Hundreds of functional assessments are currently used by occupational therapy personnel. A number of standardized paper-and-pencil instruments are listed in core occupational therapy textbooks (Asher, 1989; Hopkins & Smith, 1988; Kielhofner, 1985), and countless numbers of other nonstandardized checklists and data forms have been developed by individual therapists and occupational therapy departments. Assessments that occupational therapists use range from those that examine global activities of daily living function to those that focus on performance of specific components such as range of motion (Christiansen & Baum, 1991; Trombly, 1989). Assessments address the diverse populations that occupational therapists serve, from physical disability to mental health, from pediatrics to aging; as well as the full range of settings, from acute intensive care to long-term care and from neonatal programs to hospice. These assessments are based primarily on paper-and-pencil methodologies, which require a time-intensive sequence of activities, and their interpretation and reporting are dependent on the expertise of the practitioner.

Unfortunately, time and expertise are costly. This is not prudent in an era when the costs of health care services are being scrutinized. Practitioners must examine all options that can drive costs down, yet must maintain or improve services. Occupational therapy assessment, data collection, interpretation of results, and documentation of reports are inefficient when they depend on human observation and scoring, hand logging of data, lengthy question sets, individualized human interpretation of results, and time-consuming writing of reports. Computer technology is advancing rapidly (Angelo & Smith, 1993). All of these functions can be executed more efficiently through the use of computer technology.

Although computers can contribute to efficiency, the use of computers in the assessment process is relatively new. Thus, some caution is warranted (American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, 1985). Additionally, many computerized assessment methods do not conform to the structure of classical tests and measurements and do not use traditional psychometric approaches for validity and reliability. For example, in electrically and mechanically based instrumentation, such as with an electrogoniometer, reliability takes on different connotations. It can be measured as mean time between failures (mechanical endurance) or variance in repeated measures, which is a repeatability of equipment performance due to engineering, not observer judgment. Each measure and method of instrumentation requires a different interpretation.

Usefulness of the Computer

In the functional assessment process, computers can assist in data collection, data reduction, data interpretation,
and report writing. They contribute two basic capabilities: speed and accuracy. Computers can calculate faster than a human being; they can also perform these calculation and data manipulations without error. These two capabilities became apparent during the development of OT FACT, as assessment and documentation system distributed by the American Occupational Therapy Association (Smith, 1992). An early field test of the paper-and-pencil version of OT FACT reported the instrument to be conceptually sound but revealed that practitioners took more than 4 hr to tally and score the data, and that percentage calculations and plots on graphs exhibited more than a 50% error rate. With the computer version of OT FACT, similar data were entered and reported in 20 min (more than 10 times faster) without error (Smith, 1990). Whereas automating pencil-and-paper procedures to gain a more efficient functional assessment is an improvement on an existing system, pencil-and-paper conversions are simplistic applications of a computer. Many other functions are impossible without the computer. These include adaptive testing, continuous measurement testing, and artificial intelligence (Bunderson, Inouye, & Olsen, 1989) (see Figure 1).

Direct Data Collection

Two uses for computers that are applied early in the steps of the assessment process are (a) serving as a direct data collector and (b) serving as an assistant to the researcher or practitioner. Examples of direct data collection systems are electromyographic feedback, electrogoniometers, cardiac monitors, biomechanical video analysis (e.g., gait assessment), force meters, and cognitive assessment software. Each of these data collection systems uses electronic transducers to measure physiological phenomena (e.g., motion, muscle activity, and keyboard activation). The transducer converts the physiological behaviors into electronic information that is sent to the computer and stored as raw data. Software utilities such as Workbench™ allow users to hook switches or other data collection hardware to a computer and use a variety of on-screen controls to adjust the parameters or other electronic conditions. Data can be manipulated and displayed in various forms, such as oscilloscope wave tracking, indicator lights, or bar meters. These raw data are initially meaningless, as they are often stored as frequencies (e.g., ticks per second, amplitudes, or unlabeled values). Later, the computer reduces data into more salient and meaningful information. Although using computers for direct data collection is not new, the access to and number of instruments and systems has broadened, moving from research laboratories to clinics.

