THE UNIVERSITY OF MANITOBA

BEHAVIORAL MANAGEMENT OF COMPLIANCE WITH PHYSICAL THERAPY HOME REGIMES IN CHRONIC OBSTRUCTIVE LUNG DISEASE PATIENTS

by

Joanne J. Swain

A Thesis

submitted to the Faculty of Graduate Studies in partial

fulfillment of the requirements for the degree of

Master of Arts.

Department of Psychology

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Abstract

Rates of patient compliance are low among chronically ill individuals who must follow complex home exercise regimes. For physical therapists who work closely with this population of patients, noncompliance is a frustrating obstacle to providing optimal patient medical care, with detrimental consequences to the patients' health. Despite the severity of the problem, strategies to increase compliance with physical therapy regimes have received scant experimental investigation. The major obstacle to such research is a lack of objective measures of exercise compliance. To date, unreliable patient reports have been the prime data source.

In the present study compliance was measured as patient exercise performance on two exercise endurance tests; the 12-minute walk test and the step-up test. The specific performance measures recorded during these tests conducted in the patients' homes included: 1) duration of the test; 2) the distance walked in metres or the number of step-ups completed; and 3) the patients' exercise and resting heart rates. These objective physical measures were a preferred alternative to the unreliable patient reports used in previous studies.

A behavioral program designed to increase patient compliance with physical therapy home regimes was implemented with four chronic obstructive lung disease patients. The components of the program included: 1) self-control techniques such as a) patient self-recording of daily exercises, b) patient self reinforcement of daily exercises, and c) patient implementation of written prompts for exercise in the home; 2) exercise performance feedback on the physical endurance tests; and 3) social reinforcement for increased performance and compliance behavior. It was predicted that the behavioral compliance program would

produce an increase in exercise performance for all patients, in comparison to baseline. More specifically, it was hypothesized that when the behavioral compliance program was introduced to the patients; 1) the patients would be able to walk longer and 2) walk further during the 12-minute walk test; and 3) the patients would be able to climb stairs longer and 4) perform more step-ups during the step-up test; and 5) both resting and exercises heart rates would decrease by the end of the compliance program as a function of increased physical conditioning, after a temporary initial increase in exercise heart rate at the beginning of the program as a function of increased physical exertion.

To test these hypotheses and the effects of the behavioral compliance program, a multiple baseline design across four patients was implemented. The patients who participated in the study had been referred by their physicians to a hospital respiratory physiotherapy program for treatment of chronic lung disease. In comparing the exercise performances of the patients during the behavioral compliance program with performance levels during baseline, it was determined that the behavioral program substantially increased exercise performance. The results clearly indicated that the patients were able to climb more stairs for a longer period of time and were able to walk further distances, after introduction of the compliance program. These substantial increases were immediate and were maintained throughout the duration of the program. In addition, although two of the patients walked the maximum 12 min. during baseline conditions of the 12-min. walk test and therefore could not increase their walking time, the other two patients showed a clear, large increase in their walking durations. Unfortunately, the heart rate data were too variable to observe the predicted changes clearly, although there were strong indications that resting and exercise heart rate had decreased by the end of the program for three of the four patients.

Since daily exercise has been found to increase exercise performance during exercise tolerance tests, and since patient compliance with the physical therapy exercise regime was the programmed behavior, it was concluded that the observed increases in exercise performance were a direct result of increases in patient compliance. The results were clinically verified by the physiotherapist's assessments on the treadmill, where all patients showed an increase in exercise performance sufficient to preclude further immediate physiotherapy treatment. Thus, in summary, the behavioral compliance program produced a clinically significant increase in compliance with the physical therapy regime, as indicated by increased exercise performance.

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Members of the medical profession are continually confronted with the unsolved problem of patient noncompliance with medical regimes (Gillum & Barsky, 1974). The problem is a significant one, since a large portion of a physician's or therapist's time is often spent trying to convince the patient to follow prescribed medical instructions. However, although the failure of patients to comply with therapeutic regimes has long been an obstacle to medical professionals in their work, only in the last 20 years has patient compliance been specifically studied (Ball, 1974). As a result of these investigations it has been well documented that compliance with all types of medical regimes occurs at levels well below optimal (Mayo, 1978; Becker & Maiman, 1975).

The Importance of Patient Compliance

Patient noncompliance is probably the single greatest obstacle to providing effective medical care (Dunbar & Stunkard, 1977). It is important to successfully combat patient noncompliance, since it interferes with the quality of treatment that a patient receives (Becker & Maiman, 1975). It does so directly, by preventing the potential benefits of the treatment program which are only attainable through regular compliance; and indirectly, by involving patients in further therapy which would have been unnecessary, if the original therapeutic regime had been followed carefully. Furthermore, in experiments designed to test the benefits of therapeutic regimes, poor compliance may result in an underestimation of therapeutic efficacy (Epstein & Masek, 1978; Zifferblatt, 1975). Thus, it is essential that patients be compliant with medical regimes, so that the regimes, themselves, can be accurately evaluated (Mayo, 1978; Moon, Boon & Black, 1976).

Current Research Trends in Patient Compliance

Although the medical literature on patient compliance is fairly substantial and encompasses a variety of issues and problems, it is also largely unscientific (Zifferblatt, 1975). The literature contains numerous studies which utilize either inadequate means of measurement and data collection, or poor experimental design. Thus, the compliance research in general has yielded a multiplicity of findings which are often confusing and contradictory (Gillum & Barsky, 1974; Becker & Maiman, 1975).

Factors Which Influence Patient Compliance

A large body of the research on patient compliance has focused on the isolation of factors which influence compliance (e.g., Becker & Maiman, 1975; Carpenter & Davis, 1976; Gillum & Barsky, 1975; Davis, 1966). The basic procedure followed in these studies involves measuring compliance, usually by patient self-reports, and then categorizing the patients' reports according to various variables. The results of these studies are, however, largely variable and sometimes conflicting. To illustrate, Gillum and Barsky (1974) concluded from their study, that there are four factors which affect noncompliance most consistently: 1) psychological factors such as patient "attitudes"; 2) environmental factors such as economical or occupational status; 3) characteristics of the medical regime such as complexity; and 4) properties of the physician-patient relationship such as degree of communication. While there has been general agreement that the complexity of the regime does influence compliance (Carpenter & Davis, 1976; Mayo, 1978), there has been less consensus in regards to the other factors that they identified. Haynes (1976), for example, found little association between sociodemographic features and noncompliance. Some studies have shown that the patient's view of illness severity does not seem to correlate with compliance, whereas the actual severity of the illness does (e.g., Francis, Korsh & Morris, 1969; Charney, Bynum & Eldredge, 1976). Donabedian and Rosenfield (1964) concluded that a patient's belief in the efficacy of the treatment influenced patient compliance, however, Carpenter and Davis (1976) found no association between these factors. Thus, hardly a clear picture of important variables affecting compliance has emerged.

The factors which influence patient compliance are as multiple as the studies which have researched the issue. In attempting to organize the results of these studies, it is important to consider the ultimate practical value of knowing whether certain factors do or do not adversely affect compliance. For example, a number of studies have investigated the association between patient compliance and patient characteristics such as socioeconomic status, ethnic attitudes and personalities; all of which are inconclusive indicators of compliance (Zifferblatt, 1975). Reseachers studying such factors attribute noncompliance problems to the patients themselves, i.e., to some aspect of their personality. The problem with this focus is that even if certain personality factors were demonstrated to be significant, reliable indicators of noncompliance, the usefulness of this knowledge is limited, since there is no direct relation of such knowledge to treatment programs.

In contrast to defining noncompliance in terms of personality or illness characteristics, an alternative approach is to define compliance in terms of behaviors; in terms of what people actually do. Such a strategy leads directly to treatment programs to change patients' behavior, so that compliance can be increased (Zifferblatt, 1975). At best, patient characteristics may cue medical personnel that a patient may not be compliant, but the problem of improving the compliance remains largely unsolved.

Degree of Noncompliance

Drug regimes. Another sector of the literature on patient compliance involves investigation of the extent to which noncompliance exists in the medical field. Research in this area has basically followed two main streams: studies concerned with medicinal regimes; and studies concerned with other types of regimes (e.g., dietary restrictions, exercises). Of the two, research has been conducted primarily on compliance with drug regimes (Epstein & Ossip, 1979). In general, approximately one third of all patients studied, are noncompliant in terms of drug taking (Davis, 1966). Furthermore, between a quarter and a half of all outpatients completely fail to take any of their medications (Blackwell, 1973). Some researchers have estimated the percentage of the population not fully complying with drug regimes to be as high as 92% (Marston, 1970). Although the specific estimations of patient noncompliance vary from study to study, all estimations indicate that patient noncompliance with drug regimes is a serious problem.

Other regimes. The factor which has been found to have the greatest effect on patient compliance, is the type of therapeutic regime (Pomerleau, 1979). Regimes which demand more than intake of oral medications; regimes which require a change in a patient's established life style, are complied with much less frequently than drug prescriptions (Mayo, 1978;Gillum & Barsky, 1974). One study with diabetic patients reported that only one out of 60 patients complied with a regime requiring a special diet, urine testing and insulin administration (Watkins, Williams, Martin, Hogan & Anderson, 1967). Williams, Anderson and Watkins (1967) found that only 23% of diabetics studied followed dietary regimes for a full week. Like special dietary changes, prescribed physical exercise regimes also require a change in established habits. Bruce, Frederick, Bruce and Fisher (1976) found that 352 out of a total 603 subjects dropped out of a community cardiopulmonary rehabilitation program indicating difficulty in revamping exercise habits.

Since any medical regime necessitates some behavior change, it is understandable that a patient is most likely to comply with those aspects of the regime which are the least difficult to change. Taking oral medication is often the behavior which is least disruptive of a patient's basic life style, and may therefore, be carried out. On the other hand, changes in habits such as exercise programs or diets are the most difficult to comply with, as they are disruptive of pre-existing behaviors, and are therefore less likely to occur (Gillum & Barsky, 1974). The problem of patient noncompliance is further complicated for patients with chronic illnesses. While compliance with exercise or dietary regimes is lower than compliance with drug regimes, it is especially problematic to get patients with long-term diseases to follow long-term, complex medical regimes (Carpenter & Davis, 1976). Patients who suffer from chronic diseases must usually follow an exercise regime at home over a long period of time, frequently with little immediate improvement in their condition. Thus, home exercise programs may be especially difficult to maintain for patients with chronic medical disorders.

Assessment of Compliance

A major problem encountered in the research on compliance behavior is assessment. Central to the study of patient compliance with medical regimes is the issue of whether or not measures of compliance are reliable (Russo, Bird & Masek, 1980). It is absolutely essential that measures in compliance research be reliable, so that valid research may be conducted (Mayo, 1978).

Drug regimes. Much of the research concerned with adherence to medical regimes has focused on drug therapy since objective, reliable methods of measuring drug compliance have been developed (Mayo, 1978; Roth, Caron & Hsi, 1971; Russo, Bird & Masek, 1980). Objective measures have been possible, since traces of the drug or of some inert tracer attached to the drug, can be detected in the blood, urine, sputum or sweat (Mayo, 1978; Souter & Kennedy, 1974). Thus it can be objectively determined whether a drug has been ingested, although not whether precisely the correct dosage was followed (Charney, Bynum & Eldredge, 1967). Pill counting is another method of measuring drug compliance; however, there is evidence that this method is less reliable than, e.g., using tracers, since a patient may remove a pill from its container, but not ingest it (Roth, Caron & Hsi, 1970). The least reliable measure of compliance is the patient's own reports, which have not always been found to be in agreement with more objective measurements (Bergman & Werner, 1963; Park & Lipman, 1964).

Other regimes. The assessment of compliance to therapeutic regimes which require exercise and other life-style changes, is met with the same reliability difficulties as assessment of drug compliance (Russo et al., 1980). Despite the questionable reliability of self-reports, this is the measure most frequently used in studies of compliance with regimes other than drug therapy. More research is necessary, so that reliable measures of compliance with regimes such as exercise programs can be developed; measures comparable to those for drug compliance research.

Strategies to Increase Compliance

A final area of concern in the literature on patient compliance, is the study of strategies for increasing compliance. Although it is critically important to evaluate programs designed to improve compliance, such studies are relatively few in comparison to the amount of research into issues such as the correlative variables which influence compliance (Haynes, 1976). One factor which has contributed to this situation is the problem of measurement previously discussed (pp. 6-7). As objective measures are now being developed, so, too, are programs to increase compliance behavior. As is generally the case in the patient compliance literature, most of these studies of strategies to increase compliance have been conducted with drug regimes, since fairly objective, reliable measures have been developed in this area. Although most of the data gathered on programs to increase patient compliance have come out of drug therapy studies, much of this information is also applicable to programs designed to improve patient compliance with exercise or dietary regimes.

Of all the methods for changing peoples' behaviors, education is the one most frequently utilized. Within the specific area of patient compliance, it has been documented that although education may increase an individual's level of knowledge, in and of itself, it does not alter behavior patterns, i.e., it does not increase compliance to medical regimes (Gillum & Barsky, 1974; Mayo, 1978). In one study, Sackett, Haynes, Gibson, Hackett, Taylor, Roberts and Johnson (1975) investigated the effectiveness of an educational strategy to increase compliance. The subjects were steelworkers receiving anti-hypertension medications and were divided into two groups; one group who received medical treatment conveniently at work, and another group who were treated in their physician's office. One half of the subjects in each of these groups were then presented with a hypertension educational package. The results showed that in comparison to control groups, neither access to treatment, nor mastery of information, affected patient compliance.

Although patient education has been the focus in efforts to increase compliance, there is little research evidence to support these types of programs. Given the lack of success of educational strategies to increase patient compliance, there is a clear need to develop more direct methods of changing compliance behavior (Sacket et al., 1975).

Compliance with Physical Therapy Regimes

A review of the literature regarding the general area of patient compliance has revealed the importance of this issue. While the problem of noncompliance is relevant to all medical professionals, it is of particular concern to physical therapists because of the specific types of diseases with which they work, and the kind of therapeutic regimes which they prescribe. Physical therapists are the members of the health team who are most often involved with chronic long-term conditions such as arthritis, strokes and cardio-respiratory disorders; conditions which are typically associated with poor compliance (Mayo, 1978). In addition, a large portion of the treatment prescribed by the physical therapist requires the patient to carry out daily home regimes, such as exercise programs. As has been previously discussed (pp. 4-5), such complex, long-term medical regimes typically result in noncompliance (Carpenter & Davis, 1976; Gillum & Barsky,1974; Mayo, 1978). Also, because physical therapists work with many individuals on an outpatient basis, in many cases they have limited contact, and therefore control over, home compliance behaviors (Fordyce, 1976).

The physical therapist should be aware of the degree of noncompliance which is likely to be encountered, and should work to ensure that patients are accurately following home medical regimes. It is also extremely important that physical therapists know whether or not their prescribed regimes are being followed, so that their therapeutic exercises may be evaluated. To date, many physical therapy regimes have simply not been evaluated for their efficacy (Mayo, 1978).

Research Into Compliance With Physical Therapy Regimes

Mayo (1978) reviewed the literature on compliance and found research with physical therapy regimes severely lacking. She cites a handful of studies involving compliance with home program regimes, all of which involve patients with arthritis. In one study, Carpenter and Davis (1976) assessed patient compliance with a home exercise program, 4 mo. after patients had been discharged from the hospital. Compliance was both qualitatively and quantitatively defined in terms of how much and how often a patient complied with the regime. Compliance was assessed by a series of questions presented to the patient and this measure was "cross checked" against 1) a home evaluation form in which compliance was documented by a visiting health professional, 2) a 20 day patient record of activity, and 3) a social work interviewer's opinion. It was found that 44.5% of the patients were complying with their prescribed regimes after 4 mo. However, since only one measurement was taken, it is impossible to know what the percentage of compliance was before this period. In addition, the self-recorded and opinion data suffer deficiencies in experimental objectivity (Bergman & Werner, 1963; Park & Lipman, 1964).

Treusch and Krusen (1943) sent questionnaires to 346 patients who had been prescribed a home treatment program for arthritis. Only 218 patients replied and of these almost 10% did not follow their regime at all, and nearly 30% carried out the treatment for only 0 to 2 mo. The remaining patients implemented home treatment between 3 and 12 mo. Oakes, Ward, Gray, Klauber and Moody (1970) studied compliancy with a hand-splint regime with 66 arthritis patients. Compliance was measured by patient responses to a questionnaire. These "self-reports" were validated by comparison with a family member's responses to the same questions. Of the patients assessed at 6 mo. intervals, 32% reported that they wore the splint less than one half of the time. Family members agreed with the patients only 53% of the time. In a similar study, Moon, Boon and Black (1976) found that of 46 patients studied with arthritis, only one third complied with the splint wearing regime. Compliance was measured by questioning the patients and their physicians. Thus, the meagre literature on compliance with physical therapy regimes has focused only on the degree of noncompliance that exists, rather than on treatment programs to improve compliance levels. In addition, the research has not been well controlled (e.g., poor experimental designs, subjective measures).

Measurement of Compliance With Physical Therapy Regimes

In reviewing the existing literature on compliance in the area of physical therapy, it becomes apparent that measurement is a major problem. The exercises prescribed by the physical therapists are done largely on an outpatient basis in the home, where there is little contact between patient and therapist. As a result of this limited contact in the home, measurement of compliance is extremely difficult and is always a problem (Epstein & Masek, 1978). Physical therapists most frequently use patient self-reports as a measure of compliance, even though these have been shown to be unreliable (Bergman & Werner, 1963). Mayo (1978) suggests a number of measures of compliance which presently have not been utilized or evaluated. She suggests self recording (journal keeping), family member estimations, appointment keeping data and random personal home observations as alternatives to the questionnaires typically used. Although completely objective measures of compliance such as those used in drug studies would seem impractical (e.g., continuous therapist or spouse monitoring in the home) for physical therapy regimes, it seems clear that measurements more objective than the patient self-report questionnaires presently used, must be developed.

Programs to Increase Compliance With Physical Therapy Regimes

Physical therapists may be aware that patients are not complying with home exercise programs, but they often do not know what to do to correct this situation. Frequently what happens is that the therapist "overloads" patients with information in hopes of persuading them to change their behaviors (Mayo, 1978). As acknowledged previously for drug regimes (p. 8), this type of educational strategy, in and of itself, has not proven to be effective in increasing patient compliance (Sackett et al., 1975; Mayo, 1978). No other programs directed at increasing compliance have been studied with physical therapy regimes.

Behavior Modification and Patient Noncompliance

The Behavioral Approach to Patient Noncompliance

Direct strategies to increase compliance behavior have long been overlooked in research and medical program development, although failure to change patient behavior is now necessitating a reversal in outlook. This reversal is precisely the direction taken in a behavioral approach to the problem of patient noncompliance. Within the general field of medicine, there has been an increasing trend towards implementing behavioral principles, and their utility has been convincingly demonstrated (Fordyce, 1976; McNamara,1979). This new melding of behavioral psychology and medicine is not surprising given that difficulties in patient management and treatment often exist as the absence of appropriate behaviors or the presence of inappropriate behaviors (Bryan, Asken & Shienvold, 1978).

