AN INFORMATION SYSTEM FOR MEASURING PATIENT BEHAVIOR AND ITS USE BY STAFF¹

ARTHUR D. COLMAN AND JOHN J. BOREN

WALTER REED ARMY INSTITUTE OF RESEARCH

A behavioral measurement system was designed around a point economy for a psychiatric ward of delinquent patients. The characteristics of the system were: (1) the records of points earned for appropriate patient behavior formed the primary data. (2) After the points were recorded in a data matrix, graphs were prepared to show the behavior of individual patients, the participation of the patient group in the various ward activities, and an overall index of ward operation. (3) Several techniques were devised for reviewing the graphs so that the ward staff could evaluate the success of their procedures over substantial time periods.

We have recently designed a 24-hr point economy ward to prepare delinquent soldiers for successful completion of their regular tour of duty in the Army. A distinctive feature of this ward is its use of an information system for measuring patient behavior in which individual and group earnings and spendings are used as the primary data measurement. This paper describes the development and operation of the measurement system and emphasizes its use by the staff in the treatment process.

BACKGROUND

The treatment program is detailed elsewhere (Colman and Baker, in press; Ellsworth and Colman, in press). Briefly, a research ward, begun in January 1967 at Walter Reed, treated patients, diagnosed as having character and behavior disorders, for approximately 16 weeks and discharged them to active duty. The ward housed 16 men at a time and was staffed

by the normal complement of psychiatric staff, including one of us (A.C.), who had administrative control of the program.

Typically (according to their records), the patients were 21, single, and had enlisted in the Army after difficulty with a court, school, or family. They had a long history of school dropouts, job failure, and trouble with the police. Many had difficulty handling the routine of the Army field posts, were unpopular with peers in their unit, often went AWOL, had recurrent fights, and made "manipulative" suicide gestures.

In designing the treatment program, we assumed that these men failed in the military (and previously in civilian life) because of behavioral repertoires that provided inadequate reinforcements when operating legally in social situations. Our curriculum emphasized training in educational, occupational, and "group skills", such as written reports, drafting, and roles in ward administration. (See point-recording matrix in Fig. 1.) A point system was used to "pay off" desirable behavior. Points were paid to the men for behaviors that we believed would be reinforced in the future outside the ward. They could exchange these points for reinforcers in the system, such as cards, TV, passes, and extra education. The complete list is shown in Fig. 1. Although fines were levied infrequently, a board consisting of staff and patients met weekly to consider subtracting points for inappropriate behavior.

After 10 weeks on the ward, some of the patients were given a new status, Phase II membership, which offered access to most of

¹The authors wish to thank Allan Berry, Sally F. Oesterling, Donald L. Sturges, Agnes T. Small, and the staff of Ward 108 for invaluable technical assistance and conscientious work. We also are indebted to the Walter Reed General Hospital psychiatric residents, Drs. James Rumbaugh, Marvin Firestone, Theodore Robertson, and David Armitage, who were assigned to the ward and made major contributions to the clinical program. Finally, we appreciate the advice and support of Drs. David McK. Rioch, Joseph V. Brady, Jarl Dyrud, Israel Goldiamond, and Ewen Clague. Reprints may be obtained from John J. Boren, Department of Experimental Psychology, Walter Reed Army Institute of Research, Washington, D.C. 20012.

the ward's reinforcements without the use of points. In order to maintain Phase II membership, patients were required to perform general leadership duties such as teaching courses, running the unit at night, and supervising the ward work program. Members could be removed from Phase II if performance fell below the standards set by staff and the other Phase II individuals. This program offered a transition from control by the relatively immediate, consistent, positive reinforcement of the point system to more delayed, variable, aversive, and more naturalistic control systems of most environments. It also functioned as a test system for evaluating how much of the behavior learned under the control of the point system would transfer into a less-explicit control condition.

BEHAVIORAL MEASUREMENT SYSTEM

The primary data used for measurement was patient behavior that resulted in point earning or spending. These points were recorded directly on a data matrix designed as a daily economic balance sheet. Further data processing developed individual behavioral indices and group behavioral indices which summarized more complicated and long-term behav-

ioral patterns of patients. The description of these measures includes techniques for data review designed to focus staff attention on objective measures of patient behavior. Our aim was to put the staff under the control of the data system so that they could (1) evaluate their effect on the patients objectively and (2) devise more effective procedures for modifying the patient behaviors designated by the information system.

