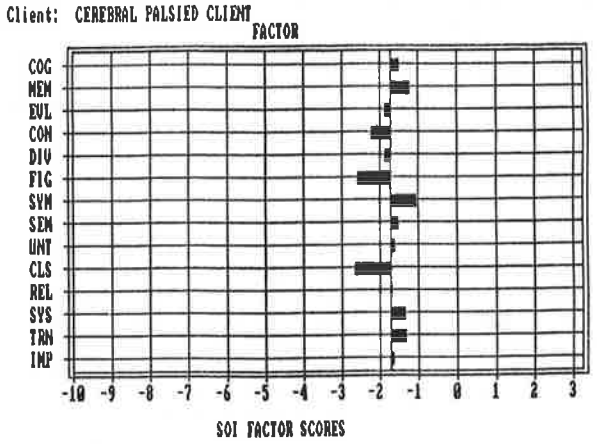

Figure III. SOI profile for Client C. to compare strengths and weaknesses in the Operation, Content and Product components of intelligence.

The SOI is a three dimensional model which assesses the functions of Operation, Content and Product components of intelligence. There are five areas of Operation, which are thought processes required to work with different types of information. They are: cognition (COG), memory (MEM), evaluation (EVAL), problem solving (CON), and creative problem solving (DIV). The Content component defines the kinds of information that persons work with, and are identified as: figural (FIG), symbolic (SYM), and semantic (SEM) functions. The Product component includes units (UNT), classes (CLS), relations (REL), systems (SYS), transformations (TRN), and implications (IMP), which are how persons work

with varying complexities of information. An example would be whether an individual can work with one detail at a time, or can understand how that single detail can be combined with other details to be transformed into a product.

Individual patterns of cognitive functioning may be compared with established patterns of vocational and career areas, thus creating a cognitive map of the individual's strengths and weaknesses (see Figure III). This may be compared to the physical functions of the individual as determined by the AMI.

The use of the SOI is especially helpful in evaluating the potential of severely disabled individuals because it looks at a wide range of vocational aptitudes. Thus, the cognitive ability of the individual to receive and process information, such as understanding routines or directions, may provide clues to appropriate types of work structure and tasks. Memory patterns identify the type of learner and the methods which must be used to maximize the understanding of instructions. Evaluative tests predict the ability to make decisions, to plan or have foresight. Scores in problem solving indicate how well an individual can use information to solve a problem or resolve a situation with a desired outcome.

Personality Characteristics This assessment reviews the personal characteristics and clinical factors which provide personal-career considerations. The Karson Clinical Interpretation of the 16 Personality Questionnaire (16PF) capsulizes patterns for problem solving, coping with stressful conditions, interpersonal interaction, and career, occupational and avocational interests. This test also provides pathological factors which might affect performance and occupational profiles of best fit patterns. Like the SOI, this, too, is a computer generated report that can become quickly accessible and meaningful in matching personality, specific abilities and the motor functions against the neuropsychological background of the individual.

Motivational Analysis Test From the initial interview with the individual and the structured Preliminary Diagnostic Questionnaire, through observations made during the evaluation, to use of the formal Motivational Analysis Test (MAT), a studied assessment is made of the factors which may or may not prompt the individual to work in a competitive market. Economic factors, family situations, pending legal suits, malingering or a vocalized desire to work despite serious physical disabilities are compared against the MAT. The MAT is an objective device with more than 15 years of basic research examining the validity of over 70 different possible motivational strength indicators (Cattell, Horn, Sweney and Radcliffe, 1964). The MAT concentrates on 10 psychologically meaningful unitary motivational systems covering the individual's interests, drives, and the strengths of sentiment and value systems. These are grouped into three major areas of Career motives, Personal and Social motives, and Family and Culture motives. Tested against observations, the interview data, the clinical and personality characteristics analysis, mental abilities, and the standards of motor functions, the weight of evidence is highly predictive of motivation for or against competitive employment.

Summary

This paper has described an approach to the development of vocational evaluation information based on objective data concerning all aspects of a severely disabled individual's employability - physical, emotional, intellectual, motivational, and neuropsychological, in addition to interests and aptitudes. It is believed that the system can make a significant difference in the quantity and quality of placements, because it seeks to conserve the integrity of the individual's ability, evaluating each aspect of functioning and its interactions with each other functioning components - cognitive, physical and neurological. In this way, the maximum potential and possibilities of individuals with severe disabilities may be highlighted and specific recommendations can be made accordingly.

References

Botterbusch, K. A comparison of seven vocational evaluation systems. Menomonie: University of Wisconsin-Stout, Stout Vocational Rehabilitation Institute, Materials Development Center, 1976.

Botterbusch, K. A comparison of four vocational evaluation systems. Menomonie: University of Wisconsin-Stout, Stout Vocational Rehabilitation Institute, Materials Development Center, 1977.

Cattell, R. B., Horn, J. L., Sweney, A. & Radcliffe, J. A. Handbook for the Motivation Analysis Test. Champaign, Illinois: Institute for Personality and Ability Testing, 1964.

Guilford, J. P. The nature of human intelligence. New York: McGraw-Hill, 1967.

Leslie, J. H. Wide battery of tests measures disabled workers for industrial roles. Rehabilitation World, 1976, 2, 16.

Luria, A. R. [The working brain: an introduction to neuropsychology] (B. Haigh, trans.). New York: Basic Books Inc., 1973.

Malzahn, D. E. Ability evaluation and job modification for the severely disabled. Proceedings of the 1979 Annual Conference of the American Institute of Industrial Engineers, San Francisco, CA., 1979.

Malzahn, D. E. Functional evaluation for task modification using the Available Motions Inventory. In A. S. Halpren and M. J. Fuhrer (Eds.) Functional assessment in rehabilitation. Baltimore, Maryland: Brooks Publishing Co., 1984.

Meeker, M. N. The structure of intellect: its interpretation and its uses. Columbus, Ohio: Charles Merrill, 1969.

Meeker, M. N. S.O.I. career and vocational test: interpretation guide. El Segundo, California, SOI Institute, 1980.

Rahimi, M. & Malzahn, D. E. A physical ability evaluation system used in rehabilitation engineering. Wichita: Wichita State University, Department of Industrial Engineering, Rehabilitation Engineering Center, 1984.

AUTHORS:

Don W. Awtrey
Harold D. Converse
Janet B. Thompson
Cerebral Palsy Research Foundation of Kansas
2021 North Old Manor
Wichita, Kansas 62708