Patient noncompliance is a behavior problem in that the patient does not follow recommended medical instructions prescribing appropriate remedial behaviors (Epstein & Masek, 1978).

Behavioral analysis of compliance behavior. In an operant conditioning analysis, patient compliance is an operant behavior which is cued by discriminative stimuli and controlled by its consequences (Zifferblatt, 1975). The stimuli which prompt a patient to follow a medical regime include, at a minimum, the physician's or therapist's instructions to carry out various components of the prescribed regime and the physical symptoms experienced by the patient. Important to whether or not the patient will emit compliance behaviors in the presence of the discriminative stimuli (i.e., medical regime instructions) in the future, are the consequences which follow compliance behaviors. That is, as an operant, regime-following behaviors must be reinforced in order to be maintained. If patients are not reinforced for compliance to medical regimes, then they will not be compliant in the future. Some patients may receive enough reinforcement in their "natural" environment, i.e., from friends or family members, to maintain their compliant behavior. Often, however, appropriate reinforcement does not follow compliant behavior. It is then necessary that the patient's environment be arranged such that reinforcing consequences follow compliant behaviors, so that they are strengthened and maintained.

Behavioral control of drug compliance. Although regime-following behavior can be understood through behavioral analysis, the behavioral control of medical compliance has not yet been thoroughly researched.

However, research which has been conducted, has demonstrated the benefits of behavioral procedures in improving medicinal compliance. For example, Bigelow, Strickler, Leibson and Griffiths (1976) contracted with 20 male alcoholic outpatients, and asked for a deposit of 100 or 150 dollars, depending on what the patient could afford. The patients were required to attend appointments during which Antabuse intake was supervised. These appointments were scheduled every day for two weeks and then every other day for at least 3 months. Whenever a patient did not attend an appointment he forfeited 5 or 10 dollars, depending on the original deposit size. The results were impressive: the patients were abstinent over 95% of the treatment days. In another Antabuse-intake study, Haynes (1973) offered 138 frequently arrested alcoholics the option of receiving Antabuse treatment twice a week for a year or going to jail for 90 days. One year later, following implementation of this response-cost procedure, almost half of the patients were still on Antabuse and the arrest rate of the patient sample had decreased from 3.8 to 0.3 arrests per year. While these results were positive, neither of these studies employed a control comparison. Thus, further controlled empirical investigation is needed in order to determine the effectiveness of the program.

Epstein and Masek,(1978) investigated the effectiveness of several behavioral procedures to control vitamin C intake with 85 college students on an "outpatient" basis. Noncompliant subjects were divided into four groups: 1) a no treatment control group; 2) a self-monitoring group in which subjects recorded at what time they ingested their pills; 3) a taste group where subjects received various flavored pills; and a self-monitoring plus taste group. Three weeks later, after these procedures had failed to produce satisfactory levels of compliance, one half of the subjects from each group was introduced to a response-cost condition. In this treatment condition, a dollar was forfeited by the subject each week that a specified level of compliance was not reached. Results showed that self-monitoring and response-cost procedures produced a significant increase in compliance behavior. It is not entirely certain, however, whether the effects found were a function of the response-cost program itself, or of the fact that the subjects were now aware that their compliance was being monitored.

Behavioral control of non-drug regime compliance. Although very few in number, there are studies which have utilized behavioral procedures to increase compliance with regimes which require more than simple oral medication. Malament, Dunn and Davis (1975) conducted a study with noncompliant paralyzed patients who would not follow instructions to do wheelchair pushups to prevent the development of pressure sores. They developed an avoidance learning procedure in which an alarm sounded if 4 sec. pushups were not performed every 10 min. For the subjects who received this contingency, increased frequencies of wheelchair pushups were observed. During baseline, subject 1 performed a mean of 3.1 pushups per session and would have experienced 63% of the possible alarms. After treatment was introduced, the mean number of pushups per session increased to 8.3 and the percentage of total possible alarms decreased to 6.7%. Although subject 2 performed an average of 14.5 pushups per session during baseline, performance rate was erratic and 33% of the possible alarms would have sounded. Following introduction of the avoidance learning procedure, pushups were performed at a consistent rate of 10.7 per session and only .3% of the total possible alarms were sounded. Inspite of these positive results, there was a major problem of design. Although the authors withdrew the aversive alarm in the third phase, an increased rate of pushups was maintained. This maintenance may be desirable from a clinical perspective; however, the fact that compliance did not decrease after withdrawal of treatment weakens the demonstration of treatment control of compliance. If the authors did not want the behavior to reverse, they might have introduced the treatment sequentially across subjects in a multiple baseline design (Hersen & Barlow, 1976).

While the previous study involved the aversive control of patient compliance, positive consequences to compliance behaviors have also produced promising results. For example, Barnes (1976) worked with a hemodialysis patient who was intaking excessive amounts of fluid. Small ammounts of water were available as a reinforcer for following dietary restrictions and a token system was developed where points were earned for daily weight gains of less than two pounds. Results showed a decrease in weight gain as well as decreases in standing blood pressure, thus indicating an increase in compliance in comparison to baseline. However, in this study only a basic A-B design was utilized. In order to demonstrate convincingly that the increase in compliance was a result of the treatment alone, possible solutions would include implementing a return to baseline in an A-B-A reversal design, or sequentially introducing the treatment across subjects in a multiple baseline design (Hersen & Barlow, 1976).

Although there have been experimental control problems in previous compliance research, the results of behavioral programs have been encouraging. Thus, behavioral principles and procedures stand to make a significant contribution in the study of patient noncompliance. Not only are behavioral approaches to noncompliance effective, but they are also relatively accepted by medical professionals (Bryan et al., 1978). One reason for this acceptance is that behavioral interventions have been demonstrated to be successful in terms of objective, practical data and replicable results. These characteristics of behavior change conform well with the scientific, experimental approaches of the medical sciences. Furthermore, behavior change is relatively rapid, and behavioral principles and techniques can be relatively easily learned and implemented by medical personnel untrained in behavior modification (Bryan et al., 1978).

Self-Control Procedures to Improve Patient Compliance

Given the need for specific strategies to increase compliance with medical regimes, a number of behavioral procedures are available for application to compliance behaviors, such as token economy systems (Barnes, 1976) and response-cost (Epstein & Masek, 1978). Of the variety of behavioral programs that can be used, self-control techniques seem to be of special relevance to the problem of patient noncompliance. Traditionally, the patient's behavior has been considered controlled by the physician or therapist. However, while medical personnel may influence patient compliance by the regimes they prescribe or by their interactions with the patient, the events which most strongly determine compliance are the everyday behaviors of the patient, her or himself (Zifferblatt, 1975). In other terms, noncompliance may be profitably conceptualized as largely a problem of self-control.

Patient noncompliance, as a self-management problem, may be the result of a number of specific factors. First, it may be a matter of poor stimulus control. If patients do not have stimuli in their environment which cue them to follow the regime, then they may forget completely, or else remember the regime at inappropriate times, e.g., while leaving the house, when it is not possible to follow medical instructions. Second, poor compliance could be the result of immediate aversive consequences which succeed regime-following behaviors. For example, performing prescribed exercises may produce discomfort for a patient and thus compliance is punished. Third, behaviors incompatible with the desired adaptive compliance behaviors may be effectively maintained by immediate reinforcement, e.g., reading a book, watching T.V., sleeping. Despite the delayed aversive consequences of not adhering to a regime (e.g., deteriorated physical condition) and the delayed reinforcing consequences of adherence to the regime (e.g., improved physical condition), the patient's behavior is controlled by other events in the environment and she or he does not comply with medical instructions.

To correct this situation, it is important that the environment be altered such that there exist: 1) stimuli which will prompt an individual to comply with the medical regime; and 2) new reinforcing consequences for adaptive compliance behavior which interfere with a) the immediate reinforcing consequences of maladaptive behaviors incompatible with compliance behaviors, and b) the immediate aversive consequences of compliance behaviors (e.g., discomfort). This can be accomplished in two ways: first, by directly modifying the environment of the patients to modify their behaviors, or second, indirectly, by self-management techniques which involve teaching the patients to modify their own environment such that it modifies the problem behavior (Pomerleau, 1979).

A self-control program would involve the patients in modifying and controlling their own compliance behavior by: 1) self-observation; 2) setting goals; 3) identifying realistic means to achieve goals; and 4) evaluating outcomes (Zifferblatt, 1975). In this way, the patient and the doctor or therapist work together to solve the medical problem and both doctor and patient experience their role in improving compliance as more mutually satisfying. Behavioral self-control techniques have been well studied and have been shown to be effective in altering a variety of behaviors, e.g., decreasing cigarette smoking (Lipinski, Black, Nelson & Cimenero, 1975), decreasing alcohol consumption (Sobell & Sobell, 1973), increasing grades (Johnson & White, 1971), decreasing shoplifting (Epstein & Peterson,1973) and decreasing weight (Mahoney, 1974). In addition, self-control techniques have been found to frequently produce durable results and therefore they fit well into the current emphasis on long-term maintenance rather than short-term intervention (Pomerleau, 1979).

<u>Feedback Procedures to Improve Patient Compliance</u>

Another behavioral program which would be particularly applicable to patient compliance is the provision of performance feedback. Feedback can work as a reinforcer (Panyan, Boozer & Norris, 1970). If patients could see that they are making progress as a result of following a regime, this could be a reinforcing consequence to regime-following behaviors and thus compliant behaviors would be strengthened. A feedback procedure would be especially important with patients suffering from chronic illness, since in these cases the effects of the regime may not be readily evident

(Carpenter & Davis, 1976). Providing the patient with some type of performance feedback, whether it is verbal, written or in the form of graphed data, would likely be effective in increasing compliance. A physical measure which would be sensitive to compliance could be taken by the therapist during each appointment and provided as feedback to the patient. Feedback has been investigated and found to be effective in the modification of number of behaviors including fuel consumption (Seaver & Patterson, 1976), academic performance and peer interaction (Van Houten, Hill & Parsons, 1975), and staff-client interaction time (Panyan, Boozer & Morris, 1970).

Summary and Behavioral Intervention

Convincing patients to comply with their prescribed medical regimes continues to be a problem for medical professionals (Gillum & Barsky, 1974). Patient noncompliance not only interferes with the quality of medical care that a patient receives (Carpenter & Davis, 1976), but also prevents accurate evaluation of therapeutic regimes (Mayo, 1978). The issue of compliance is particularly important to physical therapists for a number of reasons. First, physical therapists are the members of the medical team who have the most contact with patients who have chronic, long-term medical problems; and chronic patients are typically less compliant than patients with acute illnesses (Carpenter & Davis, 1976). Second, the medical regimes which physical therapists prescribe for chronic long-term illnesses typically involve complex exercise routines and a generally altered life style. Such regimes are associated with poor compliance (Dunbar & Stunkard, 1977). Third, many of the patients with whom the physical therapists work are outpatients. Since regimes are carried out at home, the therapist has less contact and therefore, presumably less control over a patient's regime-following behaviors. Outpatients have been found to be less compliant than patients in the hospital (Blackwell, 1973; Epstein & Masek, 1979). Fourth, patient compliance is essential so that various physical therapy regimes can be evaluated (Mayo, 1978).

It is therefore important that strategies be developed which will promote patient compliance and thus ensure more effective therapy for the patient (Mayo, 1978). However, although patient compliance is a critical issue for physical therapists, there has been little research conducted in this area. Although objective measures of compliance have been developed for drug studies (Russo et al., 1980; Mayo, 1978), no reliable measures of compliance have been utilized in research with exercise regimes. Patient self-reports, which have been shown to be unreliable measures of compliance, continue to be the prime data source (Park & Lipman, 1964; Mayo, 1978). In addition, strategies to improve compliance with physical therapy regimes have not been systematically researched.

Behavioral compliance program. Although research specifically dealing with physical therapy regimes has been limited, useful information may be gained from the growing number of successful applications of behavior modification techniques to increasing compliance with drug regimes (Mayo, 1978). In the present study, behavioral strategies to improve patient compliance with physical therapy exercise regimes were investigated. The components of the program included; 1) instructing patients in behavioral self-control techniques including: a) self-recording, b) self-reinforcement, and c) setting up written exercise prompts in the home; 2) providing verbal and graphed exercise performance feedback on physical endurance tests to the patients; and 3) providing social praise for increased exercise performance and compliance.

Since compliance with physical therapy regimes has been virtually uninvestigated, it was decided that a total treatment package consisting of self-control procedures, performance feedback, and social reinforcement procedures should be implemented, rather than a single-variable approach. Such "package" programs are sometimes criticized, since the effectiveness of single variables cannot be identified. However, Azrin (1977) suggests that new areas of clinical research receive a total treatment package, with as many components as are necessary to obtain the largest possible treatment effects. When successful results are obtained with the package program, then analytic studies of the program components may proceed.

Subjects. The subjects who participated in this study, were patients diagnosed with chronic obstructive lung disease (COLD). This patient population was selected as a result of the particular seriousness of this type of disease. The problem of COLD is an enormous one, both in terms of numbers and in terms of its detrimental effects on individuals (White, Andrews & Downes-Vogel, 1979). In 1974 13.8 million persons in the United States alone, suffered with COLD. Chronic obstructive lung disease is the leading cause of death from lung disease and is the second leading cause of disability under social security. In addition, the economic cost of these respiratory diseases is huge: billions of dollars are spent in medical bills and many more billions of dollars are lost to the economy from illness and death. The severity and size of this particular problem is obvious. In addition to its wide spread nature, COLD is a chronic disease and as such it demands dramatic lifestyle changes. As previously discussed (pp. 5, 8), it has been well documented that medical personnel treating chronic patients such as these, encounter high rates of noncompliance (Mayo, 1978).

<u>Exercise performance; an indirect measure of compliance</u>. Before the problem of patient noncompliance with physical therapy regimes can be solved, the issue of a lack of objective measurements must first be settled. A general view is that physical therapists must continue to rely on patient reports as measures of compliance with exercise regimes, since there is little in the human body which can be analyzed to determine if an exercise regime has been followed (Mayo, 1978). Although this seems likely, there are no data to support the statement.

Another possibility that should be investigated, is the development of a physical measure of compliance; a measure not of something "in the body", but rather of some "ability" of the body, such as what a tolerance test measures. If a chronically ill individual in poor physical condition is doing exercises as prescribed, a tolerance measure such as the total distance walked on a treadmill, should increase. Although tolerance measures are not direct measures of compliance, they are objective and should vary with the degree of compliance.

To support the use of exercise performance as a measure of compliance it is necessary to consider the evidence that daily exercise does, in fact, increase exercise performance or tolerance. It is of specific concern to consider research involving COLD patients. There is general agreement that COLD patients are able to increase the amount of exercise they can do, through graded exercise regimes. Among the objective measures cited to support these claims, physical work capacity or increased tolerance measures have been found to produce the most consistent results (Hale, Cumming & Spriggs, 1978). Work is calculated through the use of three types of exercise tests: the bicycle ergometer test; the step-test or stair climbing test; and most frequently, walking tests.

The effects of graded exercise therapy in COLD patients were first documented by Pierce, Taylor, Archer and Miller (1964). Exercise training consisted of walking on a treadmill and was carried out by emphysema patients 12 to 25 min. per day. After 3 to 16 weeks of training, the results indicated increased exercise performance. The patients could tolerate higher speeds on the treadmill, with a mean increase of 2 mph. In addition, there was a 24% decrease in exercise heart rate and a more rapid return to resting state following exercise, by the end of the program.

Paez, Phillipson, Masangkay and Sproule (1966) recorded a similar increase in exercise tolerance with emphysema patients following exercise training. After 3 weeks of training which consisted of 50 min. of daily treadmill exercise, positive results were produced. Patients increased their maximal speed (mean increase from 1.35 to 2.45 mph. as well as the number of steps per minute for a given speed (mean increase from 62 to 90.5).

Training COLD patients on a stationary bicycle, Bass, Whitcomb and Forman (1970) gradually increased daily exercise time from 15 to 60 min. After 4 mo. of training, their results indicated a decrease in resting heart rate (mean decrease from 98 to 78 beats per minute) and exercise heart rate (mean decrease from 120 to 98 beats per minute), as well as an increase in maximal workload (mean increase from 180 to 350 kg.m.).

Mungall and Hainsworth (1979) studied the effects of exercise training with bronchitis and emphysema patients, ranging in age from 50 to 64 years. Patients performed the graded exercises of the Royal Canadian Air Force program for 12 min. daily. The most evident effect of training was a significant increase in exercise tolerance as measured during a 12-min. walk test. After 3 mo., there was a mean increase in the distance walked, from 961 $\pm$ 19 m. to 1049 $\pm$ 22 m.

In considering these studies, there is well documented evidence that exercise training does increase exercise performance or tolerance in COLD patients. A relatively short duration of daily exercise (e.g., 12 min.) can produce an increase in exercise performance in as little as 3 weeks (Pierce et al., 1964). There is additional evidence that exercise and resting heart rate decrease over time as a function of daily exercise. However, although exercise heart rate has been found to decrease after a period of training, an initial increase should be expected at the beginning of exercise training as the heart adjusts to meet increased physical demands. Thus, as a patient first begins to exercise there should be an initial temporary increase in heart rate due to increased physical demands, followed by a decrease in heart rate due to increased physical conditioning over a period of time.

Given the evidence that consistent daily exercise increases exercise tolerance, then it follows that there should be an observable change in exercise performance when a patient is compliant and doing the prescribed exercises, from when the patient is noncompliant or less compliant and not exercising consistently. Thus, exercise performance may function as an indirect yet much more objective measure of compliance.

<u>Dependent measures</u>. Patient compliance was measured as subject performance on two physical exercise endurance tests conducted twice weekly in the patients' homes; 1) the 12-minute walk test and 2) the step-up test. During these home tests three specific performance measures were recorded: 1) the time spent walking or climbing stairs; 2) the distance walked in metres or the number of step-ups completed by the patients; and 3) the patients' resting and exercise heart rates. Additional performance measures included heart rate, respiratory rate, blood pressure and maximal work capacity (speed and incline of treadmill belt, treadmill time) recorded during the treadmill multi-stage exercise test by the physiotherapist at the hospital, at the beginning and at the termination of the study.

<u>Hypotheses and research design</u>. It was hypothesized that the behavior modification compliance program would produce an increase in patient compliance as measured by exercise performance, in comparison to baseline. Specifically, it was predicted that in comparison to baseline, the patients would: 1) walk for a longer duration of time and 2) walk a greater distance, during the 12-min. walk test; and that the patients would 3) climb stairs for a longer duration of time and 4) climb more stairs, during the step-up test; after introduction of the behavioral compliance program. It was also hypothesized that 5) there would be a change in exercise and resting heart rate between baseline and compliance program phases. Specifically, it was predicted that exercise heart rate would first increase at the onset of the compliance program as a function of increased exercise activity. This initial increase was predicted to be followed by a decrease in both exercise and resting heart rates by the end of the study, as a

function of improved physical conditioning. It was also predicted that increased exercise performance measured during the home tests, would be verified by an increase in cardiopulmonary performance and an increase in maximal work capacity, during the final treadmill multi-stage exercise test administered by the physiotherapist, as compared to the initial assessment. These hypotheses were tested in the context of a single organism multiple baseline research design, across 4 subjects.

