APPLYING MICROCOMPUTER TECHNOLOGY TO THE ASSESSMENT, TRAINING AND MANAGEMENT OF THE DEVELOPMENTALLY DISABLED

JAMES M. GARDNER and ANNEMARIE BREUER
Fairview Developmental Centre, Costa Mesa, California 92626, U.S.A.

During the past 20 years, the field of developmental disabilities has experienced a number of major innovative diffusions which have had significant impact. To a great extent, these trends have been specific to the mental health area in general, as in the case with behaviour modification (Gardner, 1982) and community based residential alternatives (Atkinson *et al.*, 1980; Gardner, 1977), while in other cases, the trends have been reflections of moves within the larger society, such as legal rights for the disadvantaged (Baer, 1981; Gardner, 1974) and alternative management and consultative styles (Gardner, 1971; Hornby & Singh, 1982).

Needless to say, the impact of a given innovation is determined, to some extent, by its congruence with the greater society which can nurture and support the diffusion. For that reason, it behoves professionals in the field of developmental disabilities to examine the potentials which exist today with respect to the microcomputer.

The microcomputer revolution is one of the most rapid and far reaching advances in technology to come along. From its origins as an infant cottage industry in 1980, it has grown to a multibillion dollar conglomerate, encompassing some of the largest companies in the world and accounting for sales in excess of 15 billion dollars annually.

To date, most applications of microcomputer technology have been directed at clients, such as automated teaching methods (e.g. Katz, *et al.*, 1981; Stoddard, 1982), and only a few have been directed to assist practitioners (e.g., Smith & Wells, 1983). This is paradoxical, as the overall impact should be greater when the innovations are directed at staff rather than through direct delivery (cf., Gardner, 1977, 1982). This article describes various applications of microcomputer technology for use by staff, and discusses the advantages and disadvantages of such an innovation.

SETTING

Subjects

This project was carried out in a programme for 148 adolescents and young adults in a state-supported residential facility. The 83 men and 65 women ranged in chronological age from 11 to 35 (Mean CA = 24) years, in social age from 10 to 81 (Mean SA = 44) months, and in length of institutionalization from 1 to 25 (Mean = 15) years. Sixty-four were epileptic, 23 had hearing defects, 21 had vision defects, 25 had cerebral palsy, and 9 had difficulty ambulating.

The clients were housed in four residential units, each accommodating approximately 38 people in bedrooms ranging from two to four beds per room. When not otherwise engaged in various activities, they spent their day in a living room arrangement where groups ranged from 10 to 15 in number. Generally speaking, the policies and procedures followed by the programme conformed to those laid down by the Joint Commission on the Accreditation of Facilities for the Mentally Retarded. (1971).

Equipment

The microcomputer applications were carried out with a Kaypro 4 portable computer. The Kaypro 4 has 64K RAM and two double-sided density disk drives which store 400K of memory per disk. The printer was an IDS Microprism 480 which prints with a 24 × 9 dot matrix that is virtually indistinguishable from letter-quality print. At the time of writing this article, the Kaypro 4 retailed for just over $1700 and IDS was just under $500.

APPLICATIONS

There is no limit to the types of applications that microcomputers can be put to. These include payroll, personnel, cost accounting, inventory, etc. The small business software that is readily available to manage your local chemist is easily adaptable to the business of caring for the developmentally disabled. Rather than devote valuable space to what can be obtained elsewhere, this article will, instead, focus on the unique contribution which microcomputers have made to the care and treatment of the developmentally disabled.

Psychological Assessment

Prior to computerization, the traditional psychological assessment for clients in this programme typically required four to six hours of time by the psychologist, including time to review the client's chart, interview relevant personnel, observe the client, calculate scores, write the report and review the typed version. The process usually took a week or more from the time that the report was started until the final report appeared in the chart, and depending upon the vagaries of the mail, the psychologist's scrawl, secretarial vacations, etc., it could take up to three weeks.

Over the course of two years, a method of psychological assessment keyed to the microcomputer's capabilities, the nature of the clients, and the demands of the environment, was developed. Entitled *The California Assessment Battery* (Gardner & Breuer, 1984) the system requires approximately one hour of time from someone familiar with the client with access to the client's chart. The Informant sits in front of a video display terminal (or monitor) and responds to questions posed by the computer programme, typing one of three kinds of responses: choosing the number which corresponds to a multiple choice stem (e.g., "From the list below, select the client's major reinforcers"), entering data as requested (e.g. "Enter the frequency of head banging for March"), or typing in unique responses (e.g. "List the client's medical conditions").

The computer programme tracks the input through a series of intermediate files which store the data for later analysis in generating recommendations and examining reliability and validity. Reliability is determined by comparison between 30 pairs of similarly worded items which are scattered throughout the 322 item behavioural checklist which comprises part of the battery. Validity is determined by a comparison of responses on 32 items with their behavioural prerequisites (e.g., a person should be able to grasp with thumb and finger before they can eat neatly with a spoon).

