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The Role of Efficacy Cognitions in the Prediction of Exercise Behavior in Middle-Aged Adults

Edward McAuley[1]

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The present study adopted a social cognitive framework to examine the role played by perceptions of personal efficacy in adherence to exercise behavior in sedentary middle-aged adults. Subjects were followed for 5 months in order to study the process of exercise as it moved through the adoption to maintenance stage of the behavior. Participation rates paralleled those reported elsewhere in the literature. Path analytic techniques examined the role over time of efficacy, perceptual, and behavioral indicators of frequency and intensity of exercise. Self-efficacy cognitions were shown to predict adoption of exercise behavior but previous behavior proved to be the strongest predictor of subsequent exercise participation. Results are discussed in terms of examining process versus static design models in exercise and physical activity research. Implications for future research and health promotion are suggested.

KEY WORDS: efficacy cognitions; exercise adherence; middle-aged adults.

INTRODUCTION

Considerable evidence exists to suggest that exercise and physical activity participation can result in meaningful health benefits from both a physiological and a psychological perspective (e.g., Blumenthal *et al.*, 1989; Emery and Blumenthal, 1989; Paffenbarger and Hyde, 1988; Siscovick *et al.*, 1985; Tomporowski and Ellis, 1986). Indeed, one of the primary exercise objectives identified by the Public Health Service [U.S. Department of Health and Human Services (USDHSS), 1979, 1980] was for the regular and vigorous participation in physical activity by 60% of the adult population by the year 1990. However,

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[1]Department of Kinesiology, University of Illinois at Urbana–Champaign, 215 Louise Freer Hall, Urbana, Illinois 61801.

according to recent figures, it is woefully apparent that the nation fell far short of achieving that objective (Dishman, 1988). Although there is some evidence to suggest that exercise participation rates are increasing (Blair *et al.*, 1987; Stephens, 1987), epidemiologic estimates suggest that more than 40% of the 18- to 65-year-old adults in the nation are completely sedentary (Stephens *et al.*, 1985).

One of the most commonly studied and least-understood aspects of exercise and physical activity concerns the problem of sustaining adherence to exercise regimens once they have begun. Well-documented statistics consistently indicate that the attrition rate from exercise programs approximates 50% within the first 6 months (Dishman, 1982; Oldridge, 1982). This figure parallels the compliance dilemma in modern medicine, one of the most serious problems in disease control and health promotion (Epstein and Cluss, 1982). In general, the exercise adherence literature can best be categorized as being fraught with theoretical and methodological problems. Much of the early work on this topic was atheoretical, with more recent approaches adopting diverse psychological theories to identify determinants of exercise behavior (Sonstroem, 1988; Sallis and Hovell, 1990). A major criticism of many of the theoretical approaches has been the failure of researchers to examine exercise adoption and maintenance as a process, rather than as a static phenomenon (Dishman, 1985; Sonstroem, 1988). Additional concerns, of a methodological nature, have also been identified. Of particular importance have been inconsistencies with respect to the definition and measurement of exercise behavior (Dishman, 1985; Perkins and Epstein, 1988).

Although a number of psychological variables have been identified as possible determinants of exercise behavior, the *belief* that one is capable of successfully adopting and maintaining a regular exercise regimen may be particularly important. Bandura's (1977, 1986) self-efficacy theory focuses on the mediational role played by perceptions of personal agency in affecting diverse aspects of human functioning and behavior. Efficacy cognitions are directly relevant to the particular behavior of concern and are, therefore, subject to change as a function of environmental stimuli. That is, positive mastery experiences are likely to facilitate increases in personal efficacy, whereas failures are likely to result in debilitated percepts of personal capabilities. Broadly defined, self-efficacy cognitions concern the beliefs or convictions that one has in one's capabilities to engage successfully in a course of action sufficient to satisfy the situational demands. Percepts of efficacy have been consistently shown to be important determinants of a number of health-related behaviors (for reviews see McAuley, 1991; O'Leary, 1985).

It is, however, important to realize that self-efficacy is not concerned with the actual skills that an individual possesses but, rather, the individual's judgments of what he or she can do with those skills (Bandura, 1986). Individuals with a high sense of self-efficacy tend to approach more challenging tasks, put forth more effort, and persist longer in the face of obstacles, barriers, and aversive or stressful stimuli (Bandura, 1977, 1986). Certainly, exercise settings present myriad choices of activity challenges and require considerable effort and persistence if health benefits are to be accrued. Such efforts and challenges might be especially salient to those individuals who are sedentary, aging, or obese. Recent reports have linked efficacy cognitions to changes in intensity level of activity in a community sample of adults (Sallis *et al.*, 1986), as well as being predictive of treadmill performance, strength gains, and exercise compliance in post myocardial infarction patients (Ewart *et al.*, 1986a, b). Furthermore, exercise-specific efficacy expectations have predicted frequency and intensity of exercise in sedentary adults engaged in low-impact aerobic exercise programs (McAuley and Jacobson, 1991).

The relationships between efficacy expectations and diverse behavioral parameters are not, however, unidirectional. Rather Bandura's (1986) social cognitive viewpoint postulates behavior, environmental influences, and physiological and cognitive factors to operate as interacting determinants of each other. This reciprocal determinism posits that behavior and human functioning are determined by the interrelated influences of individuals' physiological states, behavior, cognition, and the environment (Bandura, 1986, 1989). For example, in the exercise domain efficacy cognitions might influence, in concert with other variables, how long, hard, or often one exercises and, in turn, these latter parameters serve as sources of information for the formation of future efficacy expectations. Certainly such a temporal ordering of effects parallels the notion of exercise being a process in which growth and change take place over time. Unfortunately, this interpretation of exercise as a process runs counter to the typically static designs found in the literature that rely simply on preprogram screening measures predicting exercise behavior at later points in time (Sonstroem, 1988). Adherence is a complex phenomenon, with different variables determining different aspects of the behavior in a continually changing manner (Meichenbaum and Turk, 1987). Indeed, determinants of adoption[2] of exercise behavior may be very different from factors that influence maintenance of activity (Fontana *et al.*, 1986).