Computers also can be used as a depository or a recorder of behaviors observed by human raters (Schneider, Champoux, & Beinert, 1987). This type of direct data collection assists the researcher or practitioner in real time, meaning that the behaviors being recorded are entered into the computer as they are witnessed. The data may be reviewed later to compare frequencies over time or tabulations of different qualities.

Data Reduction

In the assessment process computers can be used to reduce data in order to present information more meaningfully or organize the data into more understandable summaries. Without such organization, raw data can be voluminous, too detailed, and overwhelming, making it difficult to discriminate meaningful information (Smith, 1989).

Large quantities of raw data can be summarized in many ways. For example, a mathematical mean is one number that summarizes a characteristic of a larger data set. More complicated statistical procedures perform similar functions. Statistical procedures resulting in a correlation coefficient or an f-value highlight characteristics of underlying sets of data. Computers process data rapidly to highlight salient information.

Data can also be reduced by generation of tables, charts, and graphs. Pictorial and tabular portrayals of

---

summary data are powerful information vehicles. Such vehicles are frequently used in news magazines to convey information. Tufte (1983, 1990) has highlighted the science and art of portraying information visually. It is important to use pictorial and tabular displays of information for communicating functional assessment results, because graphic information transcends esoteric, discipline-specific vocabularies and conveys salient concepts rapidly (Smith, 1989).

A key advantage in displaying reduced data is the capability of comparing more than one data set. A practitioner, researcher, or administrator may wish to compare initial, interim, and discharge scores, or view a client's present functional performance alongside discharge goals. Comparing a client's functional performance with his or her perceived satisfaction with performance may also be important.

Dynamic Question Sets

An assessment technique that is not practical without computers is the use of dynamic question sets. Current assessments use static question sets that walk the practitioner through a standard list of questions for all clients being assessed. In contrast, dynamic questioning can customize the set of questions and the sequence in which the questions are presented. One type of dynamic question sets is computer adaptive testing (CAT), which first emerged in the educational and psychological testing literature in the mid 1980s (Haas, Huebner, & Panizich, 1992). Application of the CAT in occupational therapy assessment has received little attention.

The OT FACT software uses a dynamic question set via Trichotomous Tailored Sub-Branching Scoring (TTSS), a simple branching system. It uses dozens of screening questions in its taxonomy and also permits "not applicable" responses. This dynamic questioning process is made manageable through the use of a computer because it tracks responses and presents more detailed questioning only as necessary, omitting unnecessary questions as determined by prior responses.

Another way that computers can make dynamic questioning manageable is through their ability to adjust and calibrate questions to customize scoring to particular raters, questions, or other variables that contribute to errors in measurement. The Assessment of Motor and Process Skills (AMPS) (Fisher, 1990), for example, uses many-faceted Rasch measurement scaling and extensive computational analysis to calibrate scores for individualizing the questions and measurement scales of questions. A post hoc computerized data analysis sets up the questions to obtain measurement scales more specific to users and situations. This allows users to validly select individualized assessment activities and more reliably compare scores obtained from different raters.

Use of dynamic questioning affects an assessment's reliability and validity. It can screen out irrelevant questions to, in theory, avoid degrading validity; it can also clarify questions that do not appear to be straightforward. By hearing a question broken down into more detail, a respondent may need to guess less often when subjective scoring is used. In theory, this approach can increase the reliability of an assessment. OT FACT (Smith, 1992) uses this approach. Calibrating scales to individual raters and selecting specific questions for particular situations can also dramatically improve the validity and reliability of paper-and-pencil assessments. The AMPS uses the Rasch techniques to optimize this potential (Fisher, 1993). EASE, a program that helps occupational therapists plan treatments for the elderly, also applies dynamic questioning. It uses clinical expert logic to assess a person's function, integrate the information, and recommend assistive devices.

Decision Aid Systems

Decision Aids (or expert software systems) are more sophisticated than dynamic question set systems. These are tools used in the field of decision analysis to create models based on information from experts in the field. The judgment of these expert practitioners is used to guide implementation of the questioning procedure or even to recommend answers for known situations. Expert information is used to guide data collection and data reduction. In the future, functional assessments are likely to incorporate information from expert decision makers or practitioners. Computer-based functional assessment software will be able to capitalize on previous occupational therapy experience and judgment by recalling scripts from its files or memory bank and integrating them into current assessments.