Method

Subjects and Setting

The subjects were four outpatients attending the physical therapy program in the respiratory unit at the Health Sciences Centre in Winnipeg, Manitoba. All subjects were suffering from chronic obstructive lung disease (COLD) and were attending the respiratory physiotherapy program at the referral of their physicians.

Patient 1 was a 69 year old male diagnosed with emphysema and bronchitis. Patient 2 was a 66 year old male diagnosed with emphysema and bronchitis. Patient 3 was a 68 year old female diagnosed with emphysema and bronchitis. Patient 4 was a 58 year old female diagnosed with emphysema. All patients had a history of smoking, although patients 1 and 3 had quit smoking since entering the program. Verbal consent to participate in the program was obtained from all the patients. In addition, a memo detailing the purpose and content of the study was distributed to all physicians in the respiratory unit, informing them of their patients' participation.

The patients were designated as patient 1, 2, 3, or 4. according to the order in which they were referred to the program. Patient 4 was the last patient to be referred to the program, at a time considerably later than the other patients. Consequently, she was not available for data collection for the first 5 weeks of the study.

The experiment took place in the natural environment of the patients' homes, and in the respiratory unit (Rehabilitation Centre) of the Health Sciences Centre. Twice weekly the experimenter scheduled home appointments during which exercises were reviewed and performance was assessed. Data collection usually took place in the living room, a hallway or the kitchen. Every two weeks the patients received instruction and were physically assessed during physiotherapy appointments at the hospital.

Disease Characteristics

Chronic obstructive lung diseases are incurable in that once an individual develops these conditions, the lung damage is irreparable. Patients who suffer from COLD experience an increasing shortness of breath with less and less activity, a chronic cough, fatigue, and frequent, severe colds. As a result of these stressful symptoms, the chronic lung patient restricts activity and must function at levels lower than the levels of healthy individuals.

The symptoms which chronic lung disease patients experience, may be viewed as a part of a detrimental cycle (Darrow, 1980). When these patients exert themselves, they experience shortness of breath and consequently they decrease their level of activity, which further leads to a decrease in muscle strength. These factors, in turn, result in an increased shortness of breath when the patient becomes active in any way, even if that level of exertion is below the previous threshold point of discomfort for the patient. In this vicious cycle, shortness of breath occurs with less and less activity; both as a result of, and resulting in, reductions in the patient's activity level.

Medical Regime

Although lung disease cannot be cured, the symptoms of the disease can be relieved, so that the patient can funtion more actively, with less shortness of breath. The exercise regimes prescribed by physical therapists are directed at breaking the cycle which results in a patient's deteriorating condition. The exercises are designed to increase the patient's activity level, despite initial discomfort and shortness of breath. As the patient's activity level and muscle strength increase, shortness of breath will decrease despite exertion, and the patient will be able to function more adequately.

The physical therapy regimes prescribed for COLD patients, consist of two basic activities; breathing exercises and graded physical exercise. Breathing exercises are designed to increase the flexibility of the thoracic spine, to increase the mobility of the ribs, breast bone and spine, and to increase the endurance of the muscles used in breathing, in order to facilitate respiration (Darrow, 1981; Sergysels, Coster, Degre & Denolin, 1979). As one example of a breathing exercise, the patient is required to lie flat on his or her back with knees bent. While slowly bending knees to the left, the patient breathes out and then breathes in while returning the knees to the starting position. (See Appendix A for a list of the breathing exercises and breathing relaxation positions prescribed,)

The progressive exercise program is aimed at increasing the patient's exercise tolerance despite initial shortness of breath. Physical exercise regimes are categorized according to "energy expenditure", i.e., according to how much energy the patient must expend in following the regime. There are three such categories of regimes: light, medium and heavy energy expenditure workloads. These are prescribed according to the severity of the patients' conditions and their exercise abilities. Physical exercises are prescribed in terms of stair-climbing, bicycle riding or walking, depending on patient needs and abilities, and the feasibility of these activites in the patients' homes. In the present study, the patients' exercise regimes required light or medium energy expenditure, and demanded between 35 and 65 min. of exercise per day. (For an example of a light and moderate physiotherapy regime, see Appendix B).

The COLD patients' medical regimes also include a variety of medications. Patient 1's prescribed daily medications included bronchodialators (Acetam and Ventolin) and an antibiotic, when necessary. Patient 2 was also prescribed bronchodialators (Acetam and Ventolin) and an antibiotic when necessary, in addition to a steroid (Prednisone). Patient 2's medications included bronchodialators (Theodur and Ventolin) and a steroid (Prednisone). Patient 4's prescribed daily medication was limited to a bronchodialator (Ventolin). However, this aspect of patient treatment was under physicians' directions, and was not a controlled part of the present program.

Equipment

For the purpose of monitoring exercise performance in the patients' homes, a stop watch was used to time all tests and to measure heart rate.

In addition, a measuring tape was used to measure the distance walked in a room or hallway, and a wrist counter was used to count the number of times that the measured distance was walked.

For the purpose of monitoring exercise performance in the respiratory unit, a Quinton TMS 100, model number 14-44A & B, treadmill was used. The treadmill could be adjusted on two variables: 1) the slope of the belt on which the patient walked; and 2) the speed at which the belt moved. These variables were adusted by the physiotherapist to determine the maximum amount of exercise work output that could be tolerated by the patient. A stop watch was used to measure heart rate and respiratory rate, and a sphygmomanometer (Daumonometer, stand by model, United States patent number 115388) was used to measure blood pressure.

Measurement of Compliance

Patient compliance with the physical therapy regime was measured by the performance of patients during exercise endurance tests conducted twice weekly in the home, and every 2 weeks in the hospital during physiotherapy appointments. Approximately 15 minutes were scheduled between tests to ensure a normal resting state at the beginning of each exercise activity. Since daily exercise increases exercise performance (Pierce et al., 1964; Mungall & Hainsworth, 1979), it follows that increased compliance with home physical therapy exercise programs among patients should produce an increase in their exercise performance during the exercise endurance tests.

Home Exercise Endurance Tests

Twelve-minute walk test. A room or hallway was selected, through which the patient could walk unobstructed by furniture. The patient was then asked to walk up and down the premeasured area at a comfortable speed until 12 min. were completed, or until it was uncomfortable to continue. The performance measures recorded during this test included: 1) walking time, up to 12 min.; 2) the distance walked in metres; and 3) patient exercise heart rate after completion of the test, calculated as the number of heart beats in 15 sec. multiplied by 4 to yield heart rate per min. Recovery time was then scheduled to allow the patient to return to resting state, or the original heart rate.

Step-up test. During this test, the patient was required to perform "step-ups", defined as climbing up and down one step, for a duration of 2 min. If the patient could not complete the 2 min. or could continue past this time, this was permitted. The measures of exercise performance during this test included: 1) stair climbing time; 2) the number of step-ups completed; and 3) the patient's exercise heart rate at the completion of the test.

In addition to the measures taken during these two exercise endurance tests, resting heart rate was also recorded. This heart rate was measured at the beginning of the home appointment, prior to exercising.

Hospital Exercise Endurance Test

Treadmill multi-stage exercise test. During each physical therapy appointment, the patients were assessed on the treadmill. The physiotherapist selected a speed appropriate for each patient, and the patients walked for 3 min. intervals at increasing inclines, until they could not tolerate further exercise. Exercise performance measures recorded during this test included: 1) heart rate; 2) respiratory rate; 3) blood pressure; and work capacity (time, incline and speed).

Inter-Observer Reliability

Inter-observer reliabilities on patient performance during the exercise endurance tests were obtained from data collected by the experimenter (primary home observer) and one other observer trained to 80% agreement. Reliability checks were made every 2 to 3 weeks, during baseline and experimental treatment conditions. The reliability observer was not naive to the purpose of the experiment.

During the reliability observations, the two observers were positioned approximately 1 metre apart and recorded: 1) maximum tolerated exercise time; 2) the number of completed step-ups; 3) the number of lengths walked; and 4) the patient's resting and exercise heart rates. Heart rate was measured by the observers checking separate wrists of the patient and counting the number of heart beats during the same 15 sec. interval.

Reliability scores for each of the performance measures were calculated by comparing the two observers' data sheets and comparing: 1) exercise time; 2) distance walked; 3) number of step-ups; and 4) heart rates. Reliability scores were calculated by dividing the smaller observed value by the larger observed value, and multiplying by 100 to yield the percentage of observations agreed upon. Inter-observer reliabilities for resting heart rate (R.H.R.) averaged to be 98% (100% baseline; 96% intervention) and for exercise heart rate (E.H.R.) averaged to be 93% (87% baseline, 97% intervention). For the distance walked, reliabilities averaged to be 98% (95% baseline, 100% intervention); for the number of completed step-ups, reliabilities averaged to be 95% (92% baseline, 97% intervention); and for duration of exercise activity, reliabilities averaged to be 90% (91% baseline, 90% intervention).

Procedure

Initial assessment. Upon admittance to the respiratory program, the patients individually attended two initial physiotherapy appointments at the respiratory unit in the hospital, with the physiotherapist and the experimenter. During the first appointment, the physiotherapist questioned the patient as to medical history. Information was obtained regarding present condition and medical care (i.e., medications), and previous history of the disease and medical treatment (e.g., hospitalization, physiotherapy). The physiotherapist then explained and demonstrated selected breathing exercises. The patient practised the exercises and received corrective feedback. A list of the breathing exercises was given to each patient as was a frequency of exercises prescribed to be performed daily.

During the second appointment, the physiotherapist reviewed the breathing exercises. The patient was then assessed during an initial graded exercise test on the treadmill. During this test, heart rate, respiratory rate and blood pressure were monitored and an EKG was taken. The patient was tested for 3 min. intervals at increasing inclines and at a fixed speed, until she or he desired to stop (e.g., for reasons of fatigue or shortness of breath). This test provided the physiotherapist with data concerning the patient's initial physical condition and tolerance for exercise. Based on this initial assessment, the physiotherapist prescribed a graded exercise regime for each patient, consisting of stair climbing and walking. The patient was told to increase the amount of exercise slowly, according to how he or she felt. It was emphasized that both the breathing exercises and the graded exercises should be performed daily.

The experimenter was introduced to the patient as a program evaluator, assisting the physiotherapist in assessing the effects of the physiotherapy program. The experimenter explained to each patient that to study the effectiveness of the regime on physical conditioning, it was necessary to make frequent assessments. Two appointments were to be scheduled weekly, and for the convenience of the patients, would take place in the patients' homes. The patients were informed that their breathing exercises would be reviewed and some exercise tests conducted in the form of walking and climbing stairs. Home appointments were scheduled over 8 to 10 weeks. Specific details and the true purpose of the program was not disclosed to the patients at this time.

All patients agreed to this arrangement, and two days and times were set up as the regular home appointments. The appointments were scheduled at two or three day intervals, such as Monday-Thursday or Tuesday-Friday.

<u>Physiotherapy appointments</u>. Throughout the course of the study, physiotherapy appointments were scheduled at the respiratory unit every two weeks for each patient. These appointments were an opportunity for the trained physiotherapist to review the breathing exercises, to make any necessary corrections and to prescribe new breathing exercises given improvement in the patients' conditions. They were also designed to keep close tab on the patients' physical condition through assessments on the treadmill. The assessments were conducted in exactly the same manner as for the initial treadmill test, except that an EKG was not taken.

Changes in the patients' physical conditioning were noted, which may have indicated a change in medical regime. Physical therapy appointments were scheduled for all patients individually, during both baseline and experimental conditions.

Baseline. Twice weekly at the agreed upon time, the experimenter arrived at the patients' homes for their one hour appointments. After some initial discussion of the patients' general condition, R.H.R.'s were recorded. The patients then performed the prescribed warm-up breathing exercises. The experimenter provided feedback to the patients at this time, correcting any errors in the exercises (eg., incorrect breathing pattern, speed) and reinforced good exercise format (eg., "That's terrific! Those exercises are perfect."). This review was to ensure that the patients were benefiting from correct exercise form.

After the breathing exercises were performed, the patients rested and heart rate was monitored until it returned to its initial resting state (as determined at the beginning of the appointment). The patients were then assessed during the step-up test, on steps ranging from 13.2 to 17.3 cm. in height. The patients were told to climb up and down one stair repeatedly for two minutes or until it was uncomfortable to continue. The patients positioned themselves at the bottom of the stair as the experimenter said "Ready", and when the stop watch was started, the experimenter said, "Go". During the test, the number of completed step-ups was counted. At the end of the 2 min., the patients were informed of the time and were asked if they wanted to continue. If so, timing and step-up counting continued until the patient stopped. The number of completed step-ups and the climbing time were recorded. Exercise heart rate was immediately recorded upon test termination and the patients were then allowed to rest. When the patients' heart rates returned to their original levels, and when the patients felt relaxed and were breathing comfortably, the 12-min. walk test was conducted. The resting time between tests was usually 10 to 15 min.

For the 12-min. walk test, a section of hallway or the length of a room was measured. For patients 1, 2, 3 and 4 the measured walking lengths were 5.2 m., 7.3 m., 7.6 m., and 11.9 m. respectively. The distance of one length walked was determined by the availability of space in each home. After the distance of one room or hall length was measured, the patients were told to walk at a comfortable speed for 12 min. or until they were tired (if this were before the 12 min. were completed). Walking duration was recorded on a stop watch and the number of lengths walked was recorded at the end of the test.

Following the 12-min. walk, E.H.R.'s were immediately recorded and then the patients rested. After sufficient recovery time was allowed during which the patients returned to their resting heart rates, the prescribed cool-down breathing exercises were performed. This completed the one hour appointment. All activities (i.e., warm-ups, step-up test, walking test, cool-downs) were carried out in the same order, for all appointments. After completion of the appointment activities, the experimenter discussed any topic of concern with the patients.

During these baseline appointments, the experimenter did not discuss or reveal the results of the tests to the patients. Although the issue of compliance occasionally arose in regards to the patients' activities, this issue was not explicitly discussed or probed by the experimenter. Any conversation regarding this matter was initiated by the patient (e.g., "I walked for 30 min. yesterday.").

Behavioral compliance program. On the first day of the experimental treatment phase, the patients were introduced to the components of the compliance program. Following the regular home appointment on the last day of baseline, the experimenter explained to the patients that they would now be assigned some new tasks in order to help them to do their exercises more regularly, to gain more information to help evaluate the physiotherapy program, and to illustrate to them exactly what progress they were making.

Each patient received a small, colored sign to post in the home to prompt him or her to follow through with the prescribed medical regime. It read:

Remember to: Take your medication

Do your breathing exercises

Climb stairs

Walk

Do these daily!!

The location selected for this prompt, depended on the daily routine of each patient. If a patient frequented the bedroom, the prompt was posted on the bedroom wall. Other locations included the kitchen table or the living room coffee table.

The patients were also instructed to schedule reinforcers contingent upon the completion of their prescribed daily exercises. A variety of reinforcers were identified, such as a favorite television program, a drink, a food treat, or a visit to a friend. For example, one day a patient might decide to complete all the requirements of the regime and then walk to a friend's home for a reinforcer. The patients were instructed to reinforce themselves only when all aspects of their regimes had been completed, and to withold their reinforcers if any component were incomplete.

The patients received self-recording data sheets and were requested to use them to record their daily exercise activities. Each day the patients recorded how far they walked, how long they walked, how many stairs they climbed, how long they climbed stairs, and whether or not they performed their breathing exercises. Each data sheet lasted for 3 weeks and was replaced by the experimenter upon completion.

In regards to the feedback component, four graphs were presented to each patient: for stair climbing; 1) the number of stairs climbed; and 2) duration of stair climbing; and for walking; 3) the number of room lengths walked; and 4) duration of walking. These measures were carefully explained to each patient, and calculation and graphing of each measure was demonstrated on the performance data from that days appointment. In general, all patients understood that an upward trend was desirable and indicated progress or improvement. The performance graphs were placed alongside the prompts.

Exactly the same appointment procedure followed during baseline was carried out during the behavioral compliance program, except that the additional program components were included. Prior to the beginning of each test, the previous assessment performance was indicated to each patient. At the end of the appointment, the experimenter sat down with the patient and reviewed the self-recorded data. The patients were reinforced for self-recording (e.g., "Terrific! You've been recording all your hard work!") and for compliance (e.g., "You have really been working hard. I see that you have done all your exercises since I last saw you. Good work!"). In addition, the patients were informed of their exercise performance that day. The results were graphed and any changes in performance were noted. Social reinforcement was given for any improvement in performance since the previous assessment (e.g., "Nice work Mr. X! You increased your time by 10 sec. and climbed 3 more stairs! See how you are improving as you do your exercises? Keep up the good work!"). Social reinforcement always associated increased exercise performance with compliance.

This procedure was followed until termination of the study. After all patients had been introduced to the behavioral compliance program, the patients returned to the respiratory unit in the hospital for a final assessment on the treadmill and were scheduled for 1 mo. and 3 mo. follow-up appointments with the physiotherapist. Patient education was also recommended for the patients, by the physiotherapist. Home appointment follow-ups and patient debriefings were scheduled at a 6 mo. interval.

Multiple Baseline Research Design

The research design chosen was a single subject multiple baseline design across patients, since it allowed all patients to participate in program with each patient functioning as his or her own control. Thus, no control group was necessary (Hersen & Barlow, 1976). A reversal design would have been undesirable since: 1) it is difficult to remove treatment conditions (once a patient receives instruction in behavioral procedures, this information cannot be withdrawn); and 2) given an improvement in exercise performance as a result of the program, it would be extremely undesirable in the case of COLD, to have the patients return to their original, lower compliance levels.

Baseline was collected on patients 1, 2 and 3 for 2½ weeks before treatment was introduced to the first patient. Patient 4 was referred to the program 5 weeks later than the other patients, and consequently data collection on her performance did not begin until the 6th week of the study, or assessment 11. When patient 1 received the behavioral compliance program, all other patients remained on baseline. Three weeks later, baseline procedures were begun with patient 4, and patient 2 was introduced to the compliance program. While patients 1 and 2 continued with the compliance program, patients 3 and 4 remained in baseline. After another 2½ weeks, patient 3 was introduced to the behavioral compliance program, with only patient 4 remaining in baseline. Patient 4 finally was introduced to the behavioral compliance program, 3½ weeks after patient 3.

Substantial variability was anticipated in the data, given the variability in COLD patients' conditions (Mungall & Hainsworth, 1979). It was therefore difficult to wait for long periods of stability or desirable trends, before introducing the behavioral compliance package to particular patients. The criterion for introducing the treatment package sequentially across patients was a stable trend, or a trend indicating decreasing physical conditioning (e.g., decreasing duration of walking, decreased walking distance). This criterion was required to be met in three of the four performance meaures during the two home endurance tests (not including heart rate which was too variable), before treatment could be introduced to a particular patient. After introduction of the treatment package to a particular patient, all other patients still on baseline were required to show a stable or decreasing trend in three of the four measures, before treatment could be introduced to the next patient. This "three out of four" criterion was specified because multiple measures were utilized, and desirable trends across all measures at the same time would have been difficult to obtain.