When a reliability or validity level less than 75% is achieved, the programme automatically erases the input and requires the Informant to begin again. When a level of 75% or greater is achieved, the programme points out the discrepancies in the data inputted, and allows the Informant to go back and correct the errors (if any). Occasionally, rather than Informant error, the discrepancies represent a splintered skill or a skill augmented by prosthetic devices, in which case the Informant has the option of allowing the apparent discrepancy to remain.

It has been our experience that by virtue of the programme used, reliability and validity are uniformly high. In one study of 40 severely and profoundly retarded clients (Swanson and Sutton, 1983), the average reliability was 93% (range 70% to 100%) and the average validity was 98% (range 70% to 100%).

Once the internal reliability/validity review is completed, the report is printed out on the spot, usually in less than three minutes. It is reviewed by the psychologist and then used as the basis for the psychologist's input at the interdisciplinary team meeting. The major sections covered by the report are outlined in Table 1.

TABLE 1

MAJOR SECTIONS OF THE CAB

- Previous Evaluations
- Diagnostic Impression
- Background Information
- Medical Conditions
  - Treatment
  - Seizure Record
  - Medication
- Adaptive behaviour
  - 24 Area Scores (with age equivalences)
  - 3 Global Scores (adaptive age, school readiness, work readiness)
  - Previous Scores
- Reinforcement Preferences
- Priority Problems
  - Antecedents
  - Six Month Data Review
  - Intervention Techniques (legal restrictions)
- Community Readiness
- Recommendations

Table 1 reveals that the report is comprehensive, covering a vast number of areas. Though much of the data presented in the report is a restatement and reorganization of the data inputted, the recommendations section is generated solely by the computer programme, based on definitive limits and decision-trees written specifically for this population. This process can involve upwards of 20 separate recommendations, dealing with such details as the method of data collection, the types of intervention techniques used, the areas where training should be directed, legal issues vis-a-vis client's rights, placement, medical contra-indications, etc. Figure 1 illustrates the breadth and depth of the recommendations generated.

FIGURE 1

SAMPLE RECOMMENDATIONS FROM CAB

1. The client should continue to reside in his present programme as the nature of his existing medical problems, adaptive behaviour, and priority problems are such that movement to a more or less restrictive environment is not recommended.

2. Emphasize the following areas which are relatively less well developed compared to other skill levels: bathing, language, and leisure.

3. Review the client's medication regiment as there exists the possibility that behaviour problem B2 (hits peers) may be aggravated as a result of the medication side effects. As well, medication side effects may be aggravating existing medical problem 646.8 (underweight).

4. All non-behaviour high priority problems should encompass assistance code data in addition to frequency data. At present, assistance code is not being recorded for S1 (voids in toilet).

5. All behaviour high priority problems should encompass severity code data in addition to frequency data. At present, severity code is not being recorded for B2 (hits peers).

6. Antecedents have not been identified for S1 (voids in toilet). Interventions can be more effective when antecedents are known, so that preventative action can be taken early. Review high priority problem S1 (voids in toilet) and attempt to determine the antecedents.

7. Consider using the following techniques (as well as the existing techniques) for high priority behaviour problem B2 (hits peers): removal of reinforcers, exclusion timeout. Fines and extinction would not be appropriate techniques to use.

8. Approval of locked timeout for B2 (hits peers) expired 8/1/83. If this technique is to be continued, new approval needs to be sought.

Research on the CAB cited earlier established the reliability and internal validity of the system. Studies of the concurrent validity of the system (Gardner & Breuer, 1984) indicate that the Adaptive Age scores on the CAB correlate .96 with Social Age scores from the Vineland Social Maturity Scale (Doll, 1965). Moreover, rank orderings based on the CAB correlate .77 with independant rankings of overall competence obtained from direct care staff. The School Readiness scores correlate .83 with Peabody Picture Vocabulary Test (Dunn, 1965) scores, and Work Readiness scores correlate .79 with vocational instructors' assessments. Overall, when compared to standard psychological reports, the computer generated reports were preferred in every case. These data suggest psychometric properties which are at least equivalent to non-computerized assessment systems. (c.f., Palmer & Jenkins, 1982).

Ancilliary Paperwork

In association with the trials and tribulations of working for a state system, there is a never-ending supply of ancilliary paperwork involving legal reports for clients scheduled to attend custody hearings, social service reports for clients who receive federal monies, statistical reporting for the state's census, and documentation for review by behaviour management and human rights committees. Normally, these tasks can take upwards of three hours.