The present study examined the role played by self-efficacy cognitions in the process of adopting and maintaining exercise behavior by sedentary, middle-aged adults over a period of 5 months (specific predictions are outlined below). Being cognizant of the theoretical and methodological pitfalls that have beset other reports on the determinants of exercise behavior, the study

[2]Some arguments might be made that "adoption" is an inaccurate term to use to describe the early stages of behavioral adaptation. However, Sallis and Hovell (1990), in a useful schematic of the natural history of the exercise process, suggest that this initial phase of initiation and adaptation is indeed the time when behavior is taken up as one's own or adopted. Therefore, adoption is employed as the descriptor of choice in this article.

was designed to overcome some of the major problems associated with this area. First, a solid theoretical framework was embraced to assess how psychosocial variables, specifically self-efficacy, influence and are influenced by exercise behavior. In essence, such an approach examines the process of exercise adherence and, through the use of path analytic techniques, the temporal ordering and influence of variables predicting exercise behavior can be examined. Second, exercise behavior was assessed in terms of both frequency and intensity of exercise. Past research has typically used attendance as the operational definition of adherence. If frequency of behavior is considered important, then this measure is quite acceptable (Martin and Dubbert, 1985). However, attendance is considered adequate as a measure of adherence only if participants are monitored with respect to intensity and duration of activity (Perkins and Epstein, 1988). The present study followed such guidelines by daily monitoring of intensity, frequency, and duration. Finally, subjects were studied for a span of 5 months, a period of sufficient duration for exercise to have health and fitness benefits as well as adopting a longitudinal approach to determining those variables which influence adoption and maintenance of exercise behavior.

METHOD

Subject Recruitment and Characteristics

Subjects were recruited via local media advertising (newspaper, radio, and television public service announcements) to participate in a 5-month-long exercise program specifically directed at middle-aged, sedentary adults. Participation criteria for entry into the program were being sedentary (operationalized as no regular involvement in exercise or physical activity regimens in the previous 6 months), middle-aged (45–64 years of age), and otherwise healthy or asymptomatic as determined by a preprogram physicians' examination and medical clearance for exercise participation. Subjects were selected for participation using stratified sampling restrictions in which approximately equal numbers of males and females from four age cohorts (45–49, 50–54, 55–59, and 60–64 years) were required. Prospective participants indicated their interest in participation by telephone and received a confirmatory follow-up letter detailing the opportunity to participate in the 5-month-long program led by trained exercise specialists. They were also informed that they would receive a comprehensive health and physiological screening assessment by trained medical personnel prior to and following the program. The initial sample comprised 103 participants (n = 50 and males and n = 53 females). Descriptive statistics for the sample suggest that the entry criteria have been met. That is, the sample was on average middle-aged (M = 54 years) and sedentary as indicated by mean values for weight (M = 182 lb) and percentage body fat (M = 31%) (McAuley *et al.*, 1991). The mean value for the group on aerobic capacity ($\dot{V}O_2$ max) was 26 ml/kg/min, a figure that is indicative of below-average fitness levels in this age group (McArdle *et al.*, 1986). Furthermore, examination of subjects' reported activity history clearly indicated that subjects were indeed sedentary prior to enrollment in the exercise program. When asked to indicate when they had last engaged in specific aerobic activities on a regular basis, 70, 97, 98, and 98% of the sample had not walked, jogged, engaged in aerobic dance, or swam, respectively, in the past 12 months. Of the total sample, 52, 72, 83, and 83% had never engaged in walking, jogging, aerobics, or swimming as physical activity, respectively.

Exercise Program

The exercise program was designed to confirm with the American College of Sports Medicine (ACSM) (1978) minimum guidelines for achieving cardiovascular benefits from aerobic exercise. Specifically, participants engaged in low-impact aerobic exercise three times per week (frequency), for a minimum of 15–20 min (duration), at a level of intensity (target heart rate range = 65–75% maximum predicted heart rate) prescribed by an ACSM certified preventive/rehabilitative exercise test specialist. Brisk walking, graduating to jogging in some cases, constituted the aerobic aspect of the program, an activity that has been reported to be of sufficient intensity to produce an adequate training effect in male and female middle-aged adults (Pocari *et al.*, 1987). The program length was 5 months (20 weeks). Although aerobic fitness improvements have been noted at 6 weeks in some studies, Pollock *et al.* (1977) suggest that regular aerobic activity can improve aerobic capacity by 15–25% over a 4- to 6-month period. Consequently, in order to ensure sufficient health and fitness gains, the program was designed to last 5 months. Moreover, a program of such length incorporates both the adoption and the maintenance stages of the exercise process.

Subjects were instructed by the exercise leaders and the supervising exercise test specialist in the correct procedures for assessing exercise heart rate via palpation of the carotid or radial artery, specifics of warm-up, workout, and cool-down phases of exercise and on the use of ratings of perceived exertion of RPE (Borg, 1985) and target heart rate as measures of workout intensity. These aspects of the program took place during an orientation prior to exercise classes and were reviewed and reinforced during the first weeks of classes by the exercise leaders.

Measures

Exercise Behavior. Three measures of exercise behavior were assessed. Program attendance was the primary measure tapping the frequency aspect of exercise. As subjects' duration and intensity levels of exercise participation were carefully monitored on a daily basis by the exercise leaders, and as frequency was deemed an important aspect of exercise behavior for previously sedentary individuals (Martin and Dubbert, 1985), this measure avoids some of the more typical problems associated with the assessment of attendance as exercise behavior.