Results

Dependent Measures

Recall that patient compliance with physical therapy exercise regimes was measured by the performance of the patients on two exercise endurance tests conducted in the home; 1) the step-up test and 2) the 12-min. walk test. The three specific measures of exercise performance recorded during each test included: 1) the duration, in seconds, during which the patient climbed stairs, or in minutes, during which the patient walked; 2) the distance in metres, or the number of step-ups completed by the patient; and 3) the patient's R.H.R. and E.H.R. calculated as the number of heart beats per minute. The use of these performance measures as an indirect measure of patient compliance with exercise regimes, was based on research evidence that regular daily exercising increases exercise tolerance or performance amoung COLD patients (Pierce et. al., 1964; Paez et al.,1966; Bass et al., 1970 ; Mungall & Hainsworth, 1979). It therefore followed that if patients increased the regularity of their exercise (i.e., increased medical compliance) then their exercise performance should also increase (i.e., they should be able to exercise longer, do more exercise repetitions, and show a decrease in R.H.R. and E.H.R. as indications of improved physical conditioning).

Timing of the two home exercise tests began with the patient's first step and terminated when the patient indicated fatigue. The total distance walked in metres was calculated by counting the number of room or hall lengths walked and multiplying by the pre-measured distance in metres. The number of step-ups was simply the number of repetitions that the patient climbed up and down one stair during the test. The R.H.R. was recorded at the beginning of the appointment when the patient was resting. The number of heart beats counted during a 15 sec. interval was multiplied by 4 to yield the number of heart beats per minute. Exercise heart rate was calculated in the same manner immediately after termination of the test.

Additional measures of exercise performance were recorded during the physiotherapy appointments. The specific performance measures recorded by the physiotherapist during the treadmill multistage exercise test included: 1) R.H.R. and E.H.R.; 2) resting respiratory rate (R.R.R.) and exercise respiratory rate (E.R.R.); 3) resting blood pressure (R.B.P.) and exercise blood pressure (E.B.P.); 4) tolerated belt speed; 5) tolerated belt incline; and 6) tolerated time duration on the treadmill.

Missing Data

Some discussion regarding the high frequency of missing assessment data in the study, is warranted. Chronic obstructive lung disease severely limits patients' activities, and because of this they cannot over schedule their daily appointments. Thus, on days when patients had a physiotherapy or doctor's appointment, or other physically demanding activities planned, the home appointments were cancelled. These cancellations were designed to benefit the patients (so as not to physically drain them), and also to provide more reliable data (if patients were too active before a home appointment, then they would be fatigued and performance would decline). All periodic missing data points in the results to be presented were occurrences of the above (e.g., assessment 2, patient 1 coincided with a physiotherapy appointment, as did assessment 6 for patient 3). Longer gaps in the data are noted for patients 3 and 4. For assessments 10,11 and 12, and for assessments 23 and 24, patient 3 was on vacation. Patient 4 was not referred to the program until assessment 6, therefore her data begin later then the other patients' data. In addition patient 4, who was employed full time, often cancelled due to a heavy schedule. Assessments 23 and 24 were cancelled for all patients due to experimenter illness. Patient 1 missed assessment 15 due to physical injury.

Step-Up Test

Duration of step-up test. Figure 1 presents the time, in seconds, during which the four patients climbed stairs for the step-up test. The baseline data for patient 1 initially reveal an upward trend increasing by approximately 10 sec. per assessment. The baseline data for patient 1 range from 68 to 101 sec., with a mean time of 90 sec.

Patient 1 was the first patient to receive the behavioral compliance program, after his data stabilized at 101 sec. and as a stable or decreasing trend was observed in patient 2 and 3's data. When the program was introduced, the stair climbing duration for patient 1 immediately increased 19 sec. in level, from 101 to 120 sec. For the remainder of the study, patient 1 climbed stairs for no less than 120 sec. (i.e., for the full 2 min.), and there are no overlapping points between the compliance

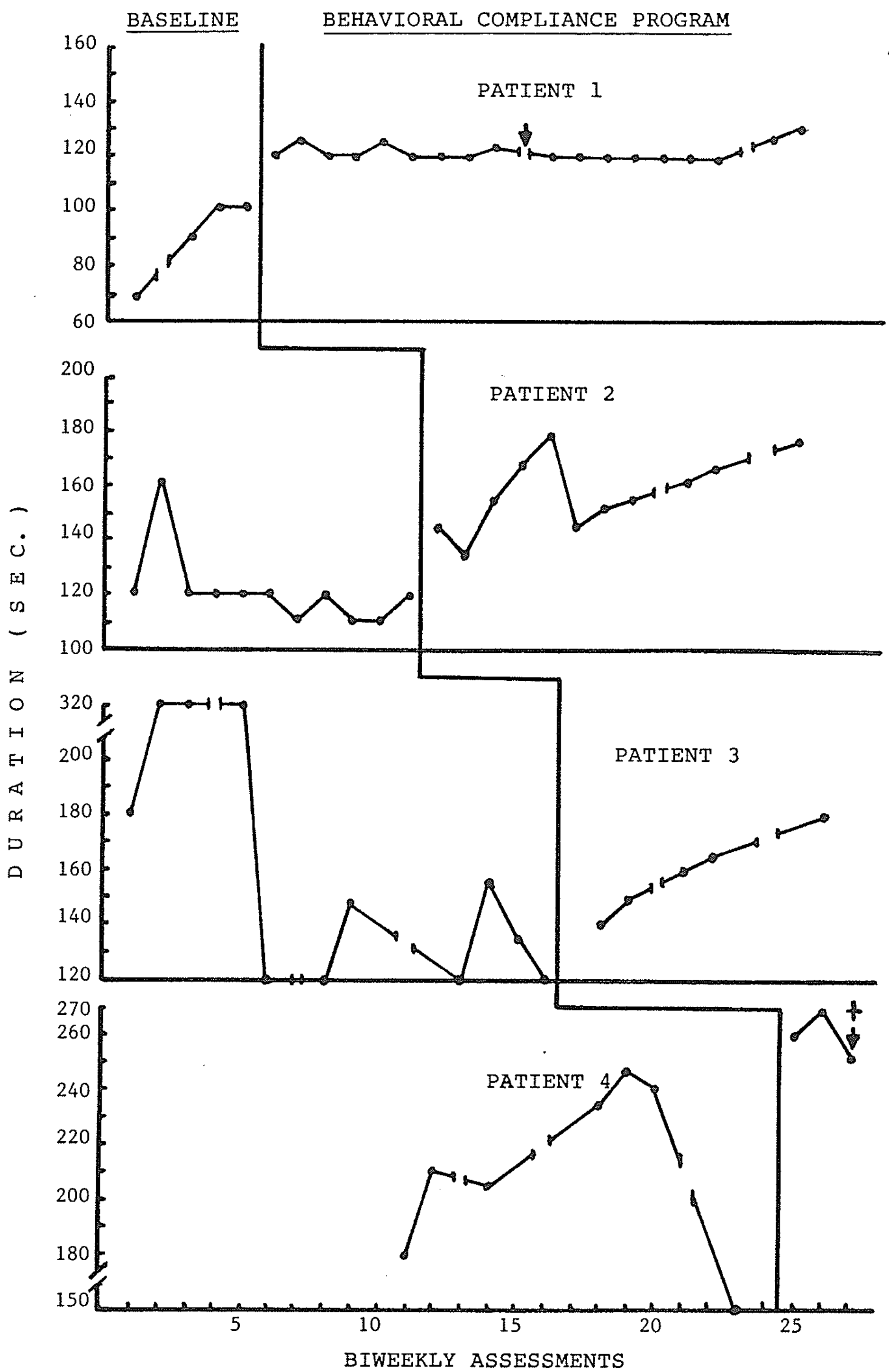

Figure 1. The effects of the behavioral compliance program on the stair climbing duration for all patients during the step-up test; (↓) indicates physical injury; (↕) indicates tranquilizer intake.

program and baseline phases. Of particular note is the first missing data point during the intervention phase (assessment 15). It was at this point that the patient encountered an accident, and due to physical injury could not be assessed. For four weeks following, the patient complained of shortness of breath and was unable to exceed 120 sec. There is a slight increasing trend observed during the final assessments. During the compliance program phase, patient 1 averaged 122 sec. of stair climbing, with a range from 120 to 131 sec.

The baseline data for patient 2 indicate more stability than those for patient 1, with durations ranging from 110 to 160 sec., and a mean of 121 sec. Only the second data point shows an unusually high elevation of 160 sec., in comparison with the other baseline durations. This high elevation coincided with a new prescription of steroids. Following the second assessment, the steroid dosage was gradually decreased and behavior stabilized.

When the behavioral compliance program was introduced to patient 2, there was an immediate increase in total stair climbing time from 120 sec. to 142 sec.; an increase of 22 sec. After a slight decrease during the second assessment of the program, there is a rapid upward trend in the data, followed by a 40 sec. drop during the 6th assessment of the treatment program and then a second more gradual increasing trend. Except for the unusually high baseline data point (assessment 2), there are no overlapping data points between baseline and the compliance program phases. During the compliance program, the duration data range from 134 to 176 sec., with a mean of 159 sec.

Patient 3's baseline data show considerable variability, ranging from 120 to 320 sec. with a mean of 188 sec. However, this mean does not appear to be representative given the unusually high level of performance during the first four assessments of baseline. This high performance also coincided with a new steroid prescription. High dosages of the steroid were prescribed to the patient beginning on the second assessment day and gradually decreased over the 2 weeks (assessments 2 through 5). The mean value of the baseline data for the assessments after the decrease in dosage (assessment 6) is 131 sec.

Patient 3 was the third subject to be introduced to the behavioral compliance program, and again an immediate improvement in duration was observed, from 120 to 140 sec.; an increase of 20 sec. Although there are two overlapping data points between the baseline and compliance phases (excluding the high performance during the first 2 weeks of baseline), there is a definite and consistent increasing trend in the data during the compliance phase, with none of the variability that was noted during baseline. During the compliance program phase, patient 3's duration data range from 140 to 180 sec., with a mean of 159 sec.

The baseline duration data for patient 4 reveal an increasing trend from 180 to 248 sec., followed by a rapid, substantial decrease to 150 sec. prior to treatment. The variable baseline data range from 150 to 248 sec., with a mean of 177 sec. Upon introduction of the behavioral compliance program to patient 4, there was an immediate increase in her stair climbing duration from 150 to 260 sec. Even if the final baseline data point is discounted as unusually low, the initial treatment duration is an increase of 19 sec. over the second last baseline data point of 241 sec. The compliance program data show an increase during the second treatment assessment; however, duration of the final assessment decreased by 15 sec., coinciding with an intake of tranquilizers (Vivol).

Patient 4 climbed stairs for a mean duration of 260 sec. during the compliance program, with a range from 252 to 270 sec. Although there is an upward shift in level, no upward trend is noted in the treatment data for this patient which are limited to 3 assessments due to program time constraints. There are, however, no overlapping points between baseline and treatment phases.

Figure 1 indicates that the patients' exercise durations during the step-up test increased when the behavioral compliance program was introduced. The terminal levels of baseline duration data for patients 1, 2, 3 and 4 are 101, 120, 120 and 150 sec. respectively. The terminal levels for patients 1, 2, 3 and 4 during the compliance program phase are 131, 176, 180 and 252 sec. respectively. Therefore, there is a total increase in the tolerated stair climbing time of 30 sec. for patient 1, 56 sec. for patient 2, 60 sec. for patient 3 and 132 sec. for patient 4.

Number of stairs climbed. Figure 2 presents the number of step-ups completed by each patient during the step-up test. Similar to the exercise duration data of Figure 1, these baseline data for patient 1 show an increasing trend to stabilization at 31 step-ups. The number of step-ups completed by patient 1 range from 25 to 31, with a mean of 29 step-ups. When patient 1 was introduced to the behavioral compliance program the number of step-ups that he completed immediately increased from 31 to 36. All remaining data points until his accident (assessment 15), are at, or above, 35 step-ups. However, following the accident, there is an explicable decrease in the number of step-ups completed, to a level similar to that of baseline, between 29 and 31 step-ups. There is some indication of a slight increase during the final assessments. Prior to the

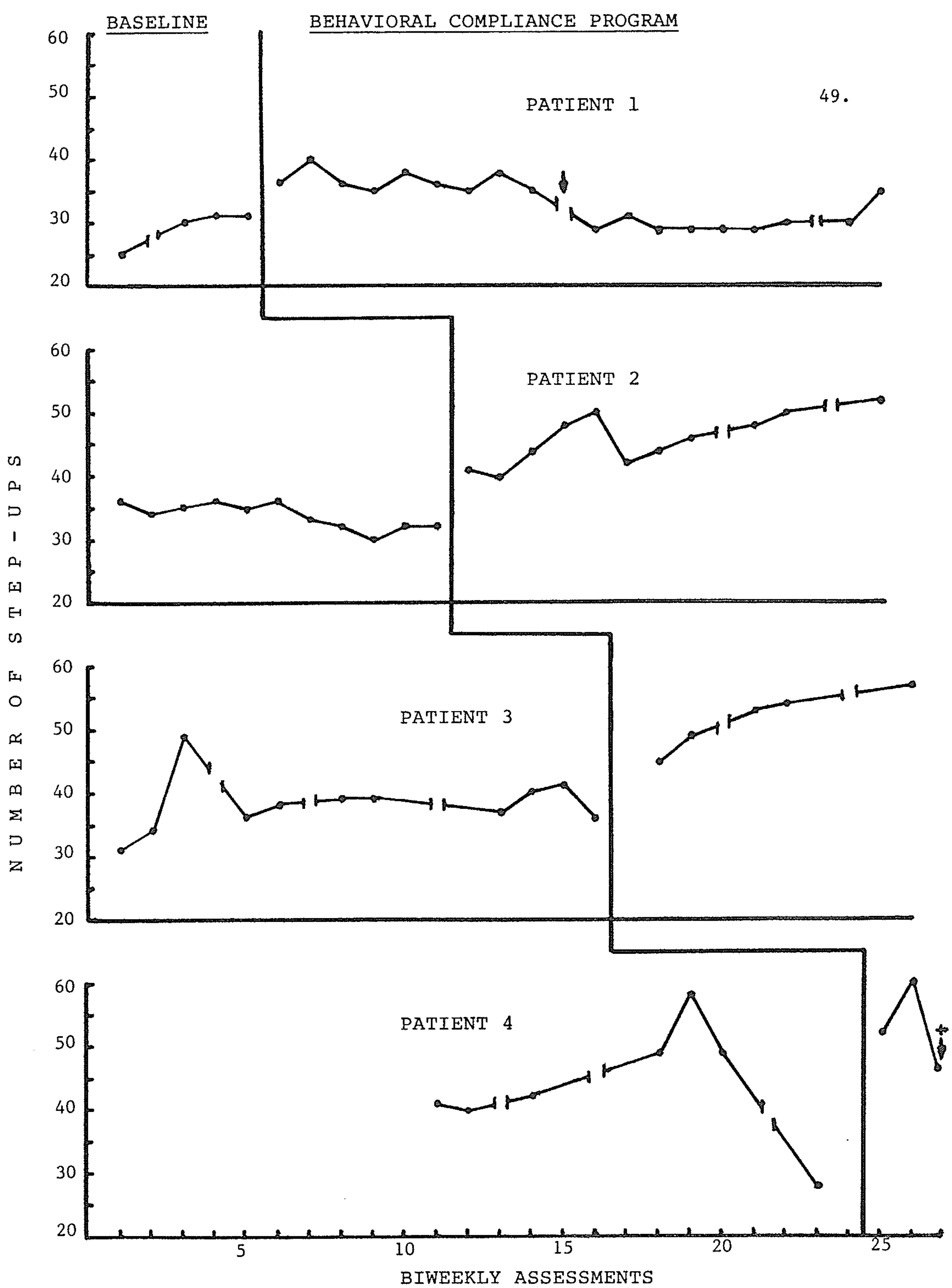

Figure 2. The effects of the behavioral compliance program on the number of step-ups completed for all patients during the step-up test; (↓) indicates physical injury; (↓) indicates tranquilizer intake.

accident, there are no overlapping points between baseline and the compliance program phase. These data (prior to assessment 15) demonstrate variable increases and decreases between 35 and 40 step-ups, with a mean of 37 step-ups.

For the first six baseline assessments, patient 2 completed between 34 and 36 step-ups. After this stable period, there is a decreasing trend to 30 step-ups over the next three assessments, with a final slight increase to 32 step-ups during the last two assessments of baseline. The number of step-ups completed by patient 2 during baseline, range from 30 to 36, with a mean of 34 step-ups.

Upon introduction to the behavioral compliance program, patient 2 immediately increased the number of step-ups that he completed from 33 to 41. Following this substantial increase, patient 2 continued to increase his step-up total to 49 by the 5th treatment program assessment. This upward trend is followed by a 7 point drop during the 6th treatment assessment, and then again the data show a steady, gradually increasing trend, terminating at 53 step-ups. There are no overlapping data points between the baseline and compliance program phases. During the compliance program, patient 2 completed between 40 and 53 step-ups with a mean of 46 step-ups.

With the exception of one high performance of 49 step-ups during the 3rd assessment, the baseline data for patient 3 reveal relatively less instability than that presented in Figure 1, with fewer elevated scores at the beginning of baseline. Disregarding the third elevated assessment score, there is a gradual increasing trend in patient 3's data to 40 step-ups, with variable decreases during assessments 13 and

16. During baseline, patient 3 completed between 31 and 49 step-ups, with a mean of 38 step-ups.

When the behavioral compliance program was introduced to patient 3, there was an immediate increase in her completed number of step-ups, from 36 to 45. Although the two initial data points overlap between baseline treatment phases, this is with the second baseline assessment data point which is considerably higher than the other baseline points. Furthermore, the data indicate a consistent, rapidly increasing trend throughout this phase. During the compliance program, patient 3 completed between 45 and 56 step-ups with a mean of 52 step-ups.

The baseline data for patient 4 reveal an initial rapid increase in the number of completed step-ups from 40 to 58 step-ups followed by a rapid decrease during the final baseline assessments to 38 step-ups. With a mean of 37 completed step-ups, patient 4's data range from 31 to 56 step-ups. When patient 4 was introduced to the behavioral compliance program there was an immediate increase from 31 to 52 step-ups, although a greater number of step-ups (58) had been completed during one session of baseline. The second program assessment data show an increase, followed by a substantial decrease to 46 step-ups on the last assessment, a day on which patient 4 had taken some tranquilizers. Patient 4's treatment data range from 46 to 60 step-ups with a mean of 53 step-ups. All but the second treatment data point overlap with the three highest baseline scores.

Figure 2 illustrates that all patients completed more step-ups after the behavioral compliance program was introduced. The baseline terminal levels of the number of completed step-ups for patients 1, 2, 3 and 4 are 20, 32, 36 and 31 respectively. Following the behavioral compliance program phase, the terminal number of completed step-ups for patients 2 and 3 are 52 and 58 respectively, indicating a total increase of 20 step-ups for patient 2, and 22 step-ups for patient 3. Utilizing the last data point before patient 1's accident (35), he shows a slight increase of 4 step-ups. Although patient 4's compliance program terminal assessment of 46 indicates a 15 step-up increase from her baseline terminal level, there are equally high performance rates during baseline making for cautious prognostications of success.