Given the data base which is generated by the assessment described in the preceding section, ancilliary paperwork requires a minimal effort. Nearly everything necessary to write

ancilliary reports is already contained in the data base, and with relatively simple computer programmes, the data base can be accessed and reports generated with no extra work, apart from calling up the data base, typing in the clients name, and requesting the report — a total of less than five minutes from start to finish.

Intervention

One of the major tasks for the psychologist is the development of effective intervention plans. For a large group of clients with diverse characteristics, and the possibilities of more than 400 individual behaviour problems, this can be a difficult and time consuming task. For example, in a recent survey, it was found that 38 clients had a total of 133 behaviour problems, an average of 3.5 problems per client. Across 148 clients (the total in the programme), there is the potential for more than 500 individual plans, and for an institution with an average of 1,000 clients, an excess of 3,000 plans.

The task of generating high quality intervention plans is an enormous one, requiring hundreds of hours of time by direct care staff. Yet as important as the function of generating plans is, this time has to be taken away from the time that otherwise might be spent implementing the plans.

Structural Analysis: To address this problem, the microcomputer was put to the task of designing intervention programmes. Using principles of community psychology (Gardner and Veno, 1978), a structural analysis programme was developed in order to identify antecedent or causative factors which could be varied in order to prevent the behaviour from occuring in the first place. Believing that "an ounce of prevention is worth a pound of cure", the programme was designed to determine temporal, spatial, and behavioural fluidity. An Informant familiar with the client and with access to the client's chart responds to a series of questions over a 20 minute period. At the end of that time, the programme analyzes the responses and then identifies patterns with respect to cylindrical behaviours (e.g., does the behaviour occur at certain times of the year, month, week, or day?), spatial arrangements (e.g., does the behaviour occur more frequently in one place or another?), and behavioural correlates (e.g., are there certain behaviours which occur just before or along with the behaviour in question?). Depending upon the patterns identified, this information is then used to develop intervention strategies which prevent the behaviour from occuring in the first place.

Our experience has shown that the structural analysis is a powerful tool in identifying behaviour problems which may be caused by allergies (hence, seasonal variations), relatively stable internal biochemical and physiological changes, and other stimulus-specific responses. Most often, this is useful with respect to self-abuse and aggression.

Behavioural Plans: Not all behaviours are amenable to preventive interventions through structural analysis, and tertiary intervention is necessary. Starting with the most frequent problems identified in the earlier analysis, a series of prototype plans (Gardner, 1984) was generated. Prototypes were identified on the basis of their association with certain unique clusters of stimulus, individual, and response factors which had to be taken into consideration in the design of an intervention plan. For example, with respect to pica behaviours, one needs to consider (amongst many other factors) the nutritional status of the client, whereas nutrition is not likely to be a factor with respect to throwing furniture. From these prototypes, intervention plans were designed which addressed the problems, using a hierarchical step-wise procedure which offered the least restrictive alternative.

Unique information specific to each individual is written directly into the plan as a result of a 10 minute interactive programme which requires that the Informant identify, for that client, such details as the effective reinforcers, antecedent conditions, special

considerations, etc. Not every issue is identified for each plan for each client, however, consideration is given to including each one. For example, the use of token economy measures is considered only when the client has the capacity to function in a token economy.

Having developed a series of prototypes, plans for related problems are easily generated. These plans are then distributed to staff responsible for maintaining the client's chart with the proviso that the plans should be reviewed and where necessary, changes inserted.

With the first edition of the plans, 133 plans for 38 clients were distributed. In 80% of the cases, the plans were reviewed and returned unchanged. In 20% of the cases, individual clients' responses were so unique as to warrant modifications. These changes, of course, required very little time to implement, as the prototype simply had to be called up, modified, and then printed out — a procedure which, on average, required 10 minutes from start to finish.

Staff input while reviewing the first edition of the plans resulted in changes, so that when the second edition was distributed to a different residence, the revision rate based on 73 problems for 38 clients was only 10 %.

Management

The most pervasive influence of the system with regard to management has been its assistance in making decisions on placement within the programme. Because the system has been programmed with concensually agreed upon limits, placement decisions can be made without extraneous factors coming to bear upon the process. This is not to say that extraneous factors cannot be introduced, but they are considered as such, rather than being interwoven with the empirical data.

Although there have been instances in which decisions have been reached which are not consistent with the decisions recommended by the computer programme, in virtually 95% of the cases, the computer's judgement and management's judgement have coincided. Considering the ease with which computer recommendations can be generated, and the relative complexity of otherwise obtaining the necessary resources to make similar decisions, the benefits of the microcomputer system are obvious.

A second management application has been the ability to compare various cohorts. On the dimensions presented in Table 1, comparisons can be made between different groups within the same residence, and different residences within the same programme. For example, the two residences discussed earlier generated 73 and 133 behaviour problems respectively. Given that the residences are virtually identical with respect to client characteristics, resources, and staffing, the fact that one residence has clients with nearly twice as many behaviour problems has dramatic implications for resource allocation.