An example of a decision aid system is the program designed by a team of psychiatrists and engineers for medical decision making. It was used to review clients, and it could predict the risk of suicide attempts better than experienced psychiatrists (Gustafson, Tianen, & Greist, 1981).

Computer-Assisted Report Writing

Word processing software can assist in report writing. Many programs can merge data into previously designed report templates. This process is often called mail-merge capability, as it was designed to create form letters that import individualized names and addresses. Additionally, some word processing software programs do more than merge raw data: they reduce data, interpret data, draw conclusions, and convert the results into written prose reports. Examples of report writing programs include
Compiling Databases

Computers collect and use data electronically, which means that data can easily be aggregated into combined data sets or databases. Additionally, electronic information can easily be sent over telephone lines with a modem, making off-site locations feasible as data depositories. There are three major benefits to compiling databases on computers: first, databases can be valuable for program evaluation and continuous quality improvement activities. Second, regional or national databases such as the Functional Independence Measure Uniform Data System for Medical Rehabilitation (Granger & Hamilton, 1992) can be developed to provide valuable quality-of-care or market information. Third, databases can be valuable for research and policy making. For example, intervention efficacy studies and epidemiology studies collect large data sets of outcome information, which health and education policy makers often use to guide policy development. Third-party funding agencies desire access to databases to assist in refining their funding-related policy decisions.

Issues Surrounding Computers and Assessment

To use computers in the functional assessment process, the occupational therapy practitioner will need to acquire basic computer literacy skills, knowledge of how to use assessment-related software, and an understanding of how computer-assisted assessment may differ from traditional assessment methodologies. These requirements have important implications for in-service and preservice education, yet we do not know how much education would be sufficient or what the content should be. Should education include technical electronic and computer science background information so that practitioners can develop and test products? Should it include information on how to develop and apply new methods like dynamic question sets?

Will education programs be too challenged by expanding their curricula to include computer-related functional assessment? Will they be too challenged by the advances in computer technology, such as the integration of expert opinion into systems to help coach inexperienced learners? Today, computers can collect and reduce data directly without much involvement from the practitioner. Soon, it may be common for computers to produce a menu of intervention options or even generate an occupational therapy report that could be included in the documentation for medical or educational records, funding agencies, or referral sources. These capabilities change the role of the practitioner as he or she steps through the assessment process and the role of the student as he or she learns how to perform assessments.

We also know little about the costs of using computers in the assessment process. Although some costs are obvious, such as the price of the equipment, there may be hidden costs in using computers (or lost savings if we do not use them). Occupational therapy administrators make purchasing and programmatic implementation decisions daily, yet we have little information about how effective these newer computerized methods are. Effectiveness research is critical and must be performed parallel with the development of these new technologies.

Future Risks and Opportunities

Although there are questions relating to how computers may best benefit the functional assessment process, it seems clear that computers can revolutionize functional assessment methodologies. The microchip and personal computer have dramatically changed the way we listen to music, cook a quick meal, dial the telephone, check out at the grocery store, bank, write, and type.

Software development in occupational therapy is important, because current software products and assessment tools do not meet the need. This development will require professionals who are functional assessment developers to obtain and apply knowledge and skills per-
taining to the research and development of computer software. The steps of software development include the conceptualization of an idea, feasibility studies, prototypes, alpha testing, beta versions and testing, empirical research, software documentation, marketing and distribution. All these steps need to be mastered by those who become involved in development of computer-assisted functional assessment.

The development of new ideas and pursuit of major advances in technology is always risky. It is difficult to know when opportunities outweigh the risks. As we review the possible benefits of using computers in the functional assessment process, however, it appears that there already are many sound and acceptable benefits of using computers in the functional assessment process. Our data can become less dependent on experienced judgment and more robust to idiosyncrasies of raters, our time can be saved in documentation and in administrative tasks, and our reports can communicate more effectively to our clients and other professionals. Because some of the newest applications are dependent on the expertise of fields outside of rehabilitation or occupational therapy, however, disability assessment professionals need to learn more about engineering and computer science and need to increase collaboration efforts with these other professionals.

The current encounter between occupational therapy and technology is not new. For decades, occupational therapists developed adaptations for looms, woodworking equipment, personal transportation systems, self-care devices, and vocational workstations. The computer is simply another technology to be integrated into occupational therapy, offering another opportunity to advance practice.

References