However, the need to assess the levels of intensity at which participants exercise is also an important aspect of exercise adherence. Although a number of methods of assessing intensity are applicable, many are simply not practical in studies such as this. As recommended by Maresh and Noble (1984), two measures of intensity, ratings of perceived exertion (RPE) and exercise heart rate, were assessed during the final portion of each activity session and recorded by the exercise leaders. The scientific validity of self-palpation of heart rate might be considered questionable and this measure was not included in subsequent path analyses. However, the RPE measure represents perceptual assessment of how hard one is physically working, information that may be equally as important as determination of physical strain inferred by physiologic responses (Maresh and Noble, 1984). Such a component also makes theoretical sense with respect to self-efficacy. One would expect the more efficacious individuals to experience less subjective strain than their less efficacious counterparts when exercising at bouts of similar dosage. Therefore, all subjects carried with them during exercise a credit card-sized replication of the RPE scale from which to gauge their perceptual response to exercise.

Self-Efficacy. Two measures were employed to assess self-efficacy cognitions with respect to exercise behavior. The first was the Perceived Physical Ability subscale of the Physical Self-Efficacy scale developed by Rhyckman *et al.* (1982). This is a general measure of how subjects perceive their physical self-confidence and hereinafter is referred to as general self-efficacy. Adequate reliability and validity for the measure have been reported previously (McAuley and Gill, 1983; Rhyckman *et al.*, 1982). Internal consistency of the measure for this sample was acceptable, .89. The second measure was 10-item exercise-specific self-efficacy scale designed to tap subjects perceived capabilities to exercise three times per week in the face of barriers to participation. These barriers were determined through an attributional analysis of subjects' reasons for dropping out of exercise (McAuley *et al.*, 1990). Efficacy measures should reflect the generative capabilities of the individual to achieve the behavior in question (Bandura, 1986). Therefore it was deemed appropriate and in line with self-efficacy theory to employ an attributional strategy to determine the items which subjects perceived as representing barriers to exercise (Bandura, 1977, 1986; Meichenbaum and Turk, 1987). Sample items included subjects' belief in ability to exercise regularly if they failed to make progress quickly enough, exercise conflicting with work schedules, being bored with the activity, feeling self-conscious about their appearance, and so forth.[3] Internal consistency for the measure was acceptable, .88.

Physiological Measures. As part of the preprogram screening a number of physiological parameters were assessed including body composition and aerobic capacity. These parameters were employed to determine the exercise prescription for each participant and to recognize and identify any contraindications that might be exacerbated by exercise in this population. Moreover, weight and body fat have been identified previously as predictors of adherence (e.g., Dishman *et al.*, 1982). Further, it might reasonably be expected that actual physical conditioning may impact upon one's perception of capabilities and ultimately one's exercise behavior. Therefore, the physiological measures were also employed as predictors of exercise behavior and self-efficacy.

A submaximal graded exercise test employing a modified Astrand Ryhming protocol (Siconolfi *et al.*, 1982) with continuous electrocardiographic and blood pressure monitoring was employed to determine predicted aerobic capacity (VO_2 max). It should be noted that such an approach is a less accurate method of ascertaining aerobic capacity then employing a maximal graded exercise stress test. However, for this population the procedure is considered adequate. Body weight and percentage body fat were assessed as measures of body composition, with the latter being calculated from the seven-site technique and generalized equation developed by Jackson and Pollock (1978).

Procedures

Following recruitment into the program, all subjects attended a 1-hr orientation session at which they were given details as to the nature of the program and informed that they would be required to periodically complete a battery of inventories. A certified nurse practitioner and exercise test technologist then gave an overview lecture on the benefits of exercise, the content and procedures of the physiological screening and graded exercise test, and the structure of the typical exercise session (warm-up, workout, cool-down). Subjects completed a detailed human subjects IRB form advising them of their freedom to withdraw without penalty from the study at any time. Finally, they

[3]The efficacy measures are available on request from the author.

completed a health history questionnaire and an attributional inventory designed to determine possible barriers to exercise participation.

Subjects were assigned to one of four exercise classes, two of which were held in the morning and two in the early evening. At this time subjects were also scheduled for their physiological screening. Two exercise leaders (one male, one female) supervised the exercise classes, alternating between groups periodically to ensure equal exposure of the leaders to all participants. Each leader was a second-year graduate student in exercise physiology with considerable teaching experience and certified in cardiopulmonary resuscitation (CPR). The leaders led and supervised the exercise classes and were responsible for monitoring and recording subjects' intensity, duration, and frequency of exercise.

The exercise class was composed of a warm-up, an aerobic activity period, and then a cool-down phase. Subjects were led in stretching, flexibility, and strength exercises by the exercise leaders for approximately 10 min each session. They then participated in the walking program, the aerobic portion of the session. Participation in this phase was closely monitored by the exercise leaders and subjects engaged in aerobic activity for progressively longer durations on a biweekly basis for the first 10 weeks. That is, the activity lasted for 15 min for the first 2 weeks, increasing to 20–25 min for the second 2 weeks, 25–30 min for weeks and 5 and 6, 30–35 min for weeks 7 and 8, and finally 40 min by the tenth week. The latter prescription of duration was maintained for the remainder of the program. In this way, a measure of control was implemented over the duration aspect of participation.

As indicated, subjects attended the exercise class three times per week for 20 weeks. Self-efficacy measures were assessed at the end of 3 and 12 weeks. It was rationalized that in order for subjects to determine accurately their self-efficacy for overcoming barriers, they would first have to have a sense or experience of what these obstacles/barriers might be. Cogent arguments along these lines are presented elsewhere, by Dunbar (1987) and Kaplan and Simon (1990). Attendance was monitored and documented on a daily basis by the exercise leaders, as were heart rate and ratings of perceived exertion. Each of these measures was aggregated to provide a continuous measure of exercise behavior at 12 and 20 weeks. Thus, assessments of exercise behavior during the adoption and maintenance phase of the program were logged.

