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BEHAVIORAL MANAGEMENT OF EXERCISE: CONTRACTING FOR AEROBIC POINTS

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Behavioral contracting was used to encourage physical exercise among college students in a multiple-baseline design. Subjects deposited items of personal value with the experimenters, which they could earn back on fulfillment of two types of contract contingencies. Subjects selected weekly aerobic point criteria, which they could fulfill by exercising in the presence of other subjects. In addition, subjects contracted to observe and record the exercise of other subjects and to perform an independent reliability observation once each week, with both of these activities monitored by the experimenters. Results indicated that the contract contingencies produced increases in the number of aerobic points earned per week for seven of eight subjects, that the aerobic point system possesses several advantages as a dependent variable for behavioral research on exercise, and that inexperienced observers could be quickly trained to observe exercise behavior and to translate those observations into their aerobic point equivalents. Finally, in a followup questionnaire completed 12 months after the end of the study, seven of the eight subjects reported that they were earning more aerobic points per week than had been the case during the baseline condition of this experiment.

DESCRIPTORS: aerobic points, behavioral medicine, contracting, exercise, adults

A prevalent behavioral characteristic of our population is a general lack of regular physical exercise. In an extensive review of data comparing the fitness levels of American *versus* Western European children, Cureton (1964) concluded that American children are inferior along several basic dimensions of physical fitness. A continued lack of exercise into adulthood has been suggested as a precipitating factor in the etiology of a wide variety of diseases (Krauss and Rabb, 1961; Fox, 1973). Further, researchers have demonstrated that many clinical conditions improve substantially in response to exercise as a treatment component (Frick, Katila, and Sjorgen, 1971; Morehouse and Miller, 1976). Finally, several large-scale longitudinal studies have associated physically active lifestyles with both less frequent and less severe episodes of cardiovascular pathology (Morris, Chave, Adam, Sirey, Epstein, and Sheehan, 1973; Paffenbarger and Hale, 1975).

Lack of exercise was viewed as a problem of sufficient magnitude to induce the federal government to devote substantial expenditures to investigate potential solutions (President's Council on Youth Fitness, 1961; President's Council on Physical Fitness, 1962, 1965). Recommendations of these commissions took two general forms: the dissemination of more information to the public concerning the value of exercise, and the provision of more exercise opportunities (*e.g.,* organized recreation programs). These approaches can be viewed as attempts to encourage exercise through the manipulation of antecedent or setting events, the assumption being that deferred consequences such as weight loss or improved health would be sufficient to maintain changes in exercise behavior. However, exercise, like many behaviors, is probably associated with reinforcing consequences on a long-term basis, but punishing consequences on an immediate basis.

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Moreover, traditional programs aimed at encouraging exercise have not paid serious attention to the fact that behavior is often more strongly controlled by immediate rather than delayed consequences. Thus, one possible solution to the problem of lack of exercise would be to arrange contingencies such that reinforcers are delivered more closely in time following the exercise behavior than is usually the case.

Several recent studies suggest that such an approach would be successful. Libb and Clements (1969) used a token reinforcement procedure to increase the rate of exercise on a stationary bicycle by geriatric patients. Other studies have demonstrated that contingency management approaches can be effective in modifying aspects of various athletic performances: swimming (McKenzie, Note 1; McKenzie and Rushall, 1974; Rushall and Pettinger, 1969), basketball (Jones, Note 2), football (Komaki and Barnett, 1977), and baseball (Heward, 1978). However, although results from these studies are highly promising for the development of procedures for modifying exercise behavior in specific settings, each of the studies possesses limitations that may render their techniques somewhat unattractive as methods for encouraging exercise in the natural environment. First, each study involved direct observation of exercise by the experimenter. Implementation of this procedure on a large scale may be extremely costly and would place excessive demands on the trainer's time and resources. Second, all of these studies required the subjects to engage in a single form of physical activity. However, changes in exercise behavior may be more likely to persist in the natural environment if subjects could engage in those activities possessing highest reinforcement value to a given individual.

The purpose of the present study was to provide a preliminary evaluation of a procedure that might prove effective in encouraging exercise in the natural environment. Three specific problems were addressed in an attempt to accomplish this goal: (1) the derivation of operational definitions of exercise behavior, (2) the development of an observation system that provides maximal assurance that exercise has occurred, yet places minimal demands on the experimenter, and (3) the selection of a contingency likely to produce changes in exercise behavior.