Data Matrix

Figure 1 shows the final version of a point-recording matrix used as the primary data collection and first-order display device. Earnings and spendings for each patient were immediately entered into the appropriate boxes. Cumulative totals such as total wages, total spendings, and daily balance were calculated daily. Point balances at the end of the week were put in a "bank" to use for special passes or additional discharge leave. Patients shifted to Phase II had their earnings and spendings recorded as a continuing measure of their behavior. The matrix was kept on a desk top, readily visible to staff and patients at all times.

In setting up the ward, we assumed that the record of earnings and spendings would be important in controlling the patients' behav-

	FIXED INCOME														ADDITIONAL INCOME						SPENDINGS																						
	FORMATION	INSPECTION	DETAILS	UNIT MEETING	P.T.	WRITTEN REPORT	TASK GROUP	COURSE	VERBAL REPORT	MISSION ASSIGN.	C.O. POINTS	ADJ. PTS. OWED	SPEC. CLEAN/UP	TOTAL WAGES	BONUS/REPORT	TEACHING CLASS	SOFTBALL PTS.	EVE. CLASS	TOTAL ADD/INC	BAL. FROM WED.	TOTAL EARNINGS	PASSES	"JIT" PASS	MOVIE PASS	CARDS	PLAYING POOL	TV EARLY	TV LATE	FEES/AREA	FEES/EARLY LUNCH	FEES/CONTRACTS	COFFEE FUND	BUYING FOOD	ADJ. PTS. NC	TYPEWRITER (OLD)	IRON & BOARD	INTERVIEW/DR	BUYING FOOD	TOTAL SPENDINGS	BAL. TO FRI.			
THURSDAY 20 JUNE '68 CENSUS: 14 SOLDIERS ON PHASE "I"																																											
EVANS	10	10	5	20	2	10	35	87						77	5	70	40	45	335	574																							
MARTIN	10	9	5	20	2	10	35	87						76		40	40	247	511																								
COLLINS	10	10	5	20	2	10	35	87						77		40	40	247	511																								
PRINCE	10	10	5	20	2	10	35	87						77		40	40	247	511																								
SOBOL	10	9	5	20	2	10	35	87						76		40	40	247	511																								
DUGAN	10	10	5	20	2	10	35	87						77		40	40	247	511																								
PICK	10	9	5	20	2	10	35	87						76		40	40	247	511																								
COLTER	10	9	5	20	2	10	35	87						76		40	40	247	511																								
CARLTON	10	10	5	20	2	10	35	87						77		40	40	247	511																								
POST	10	10	5	20	2	10	35	87						77		40	40	247	511																								
BUICK	10	10	5	20	2	10	35	87						77		40	40	247	511																								
SOLDIERS ON PHASE "II"																																											
LONER	10	9	5	20	2	10	35	87						76		40	40	247	511																								
KASE	10	10	5	20	2	10	35	87						77		40	40	247	511																								
RODMAN	10	10	5	20	2	10	35	87						77		40	40	247	511																								

Fig. 1. Point-recording matrix for a day's activities. The earnings are organized into two categories: (1) "Fixed income" from standard activities, such as the inspection and the educational course; and (2) "Additional income" from extra activities, such as teaching a class or playing on the softball team. The spendings on the right side of the matrix illustrate the reinforcers that the patients purchased with their points. The patients' names are fictitious.

ior. They would have to refer to it to plan their activities; point totals would soon become powerful conditioned reinforcers and stimuli for appropriate behavior. We only gradually realized the importance for staff of the point matrix. One of the first clues was staff's spontaneous substitution of the matrix for conventional nursing notes (which had been abandoned because of their usual focus on pathological behavior). In the absence of these notes, we noticed that when staff personnel changed shifts, they referred to the matrix in describing how individuals had behaved on the ward that day. It was being used as a visual record of performance in ward activities, educational and leadership roles, spendings, and fines. In fact, these records were discriminative stimuli for the staff; they carried an implicit set of instructions about how to behave toward each patient as a function of the level of behavior measured by the point earnings and spendings.

We noticed that certain parts of the original data system seemed to cue inappropriate staff behavior. For example, the early form of the matrix recorded negative balances, which were circled in red. But the red circles called staff's attention to the poorly functioning patients at the expense of those patients whose accounts were balanced. The economy and matrix were redesigned to exclude negative balances; patients were fined once a week and point balances reduced to zero, with the remaining debt made up as a work detail. These changes in the data system were consistent with ward policy of reinforcing appropriate behavior while ignoring disruptive behavior. Simply recording fines once a week further minimized staff's attention on negative behavior. Techniques were devised to direct the staff's attention to positive, objective performance. For example, staff calculated moment-to-moment sub-totals so that patients could keep track of their point balances. This had the effect of keeping staff aware of the patients' daily positive behavior (how different than the patient asking the staff: "How much did I get fined today?"). As another technique, the staff was asked to select a "Soldier of the Week". Since a major criterion of merit was total earnings, the staff had to examine the weekly point totals of each individual. In monitoring the "long-term contingency" the staff was asked to attend to six weeks of patient behavior.