Data Analysis

The study was designed to determine the veracity of a causal model that predicts efficacy cognitions to influence exercise behavior and to be

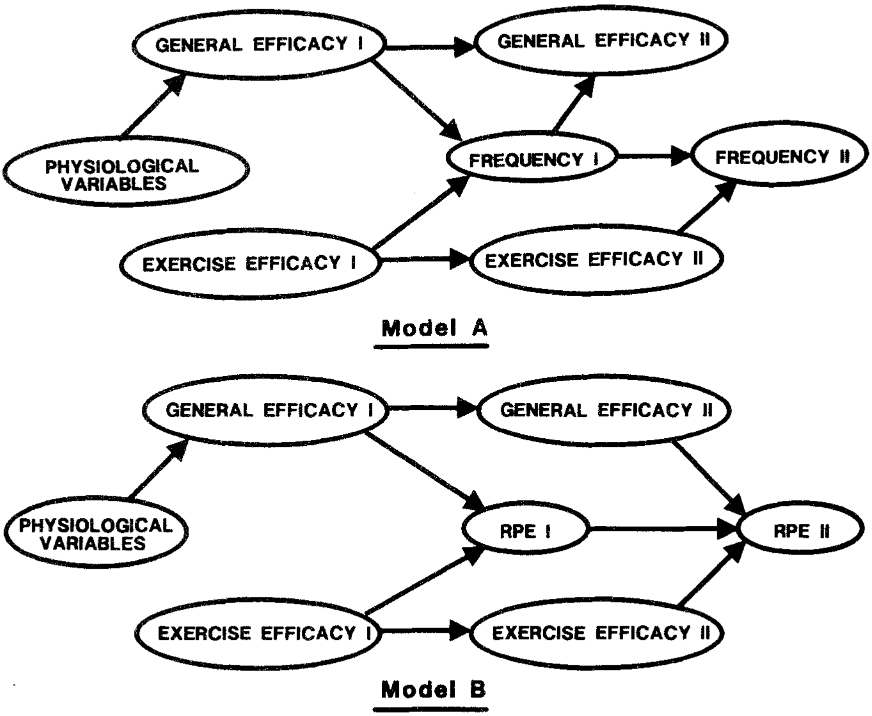

Fig. 1. Hypothesized causal relationships among physiological, cognitive, and behavioral variables during the exercise process.

influenced later by exercise behavior. Thus, the role of self-efficacy in the process of exercise was examined (see Fig. 1). Of the two primary measures of exercise behavior, one is behavioral (attendance) and one perceptual (RPE). Two causal models were hypothesized and were tested employing path analysis.[4] Each model is shown in Fig. 1.

Specifically, in Fig. 1, model A, physiological variables (aerobic capacity, percentage body fat, and weight) were hypothesized to act as sources of information from which general self-efficacy is determined. It is unlikely that

[4]It is recognized that the results of the path analyses will be somewhat biased due to the effects of measurement error. Both random error in the measures and autocorrelation due to use of parallel measures over time will influence the results. A more appropriate procedure for testing the causal model would involve the use of structural equation modeling with latent variables. However, due to the relatively small sample size and the number of parameters involved in testing the model in latent variable form, such an analysis would be inappropriate. The present sample size has been selected to ensure that the ratio of path coefficients to subjects is above the minimum of 10 cases per parameter that is generally recommended (Pedhazur, 1982).

these measures would be related to specific beliefs regarding one's ability to overcome barriers to exercise, however. In turn, efficacy cognitions are proposed to influence exercise frequency at week 12. Frequency of exercise at week 12 is theorized to influence future attendance between week 12 and week 20 and also influence perceptions of efficacy at week 12, which were hypothesized to have a direct effect on week 20 attendance. Thus, specific efficacy is proposed to have direct and indirect effects on exercise frequency. General efficacy, was proposed to have an effect on exercise only during the initial stages (first 12 weeks) of exercise adoption. Rationale for this hypothesized effect stems from the argument that whereas a generalized sense of efficacy may be salient during the adoption of exercise behavior, any influence it may have at this early stage is muted as time passes and specific efficacy cognitions become more crucial to behavior prediction.

In Fig. 1, model B, the physiological variables were also proposed to act as source of general efficacy. Both efficacy measures at week 3 are proposed to have significant direct effect on perceptions of effort sense (RPE) at week 12, although the general efficacy measure is expected to be more strongly related to RPE. Rationale for such a prediction stems from general efficacy being the measurement of confidence in overall physical capabilities, and therefore more efficacious individuals would be expected to perceive less physical strain than their less efficacious counterparts in similar circumstances. In turn, RPE at week 20 is hypothesized to be influenced directly by general and specific efficacy as well as RPE at 12 weeks.

It should also be noted that variables assessed at more than one time point are expected to demonstrate significant correlations with themselves, which, in effect, will serve to attenuate the relationships between the other endogenous and exogenous variables.[5]

RESULTS

The results are reported in a number of sections. First, the descriptive statistics of the sample along with patterns of exercise participation are presented. Then the relationships among cognitive, physiological, and exercise

[5]It is acknowledged that some individuals might argue against the use of panel or autoregressive models, suggesting that variables cannot "cause themselves." However, to circumvent such problems, variables need to be measured as chronometric factors or reference curves and latent mean structures employed to assess model fit. To do this requires continual assessment of the variable over time, something not possible with respect to the present study due to the sample size and number of parameters that would have to be determined.

Table I. Biometric and Descriptive Data for Sample (n = 65)

Variable	Mean	SD
Age	54.11	5.61
Weight	182.97	35.73
Height	68.24	3.43
VO_2 Max	26.46	5.98
Percentage body fat	30.71	6.95
Resting heart rate	77.58	12.96

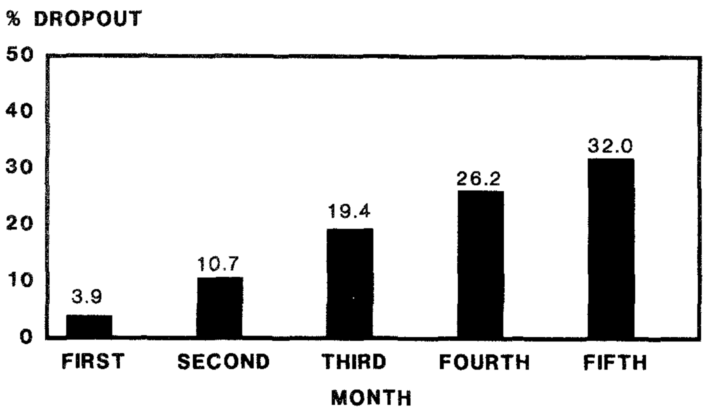

Fig. 2. Percentage of dropout behavior by month during the exercise program.

variables are examined. Finally, the proposed causal structures among the variables of interest are tested.