Cooper (1970) described a category of activities called aerobic exercises, consisting of moderate, sustained activity that produced elevated levels of oxygen consumption over extended periods of time. He studied the responses of some 15,000 Air Force cadets to programs of aerobic conditioning. In that research, he measured the amount of oxygen consumed by the body during various combinations of intensity and duration for each of the aerobic exercises (running, walking, swimming, handball, cycling, stationary running, rope skipping, basketball, racquetball, squash, golf, badminton, fencing, football, hockey, soccer, skating, skiing, tennis, volleyball, and wrestling) and reduced the oxygen consumption data to a single quantitative dimension, which he termed the aerobic point. Each aerobic point is equal to oxygen consumption at the rate of 7.0 ml/kg/min. Thus, in its simplest terms, the aerobic point is a measure of how much oxygen the body consumes during a specific activity. Table 1 presents the aerobic point values for a number of common exercises at various combinations of intensity and duration. Note, for example, that running one mile in 13 min is worth two aerobic points, while covering the same distance in 9 min is worth four points.

In addition to Cooper's research, others have provided evidence suggesting a functional relationship between the amount of oxygen consumed during exercise and the cardiovascular benefit of that exercise (Daniels and Oldridge, 1977; Pollock, Cureton, and Greninger, 1969). Several exercise physiologists (Morehouse and Miller, 1976; Sharkey, 1975) have further concluded that aerobic capacity is the best single measure of physical fitness currently available.

In view of its demonstrated validity and ability to reduce a wide variety of exercises into a common dimension, the aerobic point was selected as the dependent variable in the present research.

Several strategies are available in developing an observation system that ensures that exercise has occurred. Although personal observation of all exercise by the experimenter is likely to yield reliable data, it limits the subject's choices as to how and when to exercise. An alternative procedure might be to recruit mediators in the subject's natural environment to assist in performing observations (Tharp and Wetzel, 1969), and a likely pool of such mediators would be other subjects. This approach would allow the experimenter to distribute resources across a larger number of subjects and might also be expected to enhance maintenance of behavior change. Thus, subjects in the present study were required to observe and record the exercise behavior of other subjects and to perform occasional checks, with both activities being monitored by the experimenters.

With respect to contingencies, behavioral contracting appeared attractive for the purposes of the present research (Tighe and Elliot, 1968). The procedure involves negotiation of a contract between a client and therapeutic agent. The client deposits various items of worth (*e.g.,* money, goods) with the agent; the agent returns the items contingent on contract fulfillment (behavior change) on the part of the client. Behavior contracting has been effective in controlling numerous behaviors in the natural environment: body weight (Mann, 1972), smoking (Tighe and Elliot, 1968), studying (Homme, 1969), alcoholic drinking (Miller, 1972), and delinquency (Stuart, 1971). Several recent studies have evaluated the use of behavioral contracting in encouraging physical exercise (Turner, Pooly, and Sherman, 1976; Vance, 1976). However, in both of these studies no attempt was made to monitor directly the frequency or intensity of the subjects' exercise behavior. Instead, the experimenters relied on the subjects' verbal reports of their own exercise habits and on pre/post tests of physical fitness as the dependent measures of the effectiveness of behavioral contracting. While both of these studies suggested that behavioral contracting might be a desirable approach, a general lack of methodological rigor renders these findings somewhat inconclusive with respect to the functional relationship that may exist between contract contingencies and exercise behavior.

The purposes of this study, then, were to provide preliminary information on the utility of the aerobic point as a behavioral measure of exercise, the ability of subjects to observe and record each other's exercise and to translate those observations into aerobic point equivalents, and the effectiveness of behavioral contracting in encouraging exercise.

METHOD

Subjects and Setting

Twelve undergraduate and graduate university students (seven male, five female), ranging in age from 20 to 33 yr, participated. Subjects responded to an advertisement announcing the formation of an exercise group based on modern psychological techniques. All subjects reported recurring failures to engage in regular exercise.

Weekly meetings between subjects and experimenters were held in a large university classroom. Exercise behavior was performed in a wide variety of settings, the most frequently used being an outdoor 440-yard track, an indoor 220-yard track, an indoor 25-yard swimming pool, indoor racquetball courts, indoor and outdoor tennis courts, and subjects' homes.