Exercise heart rate. Figure 3 presents the E.H.R.'s of the patients immediately following the step-up test. The baseline heart rate for patient 1 is fairly stable at approximately 110 beats per minute (b.p.m.). During the behavioral compliance phase, patient 1's heart rate initially increases from 108 to 120 and 124 b.p.m., and then gradually decreases to 100 b.p.m.

Patient 2's baseline heart rate is quite variable, showing repeated increases and decreases ranging from rates of 90 to rates of 110 b.p.m. During the behavioral compliance program phase, patient 2's data continue to show variability, although less dramatic swings are noted in the data as compared to baseline. Similar to patient 1, patient 2's data also reveal an initial increase in heart rate from 100 to 108 and then to 116 b.p.m., followed by a variable downward trend, with the most dramatic decrease observed from the 9th to the 10th assessment of that phase (down to 92 from 108 b.p.m.).

Patient 3's heart rate initially increases sharply from 82 to 100 b.p.m. during baseline, followed by a fairly sharp decrease to 84 and

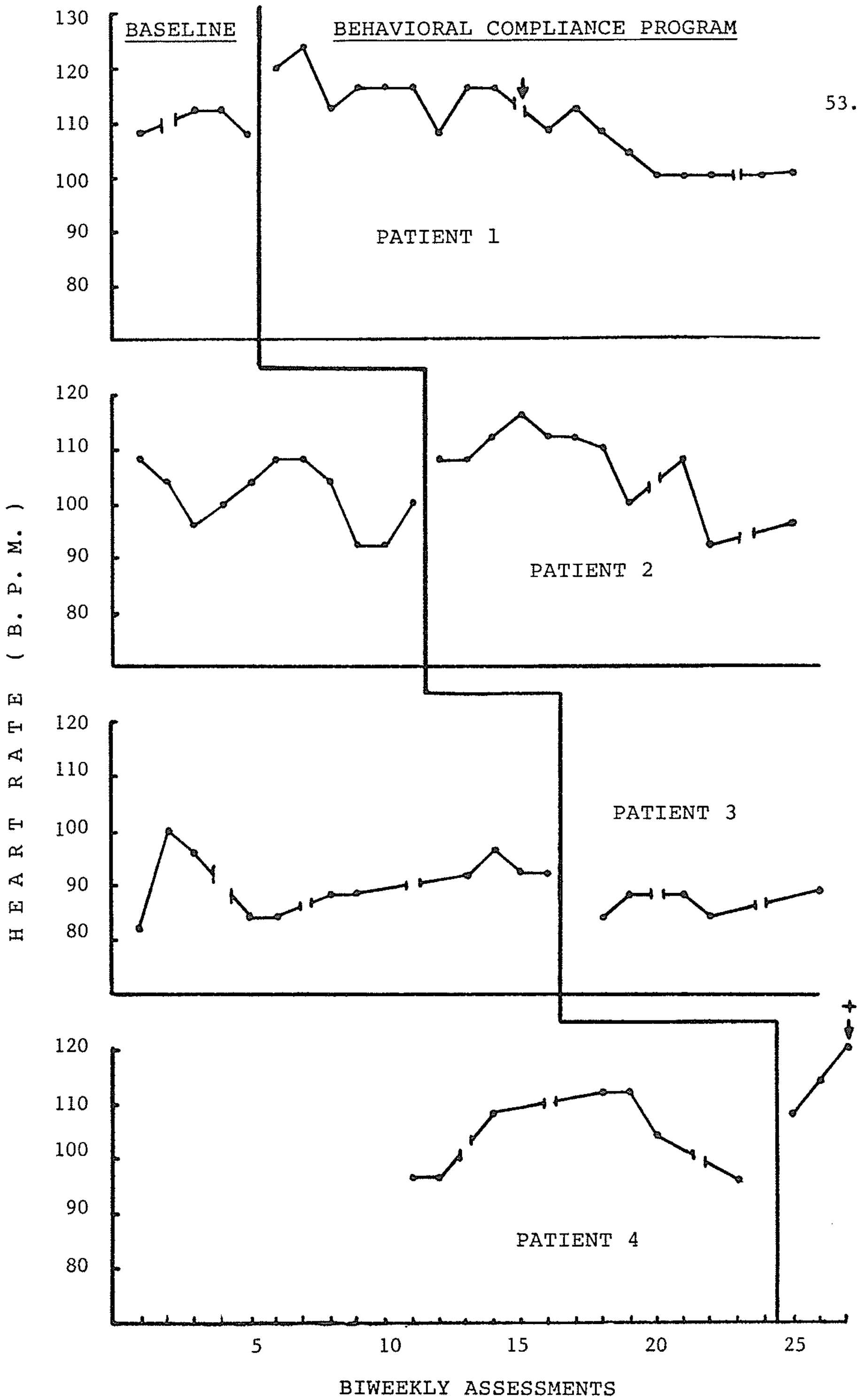

Figure 3. The effects of the behavioral compliance program on the exercise heart rate of all patients during the step-up test; (↓) indicates physical injury; (↓) indicates tranquilizer intake.

then a gradual increase again to 92 b.p.m. by the end of baseline. When the behavioral compliance program was introduced, patient 3's heart rate showed an immediate decrease of 8 b.p.m. from 92 b.p.m. to 88 b.p.m., rather than the initial increase observed in the other patients' data. Throughout the remainder of the treatment phase, patient 3's heart rate is fairly stable, between 84 and 88 b.p.m.

Patient 4's baseline data reveal substantial variability similar to the other patients' data, with first an increasing trend in heart rate from 95 to 113 b.p.m., and then a decreasing trend to a heart rate of 96 b.p.m., near the original baseline level. Patient 4's data immediately demonstrates a substantial increase in heart rate from 96 to 108 b.p.m. when the behavioral compliance program was implemented, and her heart rate continues to show a sharp upward trend to 120 b.p.m. During the compliance program, patient 4's heart rate ranges from 108 to 120 b.p.m. Data during this treatment phase are however, limited to only three assessments.

Although there are fairly strong indications of an initial increase in the exercise heart rates of patients 1, 2 and 4 during the compliance program, and later a decrease for patients 1, 2 and 3, the data are overall too variable during both phases, with too many overlapping points, to provide totally convincing evidence of substantial change or improvement in E.H.R. However, general trends in the patients' data reveal a definite initial increase, and later decrease in the exercise heart rate during the step-up test, consistent with predictions. The baseline terminal heart rates for patients 1, 2 and 3 were 108, 100 and 92 respectively. The terminal heart rate levels during the behavioral compliance program phase for patients 1, 2 and 3 were 100, 96 and 84 respectively. This is a 7 b.p.m. decrease for patient 1, a 4 b.p.m. decrease for patient 2 and an 8 b.p.m. decrease for patient 3.

Patient 4's terminal baseline heart rate was 96 while her terminal compliance program heart rate was 120; thus she shows a 24 b.p.m. increase over baseline levels by the end of the program. This trend, directly opposite to that observed in the other three patients' heart rate data, is most likely due to the limited exposure that patient 4 had to the behavioral program. Since only three assessments were conducted on patient 4 during treatment, then only the predicted initial increase in heart rate due to increased physical demands of exercise, could be expected to occur. Further data collection would be necessary to observe the predicted decrease in heart rate resulting from improved physical conditioning over time.

Twelve-Minute Walk Test

Duration of walking. Figure 4 presents the time, in minutes, during which the patients walked for the 12-min. walk test. The second baseline assessment data for patient 1 is highly elevated at 8 min. The remaining three data points are below 5 min. The baseline walking time for patient 1 ranges from 2 min. 50 sec. to 8 min., with a mean of 4 min. 40 sec. The final two baseline walking durations for patient 1 are stable at 2 min. 50 sec. Upon introduction to the behavioral compliance

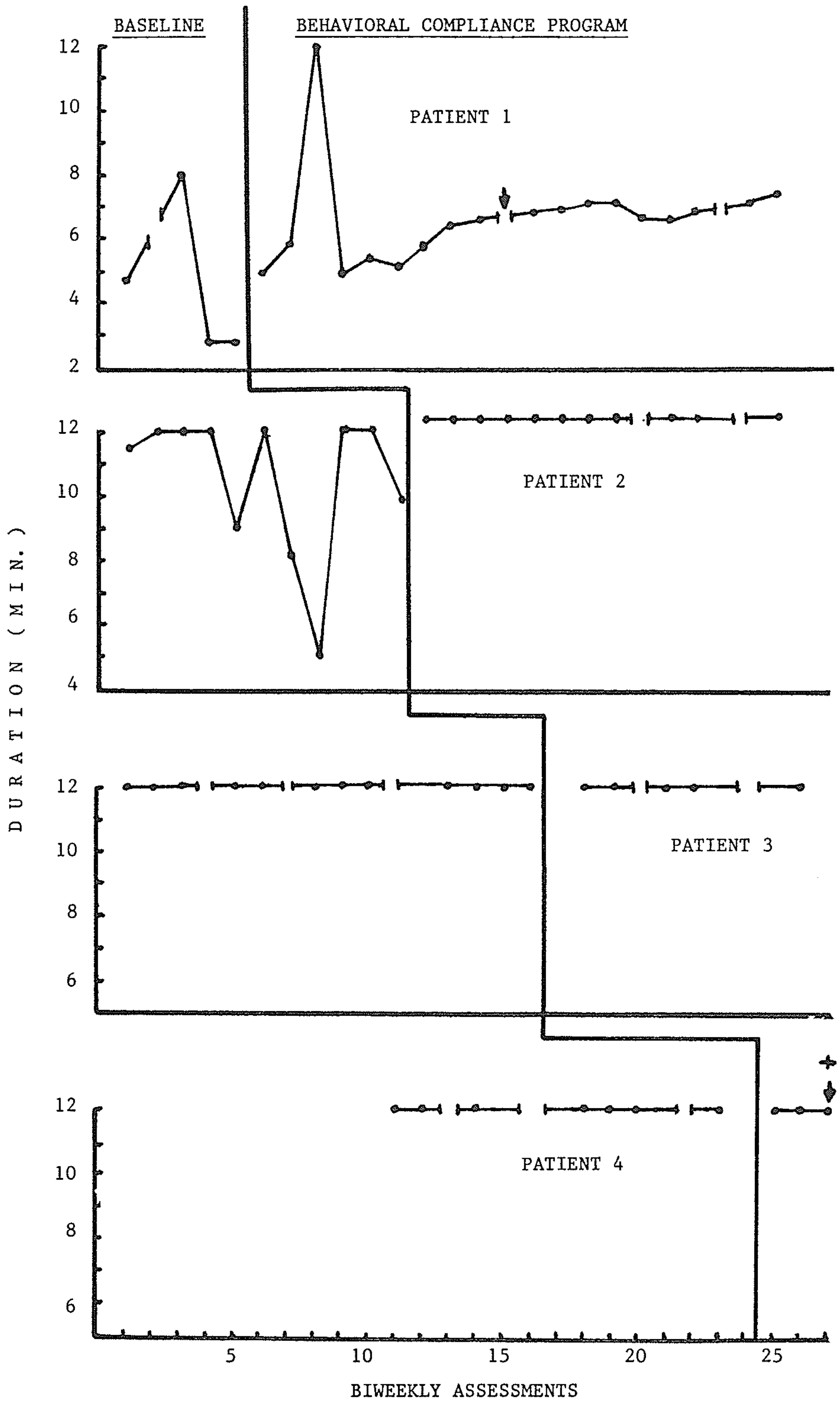

Figure 4. The effects of the behavioral compliance program on the walking duration for all patients during the 12-minute walk; (↓) indicates physical injury; (+) indicates tranquilizer intake.

program, patient 1 immediately increased his walking time tolerance from 2 min. 50 sec. to 5 min. During the third treatment assessment, the data reveal an extreme elevation, which was the only day during which the patient completed the 12-min. walk. During the walking test of this assessment the patient negotiated a walk outdoors. After declining from this extreme performance, the data show a general gradual upward trend. Excluding the one elevated point, patient 1's walking time ranges from 5 to 7 min., and demonstrates a total increase of 4 min. by the end of treatment, above the baseline terminal point of 3 min. The mean walking time for patient 1 during the compliance program phase is 6 min. 28 sec. Besides the one extreme baseline score, there are no overlapping points between baseline and compliance phases.

Patient 2 was able to complete the 12-min. walk test, 55% of the time that he was assessed during baseline. His baseline walking time is variable, ranging from a low of 5 min. to the full 12 min., with a mean of 6 min. 41 sec. When patient 2 was introduced to the behavioral compliance program, his walking duration increased 2 min. from 10 to 12 min. For the entire compliance program phase, patient 2's data stabilizes at the maximum 12 min., as he consistently completed the 12-min. test. No irregular decreases in walking time occurs as had during baseline.

During baseline, patients 3 and 4 consistently walked the maximum 12 min. 100% of the time. Therefore, because their baseline data were already at ceiling level, it was impossible to increase their walking times with the introduction of the behavioral compliance program. When they entered the treatment phase, patients 3 and 4 continued to consistently complete the 12-min. walk test. Improvements in exercise durations were thus impossible to detect.

The graphs in Figure 4 clearly indicate that in the case of the two patients who could improve their walking time (i.e., patients 1 and 2), there was improved performance when the behavioral compliance program was introduced. Specifically, they were able to walk for longer periods of time and did so more consistently. The terminal walking durations during baseline for patients 1 and 2 are 2 min. 50 sec. and 10 min. respectively. The terminal walking durations for patients 1 and 2 during the compliance program are 7 min. 12 sec. and 12 min. respectively. Thus, patient 1 increased his walking time by 4 min. 22 sec. and patient 2 increased his walking time by 2 min. by the end of the compliance program. Since patients 3 and 4 were already walking the maximum amount of time during baseline, no further increase could be expected, although continued maximum performance was noted.

Distance walked. Figure 5 illustrates the distance walked in metres, at the termination of the 12 min. walk test. Similar to the data of Figure 4, the distance that patient 1 walked during the second assessment is highly elevated, on a day that the patient reported "feeling good". Apart from this one high performance of 341 m., the other baseline points are below 170 m. Patient 1's baseline data range from 113 to 341 m. with a mean of 183 m.

During the behavioral compliance program phase, there is an immediate increase from baseline in the distance patient 1 walked, from 113 m. to 197 m. Excluding the elevated 3rd treatment assessment point which is a high 490 m. (walked outdoors), patient 1's data are fairly stable between 200 and 230 m. The distance which patient 1 walked during this phase range from 196 to 226 m., with a mean of 212 m. In addition,

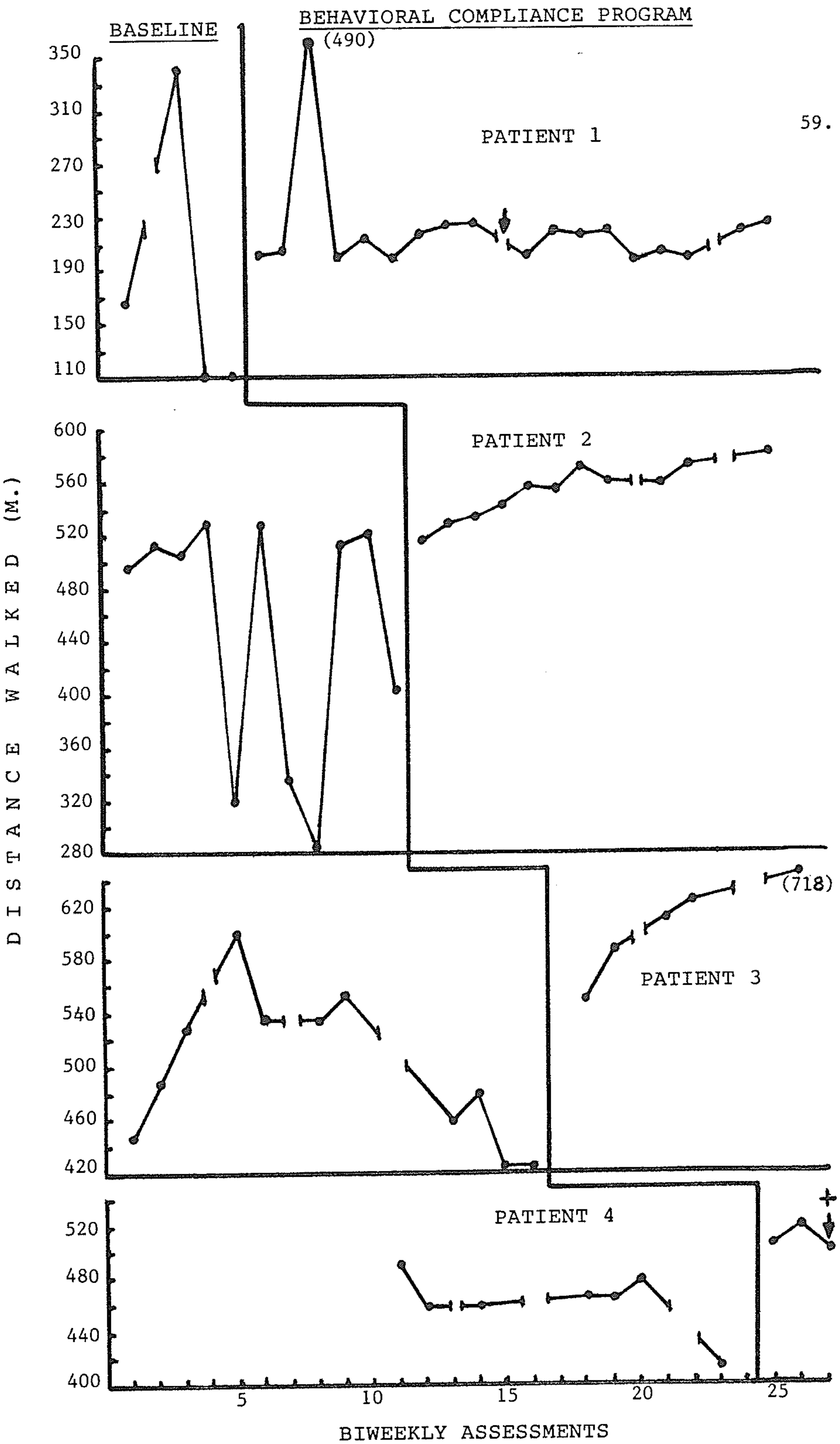

Figure 5. The effects of the behavioral compliance program on the distance walked by all patients during the 12-minute walk; (↓) indicates physical injury; (↕) indicates tranquilizer intake.

there are no overlapping data points between baseline and treatment phases, not involving the second elevated score of baseline.

The distance walked by patient 2 during baseline, is extremely variable throughout the phase, ranging from 286 to 533 m. with a mean of 449 m. No increasing or decreasing trends are clearly evident in the data. When patient 2 was introduced to the behavioral compliance program, he immediately increased his walking distance from 401 m. at the end of baseline, to 518 m. During this phase, there is a gradual increasing trend in patient 2's data, up to 586 m. Although the first three data points during the compliance program overlap with baseline data, there are no other overlapping points, and ther is a clear and consistent upward trend in the data. The distance that patient 2 walked during the compliance program, range from 518 to 586 m. with a mean of 552 m.