Subject Characteristics and Exercise Patterns

Table I details the biometric profiles of those subjects with complete date at all points during the study (N = 65). As noted earlier, subjects were overweight, had poor cardiorespiratory fitness levels, and high percentages of body fat.

Figure 2 details the patterns of exercise participation by monthly totals and for the complete 20-week program. As can be seen, during the

Table II. Correlations Among Efficacy, Exercise, and Physiological Variables

	1	2	3	4	5	6
1. Exercise efficacy I	1.0000	.5514 (p = .000)	.1834 (p = .072)	.3636 (p = .001)	.2055 (p = .050)	.2333 (p = .031)
2. Exercise efficacy II	.5514 (p = .000)	1.0000	.2088 (p = .048)	.3033 (p = .007)	.3290 (p = .004)	.3313 (p = .004)
3. General efficacy I	.1834 (p = .072)	.2088 (p = .048)	1.0000 (p = .)	.8453 (p = .000)	.0915 (p = .234)	−.0689 (p = .293)
4. General efficacy II	.3636 (p = .001)	.3033 (p = .007)	.8453 (p = .000)	1.0000	.1275 (p = .156)	.0942 (p = .228)
5. Frequency II	.2055 (p = .050)	.3290 (p = .004)	.0915 (p = .234)	.1275 (p = .156)	1.0000	.5747 (p = .000)
6. Frequency I	.2333 (p = .031)	.3313 (p = .004)	−.0689 (p = .293)	.0942 (p = .228)	.5747 (p = .000)	1.0000
7. Heart rate II	.1039 (p = .205)	.0174 (p = .445)	−.3441 (p = .003)	−.2962 (p = .008)	−.0778 (p = .269)	.0663 (p = .300)
8. Heart rate I	.0779 (p = .269)	.0927 (p = .231)	−.3772 (p = .001)	−.3120 (p = .006)	.0570 (p = .326)	.1831 (p = .072)
9. RPE II	−.3551 (p = .002)	−.2512 (p = .022)	−.2840 (p = .011)	−.2674 (p = .016)	−.2215 (p = .038)	−.2087 (p = .048)
10. RPE I	−.1869 (p = .068)	−.2171 (p = .041)	−.4115 (p = .000)	−.3365 (p = .003)	.0340 (p = .394)	.0564 (p = .328)
11 Weight	.1319 (p = .148)	−.0337 (p = .395)	.0032 (p = .490)	.0046 (p = .486)	.0146 (p = .454)	.0231 (p = .428)
12. VO_2 Max	.0411 (p = .373)	.1457 (p = .123)	.1843 (p = .071)	.1750 (p = .082)	.0637 (p = .307)	.0898 (p = .238)
13. Percentage body fat	−.0063 (p = .480)	−.2269 (p = .035)	−.4563 (p = .000)	−.4637 (p = .000)	−.2186 (p = .040)	−.1517 (p = .114)

Table II. continued

	7	8	9	10	11	12
1.	.1039 (p = .205)	.0779 (p = .269)	–.3551 (p = .002)	–.1869 (p = .068)	.1319 (p = .148)	.0411 (p = .373)
2.	.0174 (p = .445)	.0927 (p = .231)	–.2512 (p = .022)	–.2171 (p = .041)	–.0337 (p = .395)	.1457 (p = .123)
3.	–.3441 (p = .003)	–.3772 (p = .001)	–.2840 (p = .011)	–.4115 (p = .000)	.0032 (p = .490)	.1843 (p = .071)
4.	–.2962 (p = .008)	–.3120 (p = .006)	–.2674 (p = .016)	–.3365 (p = .003)	.0046 (p = .486)	.1750 (p = .082)
5.	–.0778 (p = .269)	.0570 (p = .326)	–.2215 (p = .038)	.0340 (p = .394)	.0146 (p = .454)	.0637 (p = .307)
6.	.0663 (p = .300)	.1831 (p = .072)	–.2087 (p = .048)	.0564 (p = .328)	.0231 (p = .428)	.0898 (p = .238)
7.	1.0000	.8721 (p = .000)	.3172 (p = .005)	.2615 (p = .018)	–.1254 (p = .160)	–.4345 (p = .000)
8.	.8721 (p = .000)	1.0000	.1891 (p = .066)	.2250 (p = .036)	–.1755 (p = .081)	–.4270 (p = .000)
9.	.3172 (p = .005)	.1891 (p = .066)	1.0000	.7418 (p = .000)	.0758 (p = .274)	–.0908 (p = .236)
10.	.2615 (p = .018)	.2250 (p = .036)	.7418 (p = .000)	1.0000	.2093 (p = .047)	–.2048 (p = .051)
11.	–.1254 (p = .160)	–.1755 (p = .081)	.0758 (p = .274)	.2093 (p = .047)	1.0000	–.2554 (p = .020)
12.	–.4345 (p = .000)	–.4270 (p = .000)	–.0908 (p = .236)	–.2048 (p = .051)	–.2554 (p = .020)	1.0000
13.	.3903 (p = .001)	.3113 (p = .006)	.0745 (p = .278)	.1182 (p = .174)	.2071 (p = .049)	–.3905 (p = .001)

first 4 weeks four subjects (3.9%) failed to show up for any sessions, with a further nine subjects (8.7%) attending one session or less on average per week. By the end of the second month, 11 subjects (10.7%) have "dropped out" or attended no sessions, with a further seven (6.7%) attending less than once per week. This pattern increases in months 3 and 4, with 20 (19.4%) and 27 (26.2%) members of the sample failing to attend a single session and 12 (11.6%) and 9 (8.8%) attending once or less per week on average, respectively. The final month shows the drop out rate to continue to increase, with 33 (32%) individuals failing to attend class at all and 9 (8.8%) infrequent attenders. What we see here is the percentage of individuals attending "infrequently" to be roughly equivalent to the increase in dropouts over the first 4 months of the program. Indeed, examination of the raw data proved this generally to be the case. When considered in terms of adherence patterns (as measured by frequency), of a possible 57 sessions, 24.1% of the sample attended less than once a week. At the other end of the scale, however, 51.7% of the sample attended two or more sessions per week over the course of the 5-month program. Exercising two or more times per week is considered necessary for health benefits to accrue. Therefore, the 51.7% adherence rate roughly approximates the adherence rates reported in other studies (Dishman, 1982; Oldridge, 1982; Sallis *et al.*, 1986).