Observation

Subjects could engage in any activities for which aerobic point values had been established (Cooper, 1970), and all exercise behaviors were defined by their aerobic point equivalents. The exact measurement procedure used depended

Table 1
Aerobic Point Values for Some Selected Exercises[a]

Activity Distance	*Duration (min:sec)*	*Aerobic Points*
Running/Walking		
1.0 mi	12:00-14:29	2.0
1.0 mi	8:00- 9:59	4.0
1.5 mi	15:00-17:59	4.5
3.0 mi	24:00-29:59	14.0
Cycling		
2.0 mi	8:00-11:59	1.0
3.0 mi	12:00-17:59	1.5
5.0 mi	20:00-29:59	2.5
Swimming		
200 yd	3:20- 4:59	1.5
300 yd	5:00- 7:29	2.5
400 yd	6:40- 9:59	3.5
1000 yd	25:00-33:19	8.25
Tennis		
—	40 min	3.0
—	60 min	4.5
Handball		
—	45 min	6.75
—	60 min	9.0

[a]Condensed from Cooper (1970).

on the particular activity. For example, an observer measured running/walking by counting laps around a track, timing the behavior with a stopwatch, and recording both the distance and duration. The subjects then converted these raw data into aerobic points by consulting charts provided in Cooper (1970).

Reliability

Assessment of interobserver agreement was performed by having two persons independently observe and record the exercise behavior of a third individual. Checks were made on 26% of all possible observations evenly distributed across the study. On 70% of these occasions, the two observers consisted of two subjects (recording the behavior of a third subject); on 30% of the occasions, the observers were a subject and an experimenter. Interobserver agreement was calculated by dividing the smaller number of aerobic points recorded by the larger for each individual observation, and multiplying by 100. Agreements averaged 99.2% across all observations, with a range of 83.3% to 100%. Experimenter-performed checks yielded agreements of 100%. A comparison of baseline and contracting reliabilities showed 100% agreement for each of 11 checks during baseline and 98.8% agreement across 55 checks during contracting.

Procedure

Weekly meetings. Throughout the study, subjects met weekly with the experimenters. During the initial meeting, the experimenters described the program and the subjects elected to participate on the basis of that information. The general principles of contracting were described and the differences between aerobic exercises and other types of activities were explained. Subjects inspected the aerobic point charts, data sheets, and the contract that would be in effect during the program. All received warnings as to potential risks and were informed under what conditions they would not want to participate in the study. Subsequent meetings were devoted to the following activities: assisting subjects in determining mutually agreeable sites and times for exercise, collecting and distributing data sheets, signing and renegotiating contracts, returning earned items previously deposited, and collecting new deposits.

Baseline. Subjects were told that for an unspecified period of time they would be able to explore different aerobic activities before signing contracts in order to determine realistic aerobic point criteria for themselves. They were also instructed that they might be asked to sign contracts at any subsequent meeting. Subjects arranged exercise schedules on a weekly basis and met in groups of two or more so that observation could be conducted. The experimenters were present at sessions where fewer than three subjects were scheduled at a time, to ensure that an observer would be available. No subjects ever reported appearing for exercise when no observer was available. All aerobic points earned in the presence of another sub-

ject or an experimenter were counted as baseline data.

Contracts for exercise. Subjects elected to earn a specific number of aerobic points each week and signed contracts outlining the conditions under which deposits would be refunded. Each subject deposited six items of personal value (*e.g.,* jewelry, clothing, books, and other personal items; checks made out to charitable organizations) with the experimenters, two of which could be earned back each week. Refunds were made at weekly meetings according to the following schedule. One item per week was returned for attaining the aerobic point criterion in effect and for bringing a completed form indicating the number of aerobic points earned that week. A second item was returned for recording primary observational data on another subject each time exercise was performed and reliability data at least once during that week. Before either item would be returned, subjects deposited two additional items. This requirement ensured a constant source of reinforcement for remaining in the program, because withdrawal from the group resulted in forfeiture of all items on deposit.

Illnesses that precluded exercise required verification. Acceptable forms were a doctor's note or a week-long absence from work or classes. Contracts were renegotiated every two weeks for the same number of aerobic points or higher. Forfeited deposits went to a nonprofit organization.