Patient 3's data indicate a definite rapid increase in the distance that she walked during the first four baseline assessments, increasing from 453 to 600 m. This is followed by a decreasing trend down to 423 m. by the end of baseline, with two slight increases during assessments 9 and 14. The distance that patient 3 walked during baseline, range from 423 to 600 m., with a mean of 499 m. Patient 3 dramatically increased her walking distance from the baseline terminal level of 423 m., to 555 m. after the introduction of the behavioral compliance program. Following this initial increase, the data continue to show an upward trend. The first two data points of the compliance program phase overlap with baseline, although these early data points are the only ones that do so. Throughout the compliance program, the distance walked by patient 3 range from 555 to 718 m., with a mean of 622 m.

Patient 4's baseline data reveal an initial decrease in the distance that she walked from 490 to 460 m., followed by a stable period at approximately 460 m. and finally a large decrease of 75 m. at the end of baseline. The distance walked by patient 4 during baseline, range from 411 to 487 m. with a mean of 461 m. Upon introduction of the behavioral compliance program, patient 4 immediately increased her walking distance from 411 m. at the end of baseline to 515 m. during the first treatment assessment. Following this increase in level, there is a slight increase to 520 m. and then a slight decrease to 502 m. in her distance walked. There are no overlapping points between baseline and the compliance program phase. Patient 4 walked between 502 and 520 m. during the compliance program, with a mean of 511 m.

These graphs clearly indicate that the distance walked by the patients during the 12-min. walk test, increased substantially when the behavioral compliance program was introduced. The terminal distance walked during baseline was 113 m., 401 m., 423 m. and 411 m. for patients 1, 2, 3 and 4 respectively. The terminal distance walked during the compliance program phase was 226 m., 586 m., 718 m. and 502 m. for patients 1, 2, 3 and 4 respectively. Therefore, there is a total increase in walking distance of 113 m. for patient 1, 185 m. for patient 2, 295 m. for patient 3 and 91 m. for patient 4.

Exercise heart rate. Figure 6 presents the E.H.R. data for each of the patients, immediately following the 12-min. walk test. The baseline E.H.R. data reveal a high degree of variability for all patients, although patient 3 had a slightly more stable heart rate than the others. There is a similar repetitive increasing-decreasing pattern present during

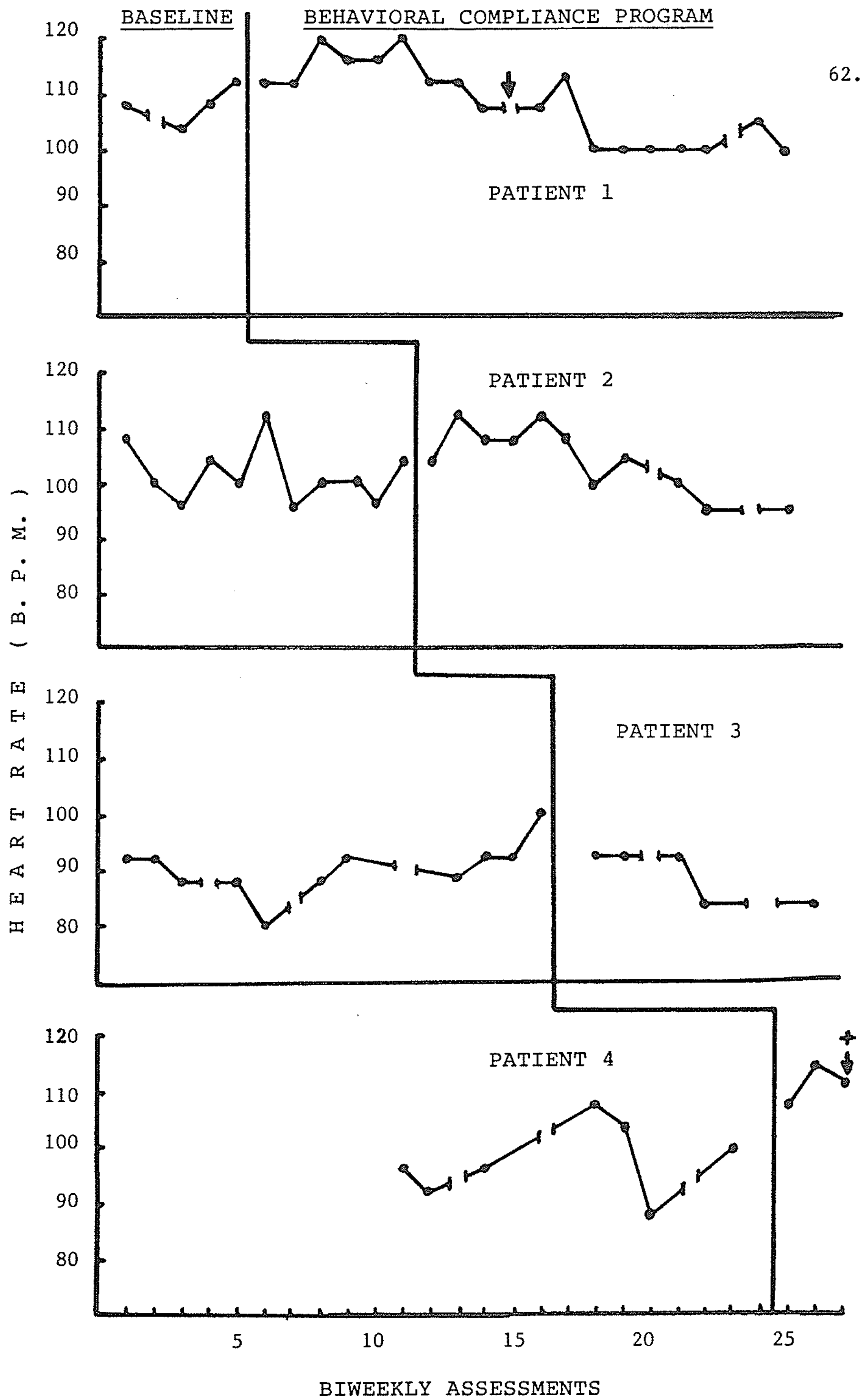

Figure 6. The effects of the behavioral compliance program on the exercise heart rate of all patients during the 12-minute walk; (↓) indicates physical injury; (↕) indicates tranquilizer intake

baseline in all the patients' data.

When the behavioral compliance program was introduced sequentially to each patient, no clear immediate change in heart rate was observed, except for patient 4 whose E.H.R. substantially increased above her baseline levels. For the other three patients, the variability observed during baseline conditions, continues throughout the behavioral compliance program.

Although there were no clear changes in the heart rate data from day to day during the course of this study, the terminal rates of the two phases are of interest. At the end of the behavioral compliance program, the E.H.R. was 100 b.p.m. for patient 1. Compared to patient 1"s baseline terminal rate of 112, this is a decrease of 12 b.p.m. Patient 2 had an E.H.R. of 95 b.p.m. at the end of the study. Compared to his baseline terminal rate of 104, this is a decrease of 9 b.p.m. Patient 3's program terminal E.H.R. was 83 b.p.m. Compared to her baseline terminal rate of 100, this is a 17 b.p.m. decrease. These three patients therefore, show a decrease in heart rate by the end of the compliance program as predicted. The decrease in terminal heart rate levels is also supported by a gradual, general (although variable) downward trend in these three patients' data.

Patient 4 represents a special case in that her treatment data are limited to three assessments, given time constraints of the study. Patient 4 had a baseline terminal heart rate of 95 b.p.m. and a treatment terminal heart rate of 112, an increase of 17 b.p.m. over the course of the compliance program. Since E.H.R. was expected to increase upon initial introduction to the compliance program as a function of increased physical demands of the exercises, the increase in patient 4's heart rate after only three assessments is as predicted.

Resting heart Rate

Figure 7 presents the R.H.R. for each of the patients, taken at the beginning of each appointment before the patients engaged in any physical activity. Similar to the E.H.R. data presented in Figures 3 and 6, the R.H.R.'s of all patients demonstrate considerable variability. Patient 1's baseline R.H.R. generally increases during baseline, from 76 to 96 b.p.m., with a final decrease from 95 to 84 b.p.m. prior to the treatment phase. After introduction of the compliance program, patient 1's heart rate continued to increase slightly to 88 and then 92 b.p.m. The data then show some variability and an increase to 96 b.p.m. during assessment 16.Following this peak heart rate, there is a rapid decrease to 80 b.p.m. and then increase to 92 b.p.m., with a final gradual decreasing trend to 80 b.p.m. by the end of the program.

Patient 2's R.H.R. indicate an increasing-decreasing trend between 72 and 90 b.p.m. throughout baseline. During the compliance program, there initially was no change in the level of R.H.R. and there continued to be variability in the data, although not as much as during baseline. There is a general gradual trend downward in heart rate during the compliance program, most notably after the midway point of the program when patient 2's heart rate decreases from 85 to 72 b.p.m. Patient 3's baseline R.H.R. first stabilizes at approximately 75 b.p.m., and then shows an increase in level to approximately 85 b.p.m. When the compliance program was introduced, patient 3's R.H.R. remained at the baseline terminal levelof 85 b.p.m. and then decreased to a terminal level of 75 b.p.m.

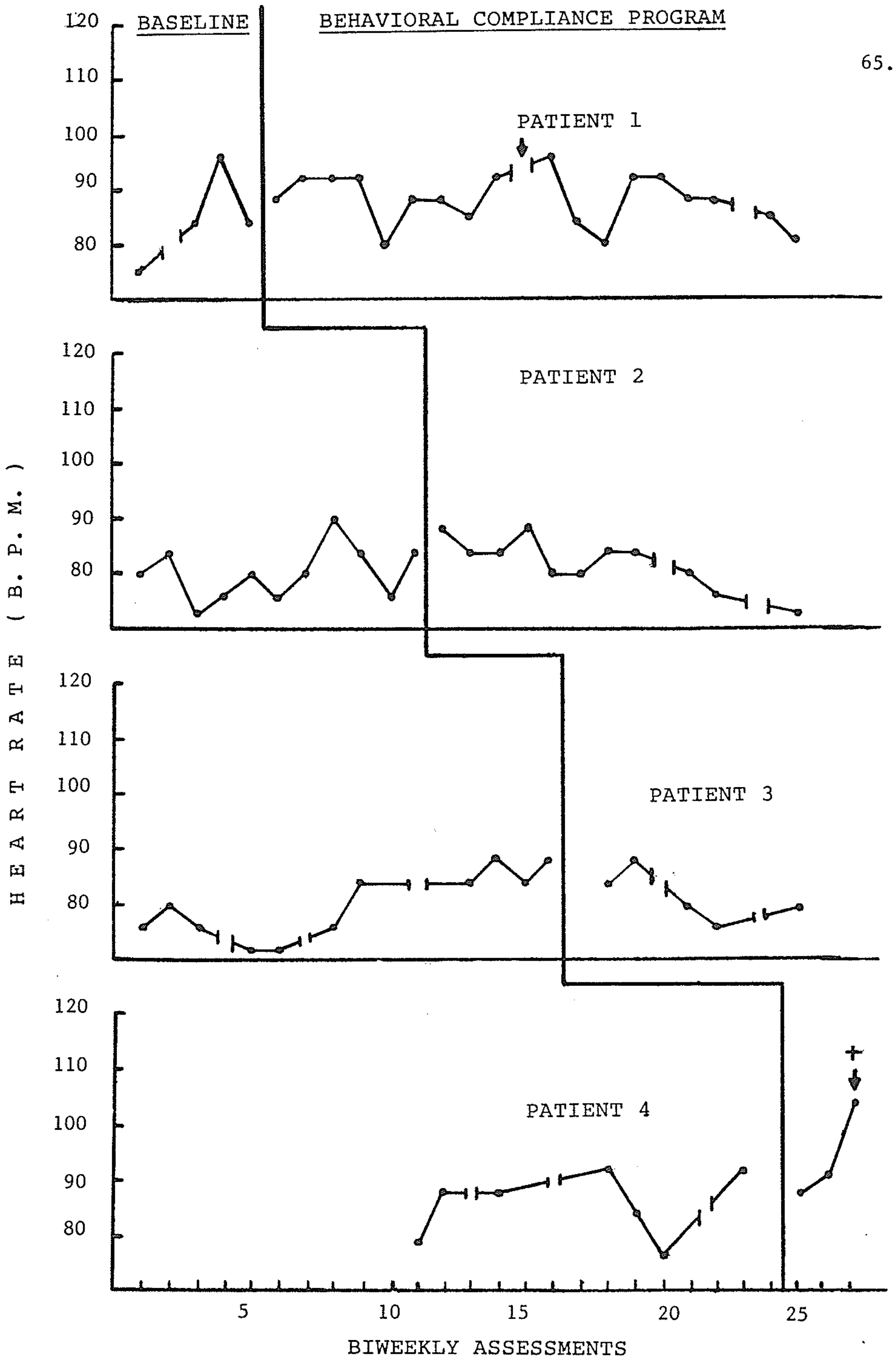

Figure 7. The effects of the behavioral compliance program on the resting heart rate of all the patients; (↓) indicates physical injury; (†↓) indicates tranquilizer intake.

Patient 4 demonstrates a high degree of variability throughout baseline, with the data ranging from 75 to 92 b.p.m. When the behavioral compliance program was introduced, her R.H.R. revealed an initial decrease to 88 b.p.m. from the baseline terminal rate of 92 b.p.m. On the final treatment assessment day, which is only the third assessment during this phase, there is a sharp increase in patient 4's R.H.R. to 104 b.p.m.

As in the E.H.R. data, the patients; R.H.R.'s reveal a high degree of variability throughout baseline and treatment phases, and therefore there are no dramatic overall observed changes in heart rates. However, once again, terminal heart rate levels indicate some promising trends. At the end of the compliance program, patient 1's R.H.R. was 84. This is a decrease of 4 b.p.m. in his heart rate in comparison to his baseline terminal rate of 80 b.p.m. Patient 2 shows a decrease of 11 b.p.m. by termination of the compliance program (73 b.p.m.) in comparison to his terminal heart rate of 84 b.p.m. Patient 3's terminal R.H.R. during the compliance program phase was 76 b.p.m. In comparison to her baseline terminal rate of 88, this is an 11 b.p.m. decrease. Thus, these phase terminal R.H.R.'s indicate a decrease, as predicted.

In the special case of patient 4 who had limited exposure to the compliance program. there is no observed decrease in R.H.R. Patient 4's data reveal an increase of 12 b.p.m., in comparing her baseline terminal heart rate of 92 b.p.m. and her program terminal heart rate of 104 b.p.m. Since R.H.R. was expected to decrease over time with exercise conditioning, it is possible that further participation in the compliance program would have produced the predicted R.H.R. decrease.

Treadmill Assessment Results

Table 1 presents the data collected on all patients during the initial and final treadmill multi-stage exercise test, conducted in the respiratory unit at the hospital by the physiotherapist. Measures taken on the patients during this test included; R.H.R., R.R.R., R.B.P., E.H.R., E.R.R., E.B.P., belt incline, speed (MPH) and test duration.

Patient 1. Although the resting state values for patient 1 appeared unchanged (as does E.R.R.) between the two assessments, there is a substantial increase in workload (3 extra min. at a steeper incline), with a decreased E.H.R. of 105 (down from 115 b.p.m.) and a decreased E.B.P. of 170/70 (down from 170/100) for that increased exercise load. For the same workloads during both assessments, E.H.R., E.R.R. and E.B.P. all reveal a decrease during the final assessment in comparison to the initial assessment (E.H.R. down to 100 from 115; E.R.R. down to 24 from 32 and E.B.P. down to 160/70 from 170/100).

Additional information is provided in terms of the assessment data immediately following this patient's accident, 5 weeks prior to the end of the study. The data shows that the patient was in extremely poor condition, with a high R.H.R. and R.B.P., and a lower capacity for work (3 min. at 0% incline). By the final assessment 5 weeks later, the patient had recovered to the level he had progressed just prior to the accident, in regards to all measures but blood pressure. While the accident set back physical progress, an improvement in performance beween initial and final assessments was still observed.

Patient 2. In terms of resting state, patient 2's R.H.R. data de-

Table 1

Results of the initial and final treadmill multi-stage exercise test

Patient 1				0% Incline				2.5% Incline				5.0% Incline				7.5% Incline								
	RHR	RRR	RBP	EHR	ERR	EBP	Time	EHR	ERR	EBP	Time	EHR	ERR	EBP	Time	EHR	ERR	EBP	Time					Speed
Initial	80	24	110 90	110	27	160 100	3 min	115	28	170 100	3 min	115	32	170 100	2 min	-	-	-	-min					.7 mph
Final	80	24	130 70	95	24	110 70	3	100	24	150 70	3	100	24	160 70	3	105	36	170 70	3					.7
Difference	0	0	+20 -20	-15	-3	-50 -30		-15	-4	-20 -30		-15	-8	-10 -30		-	-	-	-					0
Post Injury	90	24	130 70	140	40	160 90	3																	.7
Patient 2																10% Incline								
Initial	90	18	110 70	110	20	130 80	3					115	22	150 80	3	120	30	160 80	3					1
Final	80	20	100 70	95	20	115 70	3					105	22	120 70	3	115	28	135 70	3					1.5
Difference	-10	-2	-10 0	-15	0	-15 -10						-10	0	-30 -10		-5	-2	-25 -10						+.5
Patient 3								5.0% Incline				10% Incline				15% Incline				20% Incline			Time	Speed
Initial	75	18	120 80	90	18	130 80	3	85	20	135 80	3	90	20	140 80	3	100	20	150 80	3	105	20	160 80	3	1.2
Final	80	18	130 80	-	-	-	-	85	18	150 80	3	95	18	160 80	3	105	20	170 80	3	110	22	180 80	3	2.0
Difference	-5	0	+10 0					0	-2	+15 0		+5	+2	+20 0		+5	0	+20 0		+5	+2	+20 0		+.8
Patient 4																								
Initial	85	18	130 80	100	18	140 80	3	110	18	145 80	3	-	-	-	-									1.0
Final	80	18	125 80	92	18	170 80	3	98	20	170 80	3	108	24	170 80	3									1.0
Difference	-5	0	-5 0	-8	0	+30 0		-12	+2	+25 0														0

crease from 90 to 80 b.p.m. by the end of the program. In addition, patient 2 was able to tolerate an increased workload (i.e., greater speed of the treadmill belt) with a lower E.H.R. and lower E.B.P. across all inclines (0%, 5%, 10%). Final E.R.R. also indicates decreases despite the increased workload.

Patient 3. Improvement in patient 3's condition, was limited to an increased tolerated workload (i.e., greater speed of treadmill belt). Although E.H.R., E.R.R. and E.B.P. are slightly higher for the final assessment in comparison to the initial assessment, the increases are minimal given the increased workload (nearly doubled speed).

Patient 4. During the final assessment, patient 4 showed a decrease in R.H.R and a slight decrease in R.B.P. During exercise, patient 4 was able to increase her workload by walking 3 extra min. on the treadmill, with the belt set at a higher incline (an increase of 5%). Little improvement in exercise vital signs are noted, except for E.H.R. during the inital and final assessment, for the same work at a 5% incline (a decrease of 12 b.p.m.).