Relationships Among Physiological, Cognitive, and Exercise Behaviors

Table II details the zero-order correlations among the physiological parameters, efficacy perceptions, and the three indices of exercise behavior. The correlations should, in essence, determine the initial veracity of the proposed relationships in the causal models detailed earlier. The physiological variables, as one would expect, are significantly related to each other, with percentage body fat being the only physiological variable significantly correlated with any of the efficacy variables. Exercise self-efficacy at 4 and 12 weeks is moderately related to frequency at those two time points but not to heart rate or RPE. However, general physical self-efficacy is related to the intensity dimensions of exercise at both measurement points but not to the frequency measure. Weight appears to be related to very few of the variables of interest and was dropped from subsequent path analyses. As expected, given its derivation, predicted aerobic capacity ($\dot{V}O_2$ max) was significantly related to heart rate as an indicant of exercise behavior but was related to ratings of perceived exertion only at 3 weeks. Although this might appear unexpected, given the rationale used to develop the RPE scale (i.e., it parallels heart rate response during

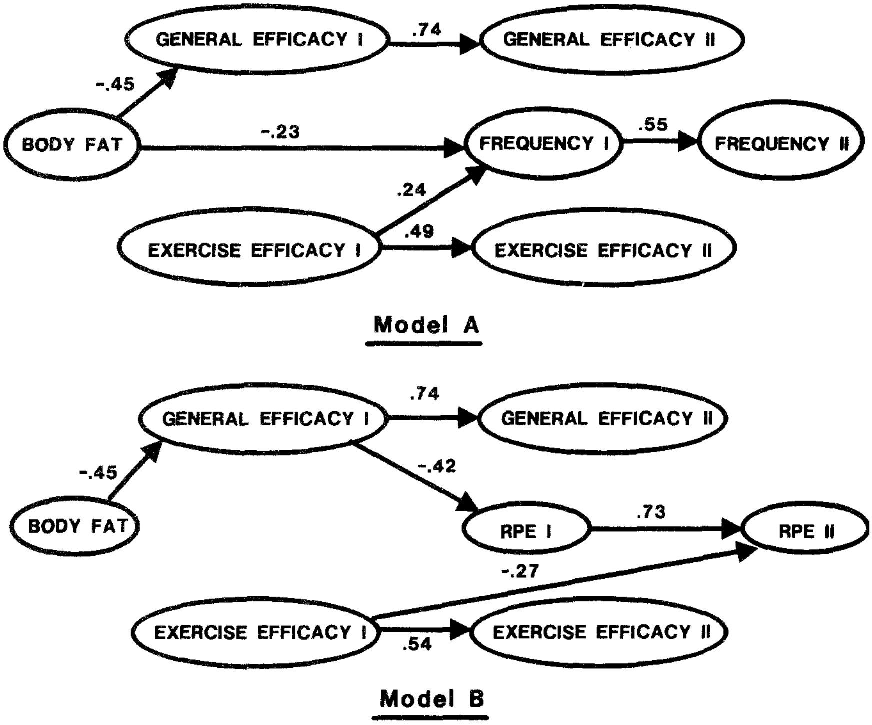

Fig. 3. Path diagrams of significant relationships among physiological, cognitive, and behavioral variables in the exercise process. All path coefficients are significant ($p < .05$).

physiological work), it must be remembered that subjects in the present study were not working at an intensity level which was maximally stressing the physiological system. Rather, the program was of a "low-moderate impact" nature (60–75% of predicted maximum heart rate). It is not uncommon to see a lack of congruence between heart rate and RPE at lower levels of intensity (Maresh and Noble, 1984; Noble, 1982). Predicted aerobic capacity was also positively correlated with levels of general self-efficacy, although these relationships only approached statistical significance ($p < .08$).

Path Analyses

Based on the correlational analyses reported above, a series of multiple regression analyses was conducted to test the causal paths previously hypothesized (see Fig. 1). Each model is presented in turn, with only significant paths shown. It should be noted that the proposed models were compared to a fully recursive model (one in which all possible paths among variables were computed) and all nonsignificant paths deleted from the final models. Standardized path coefficients are detailed above each path (all p's $< .05$). Preliminary analyses revealed no significant differences on the efficacy or exercise variables due to age or sex (all p's $> .10$). Therefore data were collapsed across these categories for subsequent analyses.

Model A: Predicting Frequency of Exercise Behavior

Figure 3, model A, shows the results of the path analysis for frequency of exercise behavior. Of the physiological variables, only percentage body fat contributed significantly to the model, having a direct effect on *general* beliefs about physical capabilities ($R^2 = .208$) and on frequency of exercise behavior ($R^2 = .044$). As predicted, exercise-specific efficacy ($R^2 = .055$), contributed to the variance in attendance behavior at the end of 12 weeks, however, the direct path between general efficacy and frequency was nonsignificant. The path between body fat and exercise frequency during the first 3 months was significant, with leaner individuals attending more classes. This is consistent with other reports in the literature (e.g., Dishman *et al.*, 1982). Initial exercise self-efficacy was the major predictor of efficacy at 12 weeks ($R^2 = .219$), while exercise-specific efficacy directly influenced general efficacy at week 12 ($R^2 = .04$). Neither specific or general efficacy was predictive of exercise behavior at the end of the program. In fact, the path between previous attendance and frequency at 20 weeks was the only significant path in the final stage of the model ($R^2 = .248$). In all, the variables in the model accounted for approximately 11.2% and 38% of the variance in frequency of attendance at 12 and 20 weeks, respectively. What appears to be happening is that self-efficacy is a significant, predictor of frequency in the early or *adoption* stage of exercise participation, but as exercise becomes more of a habitual activity, efficacy cognitions with respect to barriers to participation cease to play such an important function.