One-year followup. One year after completion of the study, all subjects received a maintenance questionnaire asking them to estimate the average number of aerobic points they had earned per week for the previous two weeks.

Experimental Design

A multiple-baseline design (Baer, Wolf, and Risley, 1968) across groups of subjects was used to assess the effects of behavioral contracting on the attainment of self-selected aerobic point criteria. During baseline, subjects agreed to be randomly assigned to one of two equal-sized groups ($n = 6$). Length of baseline condition for Groups I and II was one and three weeks, respectively. During Week 8 only, subjects were released from the aerobic point stipulation contained in the contracts. The university's physical education facilities were closed during the last four days of that week due to a holiday; thus, there were fewer opportunities for subjects to engage in many activities for which they had been earning points. During this week, subjects earned back two items for attending the weekly group meeting. Although this change in procedures cannot be considered a true return to baseline contingencies, subjects were still able to exercise in the regular facilities during the first three day of the week; they could also engage in activities not requiring those facilities throughout the week.

RESULTS

Four potential subjects (three male, one female) withdrew from Group II during the baseline condition. Three stated that time limitations would prevent them from actively participating in the study, while the fourth indicated a preference for activities other than aerobic exercises. None of these subjects earned any aerobic points during baseline.

The mean number of aerobic points earned per week by Groups I and II appears in Figure 1. For all subjects, a mean of 5.0 points was earned during baseline, 16.6 during Contract 1, zero points during Break, and 14.8 during Contract 2.

Table 2 provides an analysis of individual data throughout the experiment. The weekly number of aerobic points earned by each subject indicates that control over exercise behavior was demonstrated in seven of the eight subjects. Only Subject 6 failed to show increases in aerobic points earned after contract was introduced. She withdrew from the experiment during the fifth week, forfeiting her deposits. Similarly, Subject 4 during the fourth week and Subject 5 during the eighth, ninth, and

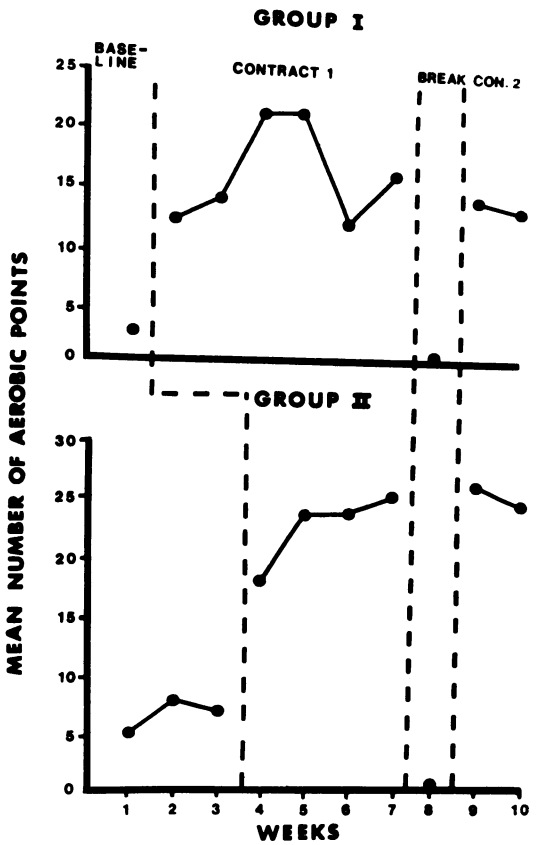

Fig. 1. Mean number of aerobic points earned per group during each week of the experiment.

tenth weeks received releases after providing verification of medical problems.

Maintenance data 1 yr after the experiment terminated show that seven subjects earned more aerobic points at that time than during baseline; three of these subjects were earning more points than at the end of the contracting condition.

Also shown in Table 2 are the individual point criteria used throughout the study. Variations are apparent between the subjects with respect to their self-selected criteria. Cooper (1970) suggested that persons in fair physical condition should earn about 10 aerobic points per week during the initial phases of a conditioning program. Six of the eight subjects set their initial criterion at or above this level. Subjects 3 and 6 selected initial criteria of seven and two points, respectively.