Here, a patient earned an extra day off on a long weekend or holiday pass if he fulfilled specified requirements such as a minimum six-week earning total, five verbal reports, and no fine actions. All of these devices insured that staff members were in continued contact with the daily, weekly, and monthly patterns of patient behavior.

Individual Behavioral Indices

We soon found that the data matrix could not provide a practical measurement for patient behavior for more than a few days. Since one aim of treatment was to teach the man to behave consistently over many weeks under the control of longer-term contingencies, we needed a data display to help the staff evaluate long-term behavioral patterns.

To meet this need we developed an instrument for studying an individual's economic profile for the duration of his ward stay. An example for one patient is shown in Fig. 2. The graph is divided into sub-units illustrating the individual's cumulative earnings and spendings for a week. The first 12 weeks show many flat earning and spending curves, indicating little control by the ward program. During five of these weeks he was either AWOL or received fine actions. However, during the week of 26 June he showed an appropriate behavior pattern, which although gradually decreasing over the next three weeks, suggested that the problem was not a behavior deficit but rather that we had not found an appropriate reinforcer to maintain longer-term behavior. These data influenced the staff to search for alternative reinforcing procedures. We discovered that he liked a particular staff member whose job included buying food snacks for the ward store. We allowed him to help with the job contingent upon perfect attendance at work periods. This and other treatment strategies resulted in the strengthening of positive behavior apparent by early September. On Phase II, his spendings soared (a common response to the sudden availability of non-contingent reinforcements), but despite an initial reduction in total earnings, his positive behavior was maintained at the same level as on Phase I.

Group Behavioral Indices

As part of the research program on the ward, we had planned a number of experiments in

Fig. 2A. Weekly graphs of point earnings and spendings for one patient. "Balance after fines" was calculated by subtracting the amount of the fine from the total earnings. These graphs illustrate a technique for examining the pattern of behavior and the reinforcements of the individual patient.

Fig. 2B. Continued weekly graphs for the patient in Fig. 2A. The patient depicted above had a history of fighting, disorderly drinking, and trouble with the police both before and after entering the Army. He was admitted to Walter Reed Psychiatric Service after four months' active duty for threatening suicide and homicide with a recently purchased mail-order gun that he kept hidden in his bunk. He has since returned to active duty and for the last nine months has functioned successfully as a data processor on a nearby Army post, an outcome predicted by the ward staff from his response to Phase II.

which the dependent variable was the patient's participation in a given ward activity. We reviewed the results in a weekly meeting with research personnel. To our surprise, ward staff, traditionally hostile to research, wanted to be included in our meeting. They wanted to see how the experiments came out. They were even more interested in developing objective data on all aspects of the ward operation, particularly their "own" activities. They felt it would help them to know what was going on.

We saw in their interest an opportunity to add to the data review techniques for staff by plotting the daily and weekly per cent participation of the men in each activity. Staff could then evaluate new procedures more objectively. For example, we developed the weekly ward index shown in Fig. 3. This was a weekly sum of the per cent participation of the entire patient group in eight representative daily activities. It provided a measure of the overall participation of the men in the ward program, much as the Dow Jones Index alerts the investor to stock market trends. A daily ward index provided a more fine-grain analysis. These indices allowed staff to measure the consequence of their behavior on the ward. For example, we found a consistent drop in

the ward index during the three to four weeks surrounding the departure of the psychiatric resident or sergeant. This information led to an important advance in ward procedures; we added long-term contingencies during crisis periods. As a result of adding long term contingencies, we seemed to be able to maintain behavior at a baseline level through such difficult times.

In addition to overall ward index, the per cent participation of the men in each activity was graphed and reviewed. Each activity graph allowed the staff member in charge of that activity to become an experimenter, devising methods for increased participation or performance in his activity. Figure 4 shows the weekly per cent participation in the ward sergeant's daily inspection over a six-month period during which a new sergeant came to the ward. For many weeks before Sgt. Sturges' arrival on July 24, the inspection participation had varied between 35 and 50%, except for a drop to 18% on July 17 which preceded the loss of the retiring sergeant. With Sgt. Sturges' arrival there was a transient increase to 50%, but for the next three weeks a strong downward trend developed. To counteract this trend he first changed the inspection time to a more favorable hour and on September

Fig. 3. The weekly ward index over a period of more than four months. This graph illustrates a technique for recording the overall participation of all men in all ward activities.