Model B: Predicting Intensity of Exercise I (RPE)

In the second model, specific and general efficacy cognitions were hypothesized to influence significantly perceptions of effort as assessed by RPE. Percentage body fat had a significant direct effect on general efficacy at week 12 and an indirect effect on RPE through the direct effect ($R^2 = .135$) of general efficacy at 12 weeks (see Fig. 3, model B). Specific efficacy had a significant effect on RPE at the 20 weeks (R^2 = .04) but not at 12 weeks. Moreover, initial exercise self-efficacy influenced perceptions of general efficacy at 12 weeks (R^2 = .053). Finally, as in the previous model the exercise variable at 12 weeks, in this case RPE, had the strongest and only significant effect (R^2 = .413) on RPE at the end of the program. Neither of the hypothesized paths between general or exercise-specific efficacy at 12 weeks and RPE at 20 weeks was significant. In all, the variables in the model accounted for 21.36 and 60.54% of the variance in RPE at 12 and 20 weeks, respectively.

Summary of Model Testing

Two models were tested that predicted self-efficacy perceptions to mediate frequency and intensity of exercise behavior. In both models, self-efficacy, either general or specific, had a significant direct effect on exercise behavior at 12 weeks into the program. However, the exercise variable assessed at week 12 was, in both models, clearly the strongest predictor of exercise behavior at the end of the program. These results suggest that perceptions of personal capabilities mediate exercise behavior in the adoption (first three months) phase for sedentary older individuals. However, once a regular routine is established, this habitual activity is a major predictor of future exercise responses.

DISCUSSION

The present study was designed to examine prospectively the possible roles played by perceptions of personal efficacy in determining the exercise behavior of sedentary middle-aged adults over a 5-month period. Inherent to the design of the study was the attempt to overcome several serious flaws that have plagued earlier studies of the determinants of exercise adherence. First, self-efficacy theory was adopted as the psychological framework from within which to study this complex and dynamic behavior. Second, the issue of exercise as a process was tackled by assessing measures of efficacy and exercise behavior at more than one point in time in an effort to determine change in both the dependent and the independent variables over time. Third, the exercise program was designed specifically for the population of interest, adopted a light to moderate mode of activity, and lasted a sufficient period of time (5 months) in which to study both the process and the longitudinal effects of exercise. Finally, some of the methodological concerns voiced by other authors (e.g., Dishman, 1985;

Perkins and Epstein, 1988) with respect to the measurement of exercise adherence were partially circumvented. Specifically, attendance or frequency of exercise participation was designated as the primary measure of importance and was closely monitored by trained personnel in terms of documenting duration and intensity. Furthermore, intensity, as represented by ratings of perceived exertion (RPE), was assessed on a daily basis in an effort to examine the roles of efficacy in predicting another dimension of exercise behavior.

Whether one can definitively identify the key determinants of exercise behavior is a contentious issue (Dishman *et al.*, 1985; Sallis and Hovell, 1990), with a host of characteristics having been identified as possible predictors. However, the results of the path analyses in this study suggest that perceptions of efficacy play a significant role in determining exercise participation in this sample of middle-aged sedentary adults. Specifically, general self-efficacy (perceptions of physical ability) and exercise self-efficacy (perceptions of capability to overcome barriers to exercise) were able to predict frequency (attendance) and intensity (RPE) of exercise. However, the two measures of efficacy played different roles in the prediction of specific aspects of exercise behavior. Common to both measures was their effect on midprogram and end-of-program exercise. Notably, in the case of frequency, exercise self-efficacy successfully predicted attendance patterns at 3 months but was unable to predict such behavior at 5 months. At 5 months, past behavior (attendance) was a considerably more powerful predictor of future behavior than self-efficacy. In the case of RPE, general self-efficacy in the early stages of the program was a statistically significant predictor of exercise intensity at 3 months, whereas exercise-specific self-efficacy only predicted RPE at 5 months. Once again, the strongest predictor of exercise intensity at program end was intensity assessed at 3 months.

What appears to be happening in this sample is that efficacy cognitions are playing a more potent role in the *adoption* phase of exercise behavior than in the *maintenance phase.* That is, in the early stage of an exercise program, how often one exercises and the degree of exertion perceived to be expended during exercise are related to one's general beliefs regarding physical abilities and one's confidence to continue exercising in the face of numerous barriers, obstacles, or aversive stimuli that are all too likely to arise during participation. More efficacious individual's are likely to adhere to exercise regimens with sufficient regularity to reach a point where the behavior has become, to a certain extent, habitual. At this point, "just having done it," to paraphrase the Nike commercials, appears to lead to continued participation. Such findings corroborate those of Feltz (1982; Feltz and Mugno, 1983), who has demonstrated similar independent effects of efficacy on performance and past performance on future performance in back-diving. At first glance, one might be tempted to consider these findings at odds with the tenets of self-efficacy. However, the directions of the effects are quite in line with Bandura's (1986) theoretical postulations, which would predict that as the desired behavior becomes more difficult, self-efficacy plays a more important role. That is, in the adoption phase of exercise behavior, where participation may be tiring, painful, inconvenient, and stressful to the system, secure beliefs in one's capabilities to overcome such aversive stimuli are of paramount importance to regimen adherence. Conversely, overcoming the stressors and the adaptation of the system (both social and physiological), that antedate the transition from adoption to maintenance of habitual activity, appear to attenuate or override the unique influence of efficacy expectations with respect to overcoming barriers. Moreover, such an interpretation supports the arguments of Fontana *et al.* (1986), which suggest the determinants of adoption and maintenance of exercise behavior to be quite different. Thus, efficacy cognitions play a more salient role at different stages of the exercise process.