Discussion

The results will first be approached in terms of each exercise performance measure separately. After consideration of these measures, their relation to medical compliance will be discussed. Contributions of the research design will then be outlined and the social validity of the behavioral compliance program will be considered. Finally, directions for future research will be recommended and the conclusions of the present study will be summarized.

Step-up Test

Duration of stair climbing. The results indicated that implementing behavioral self-control skills, utilizing of performance feedback as a reinforcer, and providing social reinforcement for exercise compliance, produced increases in the tolerated stair climbing duration of all four patients when compared to baseline. Increased exercise performance was demonstrated by the increase in the level of the stair climbing duration of all four patients, when the behavioral compliance program was implemented. Patient 1 maintained his increased step-up duration, and patients 2 and 3 continued to increase their performance, throughout the compliance program phase. Patient 4 maintained a higher step-up duration during the compliance program phase in comparison to baseline, despite a decrease in exercise duration during the final assessment (which was possibly attributable to ingestion of tranquilizers).

The temporal duration of climbing stairs as an exercise performance measure, provided evidence in all the patients, that the behavioral compliance program increased performance as predicted. However, special consideration must be given to the high baseline levels of patients 2 and 3 at the beginning of the study, and the decreased performance of patient 4 at the end of the study. During the second baseline assessment, both patients 3 and 4 had been prescribed a new medication; a steroid called Prednisone. Prednisone decreases inflammation of the airways and decreases the amount of excess mucous produced (Hartley, 1978). This results in less shortness of breath and therefore may increase exercise performance. During initial intake of the steroid especially, patients 2 and 3 reported dramatic improvement in their physical condition (e.g., "I haven't felt this good in 6 years!") and this was evident in their elevated performance scores. However, given its powerful effects, Prednisone cannot be taken for long periods, and a decrease in performance was anticipated with lowered dosages. This decrease in performance occurred for patient 2 when his daily dosage was reduced from 6 pills per day to 5 pills per day (assessment 3). The effects of the steroid on his physical performance appear to be specific to initial introduction of the drug. Patient 3, however, showed increased exercise performance throughout the course of her steroid prescription. While patient 2 reduced the number of Prednisone pills that he took by one a week, patient 3 reduced the number of Prednisone pills that she took by one every second day (i.e., 6,6,5,5, etc.) and completed her daily prescription in two weeks. These two weeks corresponded precisely with her two weeks of elevated performance during baseline (assessments 2 through 5). The initial high baseline performance for these patients therefore, appears to be a function of the effects of the steroid.

The decrease observed in patient 4's data during the final treatment assessment, corresponded with the intake of two Vivol tranquilizers; Vivol is a diazepam derivative. These tranquilizers likely interfered with the patient's exercise performance as a result of their sedative and muscle relaxant effects. In addition, patient 4 complained of some nasal congestion which may have been an indication of impending illness. Thus, in combination, these factors may have contributed to her decreased performance.

Number of step-ups. When the patients were instructed in behavioral self-control techniques and received exercise performance feedback plus social reinforcement for increased compliance, they increased the number of step-ups that they were able to perform. This was evident in all patients, as an increase in level was observed in their data when the behavioral compliance program was introduced. Although persuasive evidence was provided for the effectiveness of the compliance program by the number of step-ups data, this demonstration was less convincing than with the duration measure, where a lasting effect was produced in all patients. With regards to the number of step-ups data, all patients showed an immediate increase in the number of step-ups that they completed in comparison to baseline, and patients 2 and 3 continued to increase the number of stairs that they were able to climb throughout the compliance program phase. Patients 1 and 4 did not show a similar trend of increasing exercise performance. There are, however, important considerations to be made regarding these latter two patients.

A promising trend was developing during the first two treatment assessments for patient 4, showing substantial increases in the number of completed step-ups. Unfortunately, prior to the final appointment, patient 4 took two tranquilizers, which likely reduced her exercise tolerance that day, as previously discussed. With regards to patient 1, decreases noted after assessment 15, appear to be the result of an accident that he had. When the compliance program was first introduced, patient 1 immediately increased the number of step-ups that he performed, and maintained this level of performance until the midway point of the treatment phase. It was at this point, that patient 1 encountered an attempted robbery outside his appartment. During this incident he was severely bruised and cut in the face and the right rib cage. Immediately following this experience, his physical activity was limited due to severe shortness of breath, pain in the ribs and sore and swollen eyes. Consequently, he was unable to exercise at all for the first few days and complained of shortness of breath for the remaining weeks of the study. Without doubt, this incident produced physical effects which resulted in an immediate decrease in performance. Although he continued to maintain his stair climbing time at 2 min., he was not able to climb as many stairs. Considering the performance data prior to the accident only, the behavioral compliance program did result in an increased number of step-ups in comparison to baseline. The data following the accident should not therefore, be viewed as representative of the treatment program effects, given that the physical injury interfered with exercise performance.

Twelve-Minute Walk Test

Duration of walking. The duration results for the 12-min. walk test indicated that the behavioral compliance program produced increased exercise performance for patients 1 and 2, in comparison to their walking durations during baseline conditions. Patient 1 showed an immediate substantial increase in walking time when the behavioral package was introduced, and showed a slight but consistent increase in walking time throughout the remainder of the program. Patient 2 improved his exercise performance during the behavioral compliance phase by consistently walking the maximum 12 min. during every treatment assessment. The variability observed during baseline was not evident during the compliance program.

Patients 3 and 4 were already consistently walking the maximum 12 min. during baseline and therefore could not improve their exercise performance during this test, with respect to this measure. After introduction of the behavioral self-control techniques and performance feedback and social reinforcement procedures, these patients continued to walk the maximum 12 min. Therefore, with this walking duration measure it was possible to demonstrate experimental control in only two patients. The results, however, were promising in that those patients who could improve, did improve. Demonstration of experimental control was limited to patients 1 and 2; not because patients 3 and 4 could increase their performance but failed to when the compliance program was introduced, but because they were already at ceiling levels during baseline and therefore could not show any improvement.

Distance walked. The results for distance walked by the patients, yielded strong and consistent indications that the behavioral compliance program produced a substantial increase in the exercise performance of all four patients, in comparison to baseline. All patients demonstrated an immediate increase in the distances that they walked, when introduced to the behavioral compliance program. Furthermore, despite his injury, patient 1 maintained his increased walking performance throughout the remainder of the study. The decrease in performance that was observed in the step-up data, was not replicated during the walking test, suggesting that the injury was specific to stair-climbing, an activity which requires more energy than walking. Similarly, patient 4 maintained her increased walking performance above baseline levels, despite her intake of tranquilizers. Patients 2 and 3 further demonstrated increased exercise performance, in that they consistently increased their walking distance following the initial treatment improvement. Therefore, the behavioral compliance program demonstrated convincing control in increasing the distance walked by patients.

Heart Rate

Exercise heart rate. The heart rate data provided evidence for increased physical conditioning as a function of the compliance program, although conclusions must be taken cautiously. It had been hypothesized that the E.H.R.'s for each patient would at first increase as a result of increased activity demands, and would then decrease as the patients' physical conditioning improved. Exercise heart rate data following the step-up test indicated some approximation of this predicted pattern. Patients 1, 2 and 4 increased their heart rates between 8 and 20 b.p.m. during the step-up test at the beginning of the compliance program phase, and a variable downward trend was observed in patient 1 and 2's heart rate for the remainder of the phase. Patient 4 did not show a similar decrease, due to the short period of data collection during her treatment phase. Thus, only the initial increase in heart rate was expected in her special case. While patient 3 did not show an initial increase in E.H.R. during the compliance program, her entire collection of treatment data show a general decreased level in E.H.R. Thus, while the E.H.R. data give some indication of improvement in physical conditioning, the variability of the data and the high number of overlapping data points between baseline and treatment phases, made these data suggestive rather than conclusive in terms of clear changes in heart rate.

The E.H.R. data for the 12-min. walk test indicated a similar absence of clear, convincing changes in heart rates. Unlike the E.H.R. data from the step-up test, there were less clear initial increases in the E.H.R.'s of the patients during the compliance program phase for the 12-min. walk test. Furthermore, the heart rate data during this test were again too variable, with too many overlapping points between phases, to detect a clear decrease in heart rate and to attribute that decrease to the compliance program. However, despite variability of the data, there were some suggestions of improved physical conditioning. By the end of the compliance program, the terminal E.H.R.'s for patients 1, 2 and 3 had decreased from the baseline terminal E.H.R.'s by 9 to 12 b.p.m. Patient 4 had not participated in the compliance program long enough to show a similar decline. Therefore, in three of the four patients, there was some decrease in E.H.R. by the end of the program during the 12-min. walk test.

Of considerable importance in considering E.H.R. is the fact that the decrease in heart rate during both exercise endurance tests occurred despite a substantial increase in workload. All of the patients were exercising for longer periods of time or walking further and climbing more stairs during the compliance program, with E.H.R.'s similar to, or below, baseline rates. Taking this factor into consideration further strengthens the conclusion of improved physical conditioning with the introduction of the behavioral compliance program.

Another consideration regarding the E.H.R. data is that E.H.R. was always taken at the end of the test. Consequently, the E.H.R.'s recorded during the exercise tests, were taken at a variety of different durations depending on when the patients terminated the tests, and after differential amounts of exercise had been completed (i.e., after a variety of distances had been walked, and a different number of stairs had been climbed. Therefore, the graphed data were always of the patients' E.H.R.'s when they were performing at their maximum exercise tolerance. Regardless of whether they climbed 5 stairs or 50 stairs for a duration of 2 min. or 5 min., the recorded E.H.R.'s were always the rates when the patients were fatigued. One might conclude then, that the patients would terminate the tests at about the same heart rates, regardless of work capacity. Although increased workloads would indicate improved conditioning, a change would not, of course, be reflected in the heart rate data taken alone. To solve this problem, a fixed point of work capacity (e.g., 2 min.) could be used to record heart rate, and then patients could be allowed to continue to exercise. This would provide a measure of E.H.R. at a fixed work capacity and would likely be more sensitive to changes in physical condition than exercise terminal heart rate as it was measured in the present study.

In conclusion, taking into consideration all of these factors (i.e., increased workload, decreased E.H.R. at the end of the compliance program, E.H.R.'s recorded at variable durations), the data, although variable, provide promising evidence for improved physical conditioning as a function of the behavioral compliance program. Although caution is required, supportive data were provided for increased exertion at the beginning of the compliance program resulting in increased E.H.R., and improved physical conditioning at the end of the program resulting in decreased E.H.R.

Resting heart rate. It had been predicted that, like E.H.R., the R.H.R. for each patient would decrease by the end of the compliance program, as a function of improved conditioning. However, once again the heart rate data for the patients at rest, show too much variability and too many overlapping data points between phases to indicate conclusive changes in R.H.R. The terminal R.H.R.'s for the two phases do, however, suggest some positive results. The terminal R.H.R.'s for patients 1, 2 and 3 had decreased by 4 to 12 b.p.m. by the end of the program as compared to baseline terminal rates. Again, patient 4 had not participated in the compliance program long enough to show a similar decline. Therefore, there was some decrease noted in R.H.R. in three of the four patients by the end of the compliance program.

These decreases in R.H.R.'s give some indication of improved physical conditioning as a result of the compliance program. The decreases in R.H.R.'s are important, considering that it is desirable that general improved conditioning occur, and not just improved conditioning specific to exercise alone. The decreases noted in both R.H.R.' s and E.H.R's suggest general improvement of the patients' cardio-vascular systems. Thus, not only should the patients "feel" better physically when exerting themselves, but this improvement appears to be generalized to resting states and therefore, the positive effects should be experienced during normal daily activities (e.g., while eating or doing chores). The R.H.R. data therefore, provide further evidence for the effectiveness of the behavioral compliance program.

Treadmill Multi-Stage Exercise Test

The data collected by the physiotherapist during assessments on the treadmill provided additional corroborative information regarding the patients' physical performances. Although these data were not collected in the context of a research design, they did provide clinical verification of improvement of the patients' physical performances attributable to the behavioral compliance treatment package.

These results indicated that all the patients improved their exercise performance on the treadmill from the beginning of the study, to the end of the compliance program. Although general improvement was observed for all patients, the specific physical benefits varied amongst individuals. Patient 1, for example, showed decreased E.H.R. and E.B.P. for increased workloads while patient 2 showed decreased R.H.R, R.R.R and R.B.P., and decreased E.R.R. for increased workloads. Patient 3 was able to substantially increase her workload, but did not decrease her exercise vital signs. Patient 4 also showed improvement in terms of increased workload. Regardless of specific individual improvements, all patients increased their physical performance on the treadmill during these assessments, verifying the increased performance observed in the multiple baseline home exercise data.

<u>Increased Exercise Performance: An Indication of Increased Compliance</u>

It is clear, from the combined results of the experiment, that introduction of the behavioral compliance program produced an increase in the physical performance of all patients. This was verified by an observed increase in exercise performance only when the compliance program was introduced to each patient. The experimental control of the behavioral package was demonstrated four times in the multiple-baseline across four patients, when performance was measured by the step-up duration and the distance walked during the 12-min. walk. Increases in the number of step-ups were demonstrated in three out of four patients and increased walking times occurred with two of the patients.

Although experimental control of the compliance program was not replicated across all patients with these latter two performance measures, exceptions were interpretable and the general pattern of results was convincing. All patients increased their exercise tolerance along some dimension.

Although the observed change in exercise performance was important in and of itself, the aim of applied behavior analysis is to determine the controlling conditions of behavioral change. In this context, the single most important goal of the present study, was to increase patient compliance with home physical therapy regimes. The only completely direct measure of compliance would have been direct observation of the patients engaging in compliance in the home; i.e., exercising. Although this direct measure was highly desirable, it was also impractical, since it could only be taken by individuals living with the patient. In the present study, direct observation of compliance was not possible for all patients, since only two of the patients lived with a spouse and experimenter monitoring would have been both intrusive and prohibative of time. Thus, an alternative objective, although indirect, measure of compliance was developed.

The rationale for using exercise performance as a measure of medical compliance, was the preference for an objective measure rather than the unreliable self-reports used in previous physiotherapy compliance studies (Mayo, 1978). The use of exercise performance as a measure of compliance was supported by research on the effects of exercise on COLD patients. As previously discussed (pp. 23-25), it has been repeatedly documented in research over the past 15 yrs., that daily physical exercise increases the exercise performance of COLD patients (Pierce et al., 1964; Paez et al., 1969; Hale et al., 1978). Chronic obstructive lung disease patients were found to walk further, climb more stairs, exercise longer and decrease their heart rates, as a function of exercising. Since daily exercising is necessary to increase exercise performance, the more compliant a patient is with a home physical therapy program and the closer a patient is to exercising daily, the more performance is likely to increase.

Given the above context, the observed increase in exercise performance which resulted from the introduction of the behavioral compliance program, may be considered a function of increased patient compliance. However, other factors must be considered. Exercise performance has been viewed by some researchers as a subjective phenomena, largely influenced by "motivation" (Mungall & Hainsworth, 1979). That is, when patients are assessed during exercise tests, the increased performance may be a function of the patient "trying harder", and not because physical conditioning through compliance with home exercises programs has actually increased. This explanation may be argued to be the cause of the increase in exercise performance. Alternatively, from a behavioral perspective, it may have been reinforcing for the patient if the therapist noted an increase in performance, and it may have been this reinforcement and not increased compliance that produced improved performance. This explanation for the observed increase in performance appears unlikely, however, given the lack of a similar effect during baseline. Even though the patients were being assessed during baseline also, there was no consistent increase in performance. In fact, this "motivational" factor was constant throughout the study and yet there was an observable change in performance only when the compliance program was introduced.

Another possibility is that the feedback component may have functioned as a reinforcer for more than compliance; it may also have functioned as a reinforcer for performance during the test alone. The feedback component provided the patients with their performance levels and gave them target performances to work towards. They may have "pushed" themselves to beat the previous assessment performance; perhaps beyond the activity level at which they would have normally stopped. Increased performance feedback therefore, may have reinforced increased exertion during the tests. This, in fact, may have been partly the case. The initial increase in performance for the patients after introduction of the compliance program was typically quite large; too large for a few extra days of increased compliance. Thus, this initial increase may be partly due to the effects of performance feedback as a reinforcer for increased performance. The gradual inclines observed in the data, were likely more reflective of physical conditioning due to regular exercising.

It is highly unlikely, however, that the entire treatment effect was a function of the feedback component alone. These COLD patients are severely limited by their physical condition and shortness of breath, and consequently they cannot increase their activity level just because they are "motivated" or reinforced for doing so. Given the size of the treatment effects on some measures, it appears that physical conditioning must also have increased. In the end, however, this is an empirical question. What portion of the treatment effect is a function of the feedback component alone, and what portion is a function of increased compliance, must be further investigated. The effects of performance feedback vs. self-control procedures, could be tested in the context of a multiple baseline A-B-CB-B design; where A is baseline, B is performance feedback alone, and CB is the self-control program plus performance feedback. Only with further research will the relative effects of these components be revealed.

In the present study there was a substantial increase in performance with the introduction of the behavioral compliance treatment package. It is known that there was a change in behavior and that the experimental manipulation at the time of change was the introduction of a package a strategies to increase compliance. All the components of the program were directed at increaing compliance. Prompts were set up to remind the patients about their regime. Patients recorded their daily compliance behavior. Patients were instructed to reinforce themselves for compliance. Performance feedback was provided to the patients, as a reinforcer for compliance (e.g., "You walked for 30 sec. longer! Your exercises are improving your performance!"). Finally, social reinforcement was contingent on increases in performance and was always related to compliance (e.g., "Good work! I can see from your improved performance that you have been doing your exercises!"). Therefore, as the programmed behavior, it was assumed that increased medical compliance occurred with introduction of the compliance program, as indicated by increased exercise performance. In addition, adequate levels of patient compliance during the compliance program phase were indicated by the patients' self-reports. During this phase, when exercise performances increased for all patients, patients 1, 2, 3 and 4 reported total regime compliance 90%. 81%, 90% and 77% of the time respectively.

Single Organism Multiple Baseline Research Design

An important feature of the present experiment was the multiple baseline design. According to Hale et al. (1978), it is generally recognized that the physical effects of exercise training are difficult to evaluate, partly due to problems in experimental design. In the present study, exercise performance was used as the measure of compliance, and therefore must meet the same design problems. One problem involves the statistical significance of changes in previous research. This is invariably tested by parametric procedures even though numbers are small and the normality of the distribution is in question (Hale et al, 1978). The multiple baseline design utilized did not use statistical procedures and therefore was not limited by population sample problems. Patients' performances were observed individually and therefore changes in behavior were evident over a number of repeated observations, without the use of statistics to determine change. As in all behavioral research, the present research study was designed to produce clear, substantial treatment effects, which were evident by merely observing the data, without statistical manipulation.