DISCUSSION

The application of microcomputers to assist staff who work with the developmentally disabled offers many benefits, the most obvious benefit being the enormous savings in time and money. Psychological assessments requiring four to six hours now require less than one-quarter that amount. In addition, time spent by a typist and subsequent review by the psychologist are all but eliminated, and the resulting report is virtually error free. Multiply the savings by 60 clients per year for each psychologist and the figures are staggering.

The situation is the same with respect to designing intervention plans. Prior to the adoption of this system, mediocre plans were being generated at the rate of one per hour. With the existing system, high quality plans are generated at the rate of four per hour. Multiply the savings by 133 plans per residence and the results are impressive.

Not only are there considerable savings in time and money, the application of the microcomputer has allowed for a significant increase in quality. Both the psychological assessment reports and the intervention plans are high quality state-of-the-art products. Even for the most experienced practitioner, it is difficult to maintain this level of quality throughout, but for the computer, the process is inevitable. Indeed, the computer generated assessment reports have consistently been judged superior by direct care staff, programme management, and client advocates. Similarly, the computer generated intervention plans have been consistently judged excellent by the facility's behaviour management committee.

Along with increases in time, money savings and quality, we have found an increase in the enjoyment of the job as the odious requirements of paperwork are reduced for everyone concerned. This has the added advantage in allowing direct care staff the opportunity to address issues without the aversive threat of increased paperwork hanging over their heads. If direct care staff have to spend an hour generating an intervention plan, and if doing so is an aversive event for many, to some extent, those people may not identify the problem, in order to avoid the resulting paperwork. By reducing the aversive nature of the paperwork, it allows direct care staff to function at a higher level.

This potential advantage was dramatically underscored when, one month after completing the computerization of the first residence, there was a 50% increase in the referral of clients to the behaviour management committee, despite the fact that there had been no substantial changes in the clients' behaviours to warrant such referrals.

A further benefit is an increase in standardization, both with respect to report writing and intervention plans. This is particularly important for the intervention plans because of the importance of consistency when working with the developmentally disabled. Standardization is also an asset because it allows the pooling of talents and the generation of increasingly more sophisticated and effective plans, as witnessed with respect to the lower revision rates for the second edition.

Standardization is also an asset with respect to research, providing a readily accessible data base. It also assists management in making decisions with regard to placement, resource allocation, and future planning.

Contrary to the experiences of Byrnes and Johnson (1981), the use of the microcomputer has greatly increased the staff's involvement with their clients. This has resulted not only from freeing up their time for more fruitful pursuits, but by involving them in the generation of the plans, they become more involved in the entire process and share a sense of psychological ownership (Gardner, 1971). As well, by having them review each plan for each client, they continually review the best plans and are refreshed each time. Indeed, this process may have contributed to the increased referral rate noted above.

Of course, not all the side effects are necessarily positive. The standardization that can be an asset can also be a straight-jacket, discouraging innovation and blocking client progress. Staff can avoid anything which isn't on the plan and stop inventing new and more effective ways of training just because they believe the computer has all the answers.

Similarly, in the press of daily requirements, staff can be tempted to rely upon the computer even when they know that there are other, more effective methods of dealing with a person. When a computer can generate an impressive 10 page report, how motivated will a staff member be to generate a report without the computer's support?

Computer users speak of "GIGO" — garbage in, garbage out. It is an eloquent warning to all computer afficienados to guard against instituting programmes or plans which contradict their common sense. Yet the enormous weight and prestige of the computer generated product can work against the interests of everyone concerned unless a valid and reliable system for inputting data is developed.

Another major issue is the process of programme generation. Once developed, computer programmes can be extremely efficient and effective, however, programmes are not developed overnight, but rather after hundreds of hours of conceptualization, development, piloting, revision, and research. These costs can be prohibitive for many organizations, resulting in the adoption of computer programmes generated for one purpose, being used by other facilities for different, though related, purposes. Workable as a short term solution, the best long term approach is for each organization to develop programmes uniquely suited to their needs.

A final note of caution relates to the findings of Smith and Wells (1983) who reported that following the withdrawal of a computer assisted progress recording system at a state facility, the quality of reports declined significantly, although the post-computer rates were significantly higher than the pre-computer rates.

SUMMARY

The microcomputer revolution offers new and brighter possibilities toward improving the care and treatment of the developmentally disabled by increasing the quality of assessment and training plans, by reducing staff time associated with paperwork, by providing ready access to state of the art inputs, by broadening the data base available to management for decision making, and by giving staff a sense of psychological ownership. Yet to implement these changes, it requires diligent attention to detail, the development of reliable and valid inputs, extensive research and development, and, most importantly, acceptance of computer technology as a tool which must continually be monitored and adapted to the needs of the clients, the staff, and the larger society.

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