It is wholly conceivable that other *types* of efficacy also play a role alongside previous performance or frequency of behavior. For example, beliefs regarding one's ability to increase duration or intensity, to continue exercising for extended periods of future time, or to exercise at a similar frequency, intensity, and duration in the absence of a formal organized program or of the supportive social network of fellow participants are all possible sources of efficacy that may be playing concurrent roles in the process of maintenance. Certainly, it seems likely that the latter circumstance might cause frequency of participation to be interrupted. That is, the termination of a program that has become an integral part of one's daily routine places the onus of continuing to exercise on the individual. It is at this juncture that exercise-specific efficacy cognitions may once again take on a prominent role in the prediction of exercise behavior. Such a hypothesis has yet to be tested in this population, although McAuley and Jacobson (1991) have reported efficacy perceptions to predict duration and regularity of exercise at follow-up in sedentary females. However, their program, like many others reported in the literature, was of a considerably shorter duration than the present study. Some evidence exists in the secondary prevention literature, however, to indicate that exercise efficacy predicts subsequent adherence to a home-based activity program in post-myocardial infarction patients (Ewart *et al.*, 1986).

That general self-efficacy had significant effects on RPE in a manner similar to the efficacy–frequency relationship is also consistent with efficacy theory. Perceptions of physical capabilities resulted in lower ratings of perceived exertion. Efficacious subjects in the adoption phase appear to perceive less stress to be placed on the system while exercising at a prescribed frequency, duration, and intensity. Conversely, less efficacious subjects reported greater perceived physiological strain. Clearly, in the early stages of exercise *perceiving* one's self to be physiologically stressed, in concert with the actual stress of the cardiorespiratory response, could have dramatically detrimental effects from the perspective of continued participation and one's perceptions of personal agency. Thus, the facilitation of efficacy cognitions through the reinterpretation of physiological and perceptual feedback during exercise participation may be warranted.

That different variables have different effects on exercise behavior at different stages of the process of exercise behavior underscores the importance of conducting studies that place an emphasis on longitudinal designs with multiple measurement points. For example, these results document self-efficacy influencing the adoption but not the maintenance of exercise behavior. However, if one reanalyzes these same data but does not include midpoint measurements, a different pattern of results emerges. That is, if one attempts to predict attendance over 20 weeks using physiological and efficacy measures collected in the early stages of the program, exercise-specific efficacy emerges as the only significant predictor of frequency (McAuley, 1990). Similar relationships emerge for the RPE data, although both general and exercise-specific efficacy predict intensity. In essence, these findings emphasize the folly of employing static designs to predict complex behaviors based on one-time measurements. Future research efforts might employ telemetry to determine more scientifically heart rate responses during exercise and employ larger samples and causal modeling techniques such as structural equation modeling to examine longitudinal and cross-lagged effects of variables in the exercise behavior process. It should further be noted that the generalization of the present findings may also be dampened by the within-subjects nature of the design and the self-selection of the sample.

The present results are quite encouraging with regard to identifying possible psychological mechanisms influencing the adoption of exercise behavior in the middle-aged. Due to the rapid "graying of America," the population of the United States will comprise 15–20% individuals older than 65 years by the year 2000. Fostering and promoting healthy life-styles that include an exercise component in our younger and middle-aged populations may well contribute to greater numbers of these individuals reaching the age of 65 and beyond as we enter the next millennium. Exercise and physical activity have been repeatedly demonstrated to result in positive health improvements of both a psychological (e.g., Blumenthal *et al.*, 1989; Emery and Gatz, 1990) and a physiological nature in aging populations (e.g., Paffenberger and Hyde, 1988; Cunningham *et al.*, 1987). Although efficacy cognitions have been implicated in the adherence process of a variety of health and treatment regimens (for reviews see O'Leary, 1985; and McAuley, 1991), little evidence exists regarding their utility to predict adherence to exercise regimens in asymptomatic populations (McAuley and Jacobson, 1991). The present data suggest that the strength of the sedentary individual's beliefs in his/her capabilities to overcome barriers to exercise, real or imagined, have significant, effects on adherence during the adoption phase of participation. Once the participants move beyond the adoption phase of activity, however, previous participation plays a major role in maintenance.

Of course, these data do not profess efficacy expectations to be the sole, or even the most important, determinant of adherence to prescribed exercise regimens. After all, exercise is a complex multifaceted phenomenon, with multiple determinants having been identified (Dishman *et al.*, 1985). Such being the case, researchers in this area and those health professionals wishing to facilitate positive behavioral change should perhaps be prepared to endorse and implement such determinants, as will provide modest, incremental improvements. Self-efficacy cognitions have now been implicated as mediating exercise adherence in both secondary (Ewart *et al.*, 1986; Kaplan *et al.*, 1984) and primary prevention studies (McAuley and Jacobson, 1991; Sallis *et al.*, 1986). As evidenced by the current findings, the relationship is significant but accounts for a modest percentage of the variance. However, as has been cogently pointed out elsewhere (Booth-Kewley and Friedman, 1988; Rosenthal and Rubin, 1982; Rosnow and Rosenthal, 1989), such modest relationships can translate into rather substantial gains from a public health perspective, and it is such gains upon which one should focus.

Further verification of the current findings is needed through replication and extension. Indeed, if efficacy expectations are significantly related to exercise in the adoption phase of exercise, experimental studies are called for that effectively manipulate efficacy through efficacy-enhancement interventions in an effort to stem further the well-documented tide of attrition consistently reported to follow the onset of initial exercise participation (Oldridge, 1982; Sallis *et al.*, 1986). Moreover, investigations are called for that examine interactions of efficacy expectations with previously identified correlates of exercise participation such as social support (e.g., Duncan, 1989), which may well be instrumental in helping us understand this complex health behavior.

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