While all subjects had the option of increasing their point criteria at two-week intervals, not all did so. Although Subjects 1 and 2 kept their criteria constant throughout the study, both consistently exceeded the initial criterion that they had selected. Subjects 3, 4, 5, 7, and 8 each increased their point criteria at least once during the experiment. None of them reported that these increases exceeded their physical capabilities, nor did any of these subjects ever fail either to meet or to exceed the increased criteria.

DISCUSSION

Results of the present study support the use of behavioral contracting as an effective technique in the modification of exercise behavior. For seven of the eight subjects, aerobic point earnings increased after the contract contingencies were implemented. In only one instance did a subject fail to meet the terms of the contract. Additional evidence in support of the procedure was the fact that no exercise occurred during the Break condition, despite the opportunity to engage in exercise on three of the seven days. It should be noted, however, that although present procedures were related to increases in exercise, any of several facets of the program could have contributed to the effects observed here. Among these were the contract contingency itself, individual goal-setting by subjects, and subtle increases in social reinforcement for exercise. Only a careful component analysis of the relative impact of each variable could identify the specific factors responsible for the present results. In addition, the extent to which these results would easily generalize to populations other than college students is not clear. However, many of the problems likely to be encountered in the natural environment were successfully addressed in this study.

The aerobic point appears to possess several advantages as a measure of exercise behav-

Table 2

Number of aerobic points earned by each subject and the criterion (in parentheses) for each week.

	Weeks										
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*1-yr Followup*
Group I	Base-line			Contract 1				Break	Contract 2		
S1	6	13	17	15	27.5	11	12	0	10	15.5	10
	(–)	(10)	(10)	(10)	(10)	(10)	(10)	(–)	(10)	(10)	
S2	0	23	35	34	41	13	42	0	35	25.5	40
	(–)	(12)	(12)	(12)	(12)	(12)	(12)	(–)	(12)	(12)	
S3	3	9	7	11	11	11	11	0	12	11	6
	(–)	(7)	(7)	(9)	(9)	(11)	(11)	(–)	(11)	(11)	
S4	4	11	10	0	12	14.5	12	0	17	16	50
	(–)	(10)	(10)	(–)	(12)	(12)	(12)	(–)	(16)	(16)	
S5	4	17	17	26	16	20	23	*	*	*	30
	(–)	(10)	(10)	(15)	(15)	(20)	(20)				
S6	0	3	2	0	0	*	*	*	*	*	0
	(–)	(2)	(2)	(–)	(2)						
Group II											
S7	11	11	5	18	20	22.5	26	0	26	25	10
	(–)	(–)	(–)	(18)	(18)	(21)	(21)	(–)	(21)	(21)	
S8	0	6	10	19	28	26	25	0	26	25	24
	(–)	(–)	(–)	(15)	(15)	(25)	(25)	(–)	(25)	(26)	

*Subjects were released from the study.

ior. First, as shown in this study, high levels of interobserver agreement resulted despite minimal observer training. Second, the aerobic point reduced a wide variety of exercises to a common quantitative measure, eliminating the need for complex operational definitions for each form of exercise. Third, by imposing contingencies on the number of aerobic points earned, rather than on specific types of activities, subjects could meet exercise criteria through those activities they found most reinforcing. Finally, the aerobic point system is based on extensive physiological data indicating that aerobic capacity is a valid measure of overall physical fitness.

The observation system used in the present experiment also merits discussion. Although interobserver agreement was high regardless of whether an experimenter or a subject performed reliability checks, the possibility remained that some subjects submitted falsified data. To assess the extent of this problem, subjects were sent an anonymous questionnaire four months after the study ended, asking if they had ever submitted inaccurate data or if they had observed another subject doing so. All subjects completed and returned the questionnaire, indicating no instances of any data inaccuracies. In addition to this finding, several factors in the present study made it unlikely that erroneous data would be reported. Because subjects usually exercised in groups of three to five, instances of collaboration between two subjects to report inaccurate data would have been easily detected, and the social consequences for such behavior would discourage subjects from attempting it. In addition, subjects were informed that forfeiture of a deposited item would result if, after discarding any detected data inaccuracies, a subject failed to meet the aerobic point criterion. No such forfeitures were made during the study.

Thus, the use of subjects observing other subjects under the supervision and monitoring of experimenters appears to be both an accurate and efficient procedure for data collection.