Fig. 4. Participation in the inspection activity over four months. This graph illustrates a technique for measuring the participation in a ward activity, permitting the staff member in charge of that activity to evaluate the effectiveness of his procedures.

25 introduced the "lagniappe"² reinforcement system. These changes and the parallel increase in inspection participation are *not* construed by us as experimental demonstrations of behavioral control. Rather, they demonstrated the effective use of objective feedback from a data review technique to improve one aspect of Sgt. Sturges' work performance. He was able to identify a problem and experiment with changes with the assurance of having some measure of their effect. This kind of continually available learning opportunity seemed to have a major impact on staff's competence in modifying patient behavior.

An additional use of the activity graphs was to guide the ward administrator in exercising

quality control over the activities and modifying the point economy. For example, a systematic drop in one course compared to other activities suggested analysis and observation of the course, with the aim of changing the teaching technique or the subject matter. As another example, while comparing graphs on several activities, it was noted that the work program was less well attended than the unit meeting. Then it was found that the work program, which required hard work for several hours, offered fewer points than the half-hour unit meeting. As a result, points were shifted into the work program and participation increased.

Maintenance of the Information System

The reliability of the behavioral recording was not formally studied. However, the accuracy of the data was constantly monitored by both patients and staff. The patients audited their own accounts to insure that they received credit for all points earned. They also complained if points were improperly awarded to other patients. For example, since the "Soldier of the Week" was selected largely on the basis of a high point total, one man was likely to point out mistakes in another's earnings. As

²The lagniappe is a Southern Louisiana expression meaning gratuity or tip given with a purchase to a customer as a compliment or extra bonus. For example, a New Orleans fruit dealer might give a banana along with the purchase of 10 apples, calling it a lagniappe. Point payment for inspection had been on a 0 to 10 continuum depending on appearance, bearing, etc. Sgt. Sturges introduced into this reinforcement continuum a 10-sharp and 10 sharp-sharp at the upper end of the scale, non-exchangeable verbal gifts greatly valued by the men as reflected in the increased behavior. (This concept was first called to our attention by Dr. Thomas Lewis.)

another example, if the ward sergeant awarded points to one man during inspection for neatness of dress, another man not receiving points would want to know why. Repeated questioning of this nature appeared to force the sergeant to award points on a fair and objective basis. Although a ward technician was assigned to record attendance at every activity, we arranged alternate checks. Course instructors were asked to turn in a separate attendance record. Furthermore, the ward sergeant monitored each activity because she was held responsible for the accuracy of the data matrix by the ward administrator (A.C.), who spot-checked the accuracy of the recording.

Some aspects of the information system were automatically maintained by inherent reinforcement contingencies: since the point awards were public knowledge, the patients could audit their own accounts. However, the appropriate use of the information system required the intervention of the senior staff. The ward administration had to reinforce the staff behavior of using the behavior indices in Fig. 1 to 4. This was accomplished largely through two weekly meetings where the ward data was reviewed. Here, the ward administrator and his staff carefully scrutinized the week-to-week changes in the graphs and commented favorably on effective new procedures.

DISCUSSION

In the experimental analysis of animal behavior, the investigator's ability to control behavior is largely dependent on his ability to measure it; he has a large number of sophisticated measuring instruments at his disposal. Just as the cumulative recorder of the pigeon's responses can control the investigator's next responses in his experiment, so the point

records can influence the staff's responses in the treatment program.

The information system had the following main features:

(1) The record of points earned and the behavioral measurement system were identical. Other measures, such as rating scales and nurses notes, were not essential.

(2) The staff's attention and work was directed toward increasing objective, positive behaviors of the patients.

(3) Data review techniques allowed the staff to evaluate the effectiveness of their procedures on patient behavior.

Point economy "managers" are increasingly finding that the control of staff behavior is as important and often more difficult than control of patient behavior. The option of controlling staff's monetary reinforcement or job security is rarely available to the manager. On our ward, one of the few aspects of the staff environment totally under our control was the behavioral measurement system. We suggest that the techniques described in this paper can aid staff in their professional roles as behavior modifiers.

REFERENCES

- Colman, A. D. and Baker, S. L., Jr. Utilization of an operant conditioning model for the treatment of character and behavior disorders in a military setting. *American Journal of Psychiatry*, in press.
- Ellsworth, P. D. and Colman, A. D. Occupational therapy in a military milieu unit: the application of operant conditioning principles to work group experience in the treatment of character and behavior disorders. *American Journal of Occupational Therapy*, in press.

Received 5 March 1969.

(Revised 5 June 1969.)