A second problem is that many studies do not allow for habituation to equipment, personnel and environment. This was not the case with the single subject design since frequent repeated measures were taken and the patients could therefore adjust to environmental variables. A third criticism of previous studies is the use of a single instrument such as a cycle or treadmill for training and testing. In these studies, improvement is specific, not general. In the present study, two tests of performance were given (i.e., walking and stair climbing tests) and results were recorded during each of them. Cycling was not included since it was not a typical activity in the patient's daily schedule; from a behavioral and personal perspective, walking and stair climbing were more important to daily functioning. A fourth and final criticism is that not all previous studies had a control group, and those that did, were treated inappropriately. Experiemntal groups received much attention while control subjects were ignored. Changes that occurred in the experimental groups were unlikely a result of the exercise regime alone (Roethlisberger & Dickson, 1939). This problem was avoided with the multiple baseline design since no control group was necessary. Each patient functioned as his or her own control, and received the same amount of nonspecific attention during both the baseline and intervention conditions.

The multiple baseline design was therefore, a considerable advantage. Because the patients were used as their own controls, statistical measures were avoided and treatment effects were not averaged or "lost" in large numbers (Hersen & Barlow, 1976). The individual patient was not obscured by statistics and a detailed record of the effects of the treatment on the individual was provided by the repeated measures. One final consideration is that COLD is a variable disease in that patients rarely "feel" the same for more than a few days; during one assessment they may feel very good, and by the next appointment they may feel restricted by shortness of breath. Thus, there are often large variations in test results, despite stable clinical conditions (Mungall & Hainsworth, 1978). Because of the disease characteristics, the comparison of only two estimates (as was frequently the case in previous studies) would not be a truly representative picture of the patients' conditions and would not show significant changes unless the changes, and the number of subjects, were extremely large. The repeated observations made on patients in the multiple baseline design, yield more reliable estimates of the value of each dependent measure, than the two assessments typically made.

In conclusion, the multiple baseline research design implemented in the present study provided some definite methodological advantages over the traditional group designs of previous studies, as well as valuable detailed data on individuals as a result of frequent assessments. An important contribution of this design was to provide clear evidence for the effectiveness of the home physical therapy exercise program when properly managed by patients. Given the lack of data verifying the effectiveness of physiotherapy exercise regimes, this research design should be of great interest and value to practising therapists interested in the effectiveness of their techniques for individual patients.

Social Validity of the Compliance Program

In addition to being experimentally effective, the behavioral compliance program was also practical and economical to implement. The cost of the program was limited to paper expenses, and the program could be implemented out of regular physiotherapy appointments. The self-control techniques of self-recording, posting and self-reinforcement were taught to each patient in 30 to 40 min. Performance feedback was provided in minutes at the end of each appointment. Reviewing the self-recorded data and providing encouragement and reinforcement for compliance also took a minimal amount of time. Each of these procedures could function as one component of the regular physiotherapy appoinments which are typically scheduled bi-weekly in the respiratory program as it presently exists.

The behavioral compliance program could easily fit into the physiotherapist's schedule with little effort. Self-management techniques, for example, could be taught in the context of general patient education. By periodic checks of self-recorded data, by reinforcement of compliance, and by providing performance feedback and reinforcement for improvement, the physiotherapist could encourage medical compliance throughout her or his interactions with the patients, and a more mutually reinforcing patient-therapist relationship would thereby develop. Given the effectiveness of the compliance program, it would be particularly useful for therapists encountering resistant, noncompliant patients. Increasing compliance through behavioral techniques would be a desirable alternative to the frequent discharging of noncompliant patients.

From the patient's point of view, the behavioral compliance program offered positive benefits with little effort on their part. As COLD patients, they were confronted with fairly extensive life style changes in terms of their medical regime, as well as with adjustments to shortness of breath. The behavioral program placed minimal additional demands on the patient and hopefully made the life style changes easier. Self-recording required minimal effort and easily became as routine as exercising. Self-reinforcement was both enjoyable and powerfully effective.

Some of the patients admitted that "motivation" was a problem from time to time, and could appreciate scheduling reinforcing activities following their exercises. They never complained about the self-recording and consistently recorded their exercises. They expressed appreciation for knowledge of their exact progress and eagerly waited to hear their results. In addition, anecdotal data revealed that the patients frequently talked about their compliance following introduction of the compliance program. Unprompted, they consistently reported to the experimenter at the beginning of the appointment, what they had been doing in terms of their exercises. Thus, there appeared to be increased "awareness" of their own compliance.

Clinical significance of the results is another important issue. Although there was an experimentally demonstrated increase in performance with the introduction of the compliance program, it was important that the change be a clinically significant one. In reviewing the results in terms of increases in the patients' performances, the physiotherapist involved in the present study, indicated that they were clinically significant. This professional opinion was verified by the results of the treadmill multi-stage exercise test, which indicated that all patients showed a greater tolerance for exercise by the end of the study. In addition, the physiotherapist believed that all patients had progressed enough in terms of their physical performance, to be put on follow-up, without further immediate treatment. This information provides strong evidence that the patients' increased exercise performances were clinically significant.

Directions for Future Research

As previously discussed (p. 83), given the general effectiveness of the behavioral compliance program as a whole, it is important to next determine the relative effectiveness of the various components. Performance feedback effects are of particular interest and conceivably might stand alone as effective compliance program components. However, the other individual components of self-monitoring, self-reinforcement and social reinforcement should also be tested for effectiveness.

A new approach taken in the present research, was the use of objective exercise performance measures as indirect measures of patient compliance. Further investigation of the use of performance as a compliance measure should be carried out; such as by engaging subjects in different frequencies of weekly exercise and measuring differential performance. In addition, direct spouse monitoring of compliance behavior (i.e., exercising) could be used as a compliance measure in future research, or to further validate the indirect exercise measures.

In the present study, behavioral self-control techniques were taught to the patients, and then implementaion of these procedures were left to them. Although it was evident whether the patients were self-recording their exercises, it was not possible to know if the patients were actually carrying out the self-reinforcement procedures. There were some verbal indications that they were doing so, however, it was not known how consistently they implemented this aspect of the program day to day. The self-reinforcement procedures were thus "patient-controlled" in that the therapist did not control the patients' reinforcers that were contingent on compliance. Future research should be conducted to test the relative effectiveness of therapist-controlled vs. patient-controlled self-control procedures in increasing medical compliance (Pomerleau, 1977).

Systematic replication of this research should be carried out, perhaps during the winter months when physical functioning is typically low as a result of cold weather, and when compliance consequently is also poor. Since the present study was conducted indoors, it can be replicated despite weather conditions. The effectiveness of the behavioral compliance procedures should also be tested with other patient populations; such as patients with different diseases (perhaps with less complicated medication regimes) or patients from a different age group (all the patients were above 50 yrs. in the present study).

The pool of available patients in the present study was very small. Suitable patients were being referred to the physiotherapy department at the Rehabilitation Centre at extremely low rates, and it was some weeks before enough patients were obtained to begin the research. Consequently, because of the small number of available patients, initial assessment could not be carried out to screen out the most compliant patients. All patients were used, despite possible varying levels of compliance. Future research should consider the initial screening of potential subjects for noncompliance, so as to provide even more stringent tests of the treatment package. Finally, the long term benefits of the behavioral strategies implemented in the present study should be studied during follow-up assessments. This is essential since COLD patients must continue their medical regimes throughout their lives.

Conclusions

In conclusion, the behavioral compliance treatment package; consisting of self-control techniques, performance feedback and social reinforcement procedures, was found to be highly effective in increasing medical compliance of COLD patients with exercise regimes, as measured by exercise performance during walking and stair climbing tests. More specifically, the hypotheses that the behavioral compliance program would increase the number of step-ups completed by the patients and their step-up times, as well as increase the distance walked by the patients, were well supported by the results in the multiple baseline design. The hypothesis that the patients' walking times would increase with the compliance program was supported by substantial increases in two of the four patients. The patients who showed no change, were those who were already walking the maximum 12 min. during baseline. Given these ceiling performance levels during baseline, changes in walking duration were naturally limited to two patients. There were also encouraging indications of improved physical conditioning in the heart rate data. Although variable, the results of the present study demonstrated initial increases in the E.H.R. data of three of the four patients, as well as decreases in the E.H.R. and R.H.R. by the end of the compliance program. These results indicated improved physical conditioning.

Patient noncompliance remains a serious problem for medical practitioners. There is a special need for more investigation of compliance with physical therapy regimes, an area which is virtually devoid of well controlled experimental research. The results of the present behavioral study indicate that the behavior modification treatment package produced a substantial increase in patient compliance, utilizing a new objective measure of compliance, i.e., exercise performance. In addition, the multiple baseline research design provided an effective means of evaluating therapeutic techniques. Certainly research should continue in the refining of behavioral control of patient noncompliance. Although relative newcomers to the world of medical research, behavioral practitioners have provided encouragingly effective results in tackling serious medical problems. Continued research is, of course, necessary to increase understanding both in medical personnel of behavioral strategies and in behavioral practitioners of medical problems. It is only through such cooperative professional development that "behavioral medicine" may properly reach its prophesized potential.

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Appendix A

Remember This About Breathing Control:

1. Start all breathing exercises by exhaling completely before breathing in.

2. If you can tolerate this position, lie on your back, with the foot of the bed raised 15 to 20 degrees. Some improvisation-- such as using thick chesterfield cushions under your hips -- may be necessary at home; but it is important that your hips be raised and your trunk supported at an angle of 15 to 20 degrees.

3. Breathe out through pursed lips. Breathe in through the nose slowly and smoothly, while relaxing the upper chest and attempting to fill the lower areas of the lungs.

4. Note that the time for breathing out should be two or three times longer than the time for breathing in. This applies to relaxed breathing as well as to breathing during increased activity.

5. Avoid raising the upper part of your chest or tightening the neck muscles while breathing in. This unnecessary effort increases the work of breathing.

6. In the Exercise Section of this pamphlet the physiotherapist will indicate the exercises you are to perform and the number of times they are to be repeated. This will be specified according to your exercise tolerance.

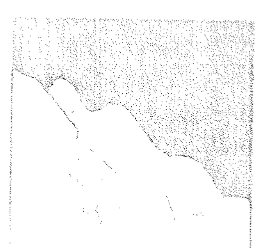
Relaxation Positions:

When breathing is difficult, use one of the following positions to promote relaxation. This will help you to control your breathing with minimum effort. The choice of position will depend on the circumstances at the time.

In all positions gradually relax your neck muscles, shoulders and upper chest, and try to breathe quietly with the lower part of the chest.

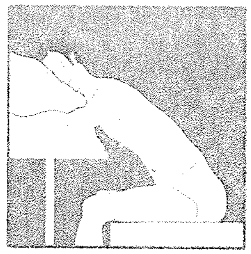
1. If you are lying down, make a slope with three or four pillows, placing an extra pillow to fill the gap between waist and armpit.

   Lie high up on these pillows, with the whole of the side supported and the shoulder underneath the top pillow (See Figure 1.)



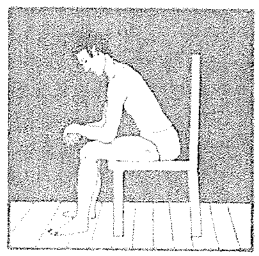
2. (a) Sit leaning forward from the hips with a straight back, resting your head, shoulders and arms on the pillows. When you are well relaxed, your arms should be lying loosely on the table, while your shoulders and upper part of the chest rest against the pillows. (See Figure 2a.)

FIG 2a



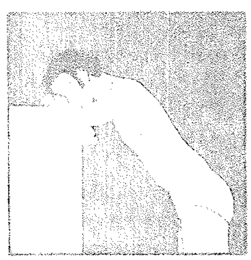
(b) Sit and lean forward with a straight back. Rest your forearms on your thighs with wrists relaxed. (See Figure 2b.)

FIG 2b



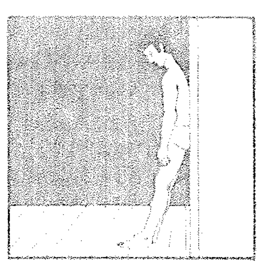
3. (a) Stand and lean forward from the hips onto something of the required height. Your back should be straight, your arms should be spread well apart, and your head should rest on your hand. (See Figure 3a.)

FIG 3a



(b) Lean the lower half of your back against a wall, with your feet placed 12 inches away from the wall. Your shoulders should be relaxed, your arms hanging loosely by the side. (See Figure 3b.)

FIG 3b



Breathing Control Exercises:

Breathing control exercises and general relaxation should be carried out in various positions and during difficult grades of severity of exercise. During exercises breathe out through pursed lips. Breathe in through the nose slowly and smoothly. Repeat each exercise according to the frequency indicated.

Starting Position: Lying on back with knees bent.

1. While breathing in raise arms from side to above head and try to touch the floor behind. Breathe out as arms return to sides.

2. While breathing out rotate both knees to the right. Return to starting position while breathing in. Alternate sides. NOTE: Shoulders must remain flat on mat.

3. While breathing out stretch right arm from the side, across the body and to the left as far as possible. Breathe in as arm is returned to side (starting position). Alternate sides. NOTE: Seat must remain flat on mat.

4. while breathing out raise right knee to chest. While breathing in return right leg to starting position. Repeat - alternating legs.

5. Breathe in fully while lifting seat off floor, then set down. Relax and breathe out.

6. While breathing out lift head and shoulders off mat and touch left knee with right hand. Breathe in while returning to starting position. Alternate arms.

Starting Position: Sitting in front of a mirror, feet apart and flat apart and flat on floor. The following exercises will aid in relaxation of your neck and shoulder muscles. They should be done slowly.

7. Breathe in while shrugging shoulders tightly towards the ears. Allow shoulders to return to a relaxed position while breathing out.

8. Head Movements: (If lightheadedness occurs during head movement avoid the exercise causing this sensation).
   (a) Bend head forward, chin on chest while breathing out. Lift head upwards to look at ceiling while breathing in.
   (b) Turn head to right side while breathing out. Return to starting position while breathing in. Repeat exercise to left side and continue alternating sides.
   (c) Circle head slowly, starting with head bending forward onto chest while breathing out. Continue circling, breathing in on backward motion. After ___ repetitions pause, repeat circling to opposite side.

9. Swing arms forward and up while breathing in. Allow arms to continue pendular swinging motion while breathing out.

10. Stretch arms sideways to above your head while breathing in. Lower arms while breathing out.

11. Clasp hands behind neck. Move elbows backwards while breathing in. Move elbows forward while breathing out.

12. Hands on shoulders. Rotate elbows forwards, upwards, while breathing in, and backwards and down while breathing out.

Starting Position: Either sitting or standing with feet apart. Arms may be relaxed at your sides or for more vigorous exercise a broom handle may be held at shoulder level or above.

13. Bend trunk to right while breathing out. Return to starting position while breathing in. Bend to alternate sides. NOTE: Trunk should not bend forwards.

14. While breathing out, rotate head, trunk and arms to right as far as possible. Return to starting position while breathing in. Alternate sides.

15. Raise arms overhead while breathing in, bend trunk forwards while lowering arms and breathing out.

Appendix B

Home Program

Light Work (up to 2.4C)

I Warm Up:

1. Standing legs apart. Hands on hips. Bend trunk sideways, keeping shoulders in line with hips. Repeat ___ times (1.2C)

2. Standing legs apart. Stretch arms sideways to above your head while breathing in. Lower arms while breathing out. Repeat ___ times (1.8C)

3. Standing legs apart with fingertips resting on shoulders. Straighten arms out at shoulder level as you turn body to the right, breathing out as you turn. Repeat sequence turning body to the left. Repeat ___ times a;ternate sides (2.3C)

4. Standing legs apart with arms hanging at your sides. Wwing arms forward and up while breathing in. Allow arms to continue pendular swinging motion while breathing out. Repeat ___ times (about 2.3C)

5. Sitting on floor. Lean back slightly to support yourself with your arms. Brace knees straight. Lift right knee up just to clear the floor and swing out to the side and back to the middle while breathing in. Repeat with left leg. Repeat ___ times (2.4C)

6. Lying on mat with knees bent. While breathing out through mouth raise both hands to touch knees. Breath in through nose once returned to resting position. Repeat ___ times (2,5C)

II Training Program:

a) Walking; (strolling) 1 mile/hour for 1 mile (60 minutes). This is your desired goal at this level. Initially begin with a short walk, timing how long it will take you to walk the distance at which you needed to stop due to shortness of breath and/or muscle fatigue. Attempt this same distance daily adding a few more paces until you achieve the desired exercise maximum of walking 1 mile in 60 minutes. Once you achieve this level and are able to repeat this distance on 3 or 4 consecutive days, then you may either increase your distance or your speed to continue to increase your tolerance.

b) Stair Climbing; initially climb up and down 5 steps as many times as you can within a 2 minute period. Do not do this quickly - the aim of this exercise is to increase your capacity for this type of work therefore it is important that you exercise for 2 minutes at a speed with which you are comfortable.

c) Stationary Bicycle; Begin this portion of your exercise program with a resistance and/or speed less than your more difficult working level for 2 to 5 minutes. At this time increase the speed and/or tension to a level that you will be able to carry out for at least 15 minutes. At the end of the exercise decrease speed and/or tension for 2 to 5 minutes.

Moderate Work (2.5 to 3.8C)

I Warm Up:

1. Lying on mat with knees bent. While breathing out, lift head and shoulders off mat and touch left knee with right hand. Breathe in while returning to starting position. Alternate arms. Repeat ___ times (2.4C)

2. Standing with feet apart. Swing arms forward and up while breathing in. Allow arms to continue pendular swinging motion while breathing out. Repeat ___ times (2.6C)

3. Standing with feet apart, bend trunk to right while breathing out. Return to starting position while breathing in. Bend to alternate sides. Note: Trunk should not bend forwards. Repeat ___ times (2.9C)

4. Standing with feet apart, hands on hips. Circle your upper body so that you reach towards the right, the floor, the left and then upright. Exhale on lower half of circle. Repeat ___ times (3.1C)

5. Lying on mat with knees bent and arms by sides. While breathing out through mouth raise both knees to chest. Breathe in through nose as legs are returning to centre and are in the resting position. Repeat ___ times (3.2C)

6. Sitting on floor, lean back slightly to support yourself with your arms. Brace knees straight, lift both legs just to clear the floor and swing out to the side and back to the middle while breathing out. Pause while breathing in. Repeat ___ times (3.4C)

II Training Program:

a) Walking; 30 minutes for 1 mile (3.8C). This speed and distance of walking is only to be carried out once you have successfully achieved and maintained the goal of the light work exercise program. This level of work requires a more brisk pace and you will need to gradually build up to this level. It may take a few days to become comfortable with the increased speed for the same distance. You may feel more tired or short of breath initially, but this will soon decrease as your body adjusts to the increased demands.

b) Stair Climbing; climb up and down 5 steps as many times as you can in a 5 minute period. As in the light work program you must choose a speed that will allow you to exercise for the complete 5 minutes.

c) Cycling; begin this portion of your exercise with a speed of ___ and a tension of ___ for approximately 3 to 5 minutes. Following this increase the tension until heart rate is increased to ___ beats per minute after 3 minutes of exercise and is maintained at this rate until either shortness of breath or muscle fatigue limits activity. Reduce speed to ___ and tension to ___ but continue to pedal foe 2 to 5 minutes until heart rate had decreased to ___ beats per minute.

III Cool Down:

To adequately complete your program, finish your exercise session with ___ repetitions of exercises _____, _____, _____, and _____ from your warm up program.