Although a relatively small number of subjects participated in the present study, the group could have accommodated additional members. Also, because the experimenters were able to manage the exercise of more subjects than would have been possible using experimenter observations only, the program was probably more flexible for subjects, both in terms of the variety of exercises available and the ease with which those activities could be assimilated into the subjects' daily routines. An unexpected benefit of the observation procedure was the fact that it forced subjects to exercise in groups, thereby occasioning the delivery of immediate social reinforcement. Many instances of cheers, backslapping, and other positive social interactions were observed following improved performance by subjects.

The results of the maintenance questionnaire completed 12 months after the end of the study showed that seven of the eight subjects were at that time engaging in more exercise than they had been before exposure to the contract contingencies. Several subjects commented that the contract had enabled them to endure the more aversive early periods of the exercise program, allowing the natural reinforcing consequences of long-term exercise to take control of their exercise behavior.

A paradoxical aspect of the maintenance data is that no subject exercised during the Break condition, while seven of the eight subjects reported continuation of exercise 1 yr later. Apparently, the subjects responded differentially when the termination of contract contingencies was temporary as opposed to permanent. One possible explanation for these contradictory results is that subjects continued to exercise during the Break; however, they did so at home. Another is that subjects may have realized the benefits of aerobic exercise conditioning sometime after the program terminated, at which time they developed their own programs. Further research will be necessary to examine maintenance effects and to identify the controlling variables.

Another interesting aspect of these maintenance data is that the number of aerobic points reported on the followup questionnaire appeared to be directly related to the number of aerobic points earned during the experiment. That is, subjects who earned a substantial number of aerobic points during the experiment reported more exercise behavior on the followup questionnaire than did the subjects who earned relatively few aerobic points during the experiment. Further research will be necessary to determine if there is a functional relationship between these variables.

Future research on the behavioral management of exercise should extend the present findings to populations for whom exercise would not only be of long-term benefit, but also whose clinical conditions may indicate exercise as of immediate therapeutic value (*e.g.*, obese persons and those having various cardiovascular disorders). Furthermore, future investigations should address several problems apparent, but not solved, in the present study.

The first problem concerns dropout rate. Although only one subject withdrew from the experiment after exercise contracts were implemented, four potential subjects withdrew during baseline. As no contingencies were in effect during that condition, one possible solution may be to implement attendance contracts during baseline. Following a full description of the program, initial contracts could be written such that subjects earn back deposits for maintaining meeting attendance throughout the study. The aerobic point criteria could be introduced at a later time.

A second problem is that, because the aerobic point criteria were self-selected, there was no guarantee that subjects would not choose exceedingly low values (*e.g.*, Subject 6). A procedure that was considered in the initial planning of this study involved requiring subjects to set initial criteria at or above baseline performance. However, the procedure was rejected in that it might artificially depress baseline levels of responding and still allow subjects to

set initial low criteria. A more attractive alternative would be for the experimenter to set initial criteria on the basis of laboratory tests of physical fitness. In addition, it would be desirable to have subjects increase their weekly point earnings up to some level over time. Although subjects in the present study were never allowed to reduce their weekly criteria to a previous lower level, no systematic procedures (other than social praise) were employed to encourage subjects to increase their criteria. Such a provision could be written into the exercise contract, or other reinforcement procedures (*e.g.,* release from data collection responsibilities for a week) could be utilized.

A third potential problem was that 84% of the total aerobic points were earned via running. The rest were about equally distributed among swimming, raquetball, and tennis, with single instances of stationary running, rope skipping, and stair climbing. Two possible explanations account for this finding. Running is the most efficient method for accumulating aerobic points, since it produces more oxygen consumption per unit time than any other activity. Also, it may be that individuals with poor exercise histories do not have sufficient skills to engage in more complicated forms of exercise. Since exposure to a variety of exercise forms might increase the probability that a subject would make contact with the natural reinforcer associated with a given activity, it would be advantageous in terms of behavior maintenance to have subjects sample more than one activity. Two procedures to achieve such a goal would be a requirement of point earnings in several exercise categories or the offering of "bonus" points for changing activities from time to time.

Finally, although much data support aerobic capacity as a measure of physical fitness, the physiological effects of exercise were not assessed in this study. Such measures may not be important for persons who are merely "out-of-shape" and in need of a more consistent exercise program. However, independent measures of physiological benefit should be used to document the usefulness of exercises as a treatment for specific physical disorders.

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