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Trait versus social learning approaches to adherence with an exercise regimen

Author
Weinstein, Anne Deborah

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Trait versus Social Learning Approaches

to Adherence with an Exercise Regimen

by

Anne Deborah Weinstein

DISSERTATION

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To Bubby and Zeida,
who I can never thank enough
for their love and understanding,
I dedicate this thesis.

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There were two psychological characteristics under study in this investigation. One was self-motivation, defined as one's ability to persevere at a task even without immediate gratification. A second one was self-efficacy, confidence in one's ability to perform a potentially difficult task. Oddly enough, as I pursued completion of the ever elusive thesis, I have come to know each of these characteristics personally. Fortunately, whenever my motivation or self-confidence wavered, one of my many "significant others" was always there to listen, sympathize a bit and encourage me on. I am very happy to finally have a moment to thank them.

I would like to begin by expressing my appreciation to my dissertation committee for their kind support and attention. As my thesis chairman and my academic advisor (yes, George, you are my advisor!), George Stone has provided me with the type of counsel that is frequently sought but seldom obtained--seemingly endless patience, combined with considerate, intelligent advice that was designed to help me meet my objectives, not his. I am also grateful to Bill Hargreaves as he enabled me, with a single look from his twinkling eyes, to put the current insurmountable task back into perspective. John Hutchinson provided a valuable contribution with his psychological insights and kindred passion for sport and exercise. I am also indebted to Abby King who so competently critiqued my work, helping me ferret out the forest from the trees.

This project would not have been possible without the support of the Stanford Center for Research in Disease Prevention in general and the SSHIP staff in particular. I greatly appreciate their friendly cooperation and invaluable assistance. I am also grateful to the subjects who participated in SSHIP and I am hopeful that the exercise habit is a welcome new addition to their lifestyle.

The completion of my thesis represents more to me than the awarding of the doctoral degree. It marks the end of a long period of formal schooling. Although I expect the education process to continue, I welcome the end of my student status. I would like to

take this opportunity to thank the many relatives and friends who have helped me both during the thesis work and for many years before.

To say that my family has been supportive is a classic understatement. Given the size of my family, I must limit my thanks to those people who have been most intimately involved. I send my love and affection to my brother Gary and his family, Doris, Erica, and Paula for their imperturbable calm and loving acceptance as I frequently vacillated from periods of panic to moments of exultation. Also, always with me step by step were Uncle Jerry and Aunt Nancy, my emotional confidants who so often wiped my tears and hugged my heart. Again, I offer my love and admiration to my Bubby and Zeida for their support and encouragement; even as I outlined one hurdle after another, they never seemed to doubt me.

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Finally I offer my love and gratitude to my very special friend, George Garcia, not just because he offered excellent technical assistance, not only because he advised me intelligently and conscientiously regarding the content, not simply because he worked with me during many long nights, but most importantly, because he cared.

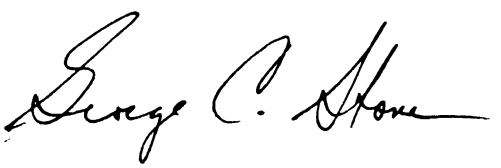
ABSTRACT

Despite the enthusiastic endorsement of health benefits attributed to regular exercise by health professionals and laypeople alike, it is estimated that approximately 20% of the population exercise enough to increase/maintain cardiovascular fitness or to markedly lower associated risk factors. The present study compared the explanatory power of two psychological theories in relation to exercise adoption and maintenance. A pool of 357 subjects engaged in a two-year clinical trial of exercise at Stanford University were examined to evaluate the relative effectiveness of five variables (self-motivation, self-efficacy, perceived exertion, enjoyment and convenience) in predicting exercise adherence.

The subjects comprised a community-based sample of older sedentary men and women without prior history of CVD. At baseline subjects were administered a variety of physiological and psychological tests, including the self-motivation and self-efficacy questionnaires, and were randomly assigned to one of three exercise regimens or a control condition for the following year. The subjects documented each bout of exercise and rated the experience in terms of perceived exertion, enjoyment, and convenience (PEEC) on monthly logs. Each month's adherence score was defined as the amount of exercise reported on these logs divided by the amount of exercise prescribed.

The primary research question was whether Bandura's social-learning theory provided a better explanation of adherence than a trait approach. According to Bandura's formulation, cognitions, behaviors, and the environment influence each other in a reciprocal manner. Based on this theory, it was postulated that self-efficacy and acute (immediate) aspects of exercise, such as PEEC, would influence exercise adherence more than a general trait, self-motivation, measured appreciably before the exercise bouts. The second research question addressed the importance of a stage approach to adherence behaviors, using exercise as a case in point. By measuring adherence at several points in time, it was possible to test whether self-motivation, self-efficacy, and/or the PEEC variables were differentially predictive across the adoption/maintenance continuum.

Analyses of the data provided mixed results. Self-motivation was not related to exercise adherence at any point, nor did it interact with PEEC to influence exercise behavior. Self-efficacy, however, did have a strong positive association with exercise adherence, demonstrating a correlation from 0.31 to 0.51 depending upon which three-month time period was under evaluation. On the other hand, the PEEC components did not exert any influence on adherence as a main effect or as an interaction with time. Although the social learning theory was generally supported, further investigations are necessary to determine whether situational aspects of the exercise experience examined in this study are not relevant determinants of adherence or whether the limitations of the design precluded detecting their effect.



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INTRODUCTION

With the advances of the twentieth century, the medical community's attention has been diverted from the demons of the past, infectious diseases, and directed toward the scourge of the present, chronic illnesses. Powell (1988) describes our present concern with contemporary health problems--chronic conditions, accidents, and violence--as the second public health revolution. One distinguishing feature of this revolution is the need to go beyond the germ model of disease and toward a more holistic approach. As testimony to this generalization is the report that as early as 1977, for the ten leading causes of death, lifestyle was estimated to account for 53% of the years of potential life lost before age 65 (Center for Disease Control, 1980).

The impact of lifestyle on conditions such as cardiovascular disease, diabetes, and cancer, has generated an increased appreciation for the importance of behavior change and, indirectly, behavioral scientists (Koop, 1983; Kirscht, 1983). Knowing that change is beneficial is not synonymous with instituting that change; both individuals and society may at times need help from experts to make important changes. As part of the growing emphasis on behavioral medicine and behavioral health in general (Blanchard, 1982; Matarazzo, Weiss, Herd, Miller, & Weiss, 1984), many investigations are underway in the effort to explain and influence adherence to health behaviors. As opposed to early descriptive studies, which only "characterize" non-adherers, experts urge current researchers to approach the problem by explicating the process of adherence. Specifically, psychological theories and corresponding interventions are being brought to bear to better understand and possibly have an impact on many health behaviors.

As a case in point, the present research compares the predictive power of a trait explanation versus a social learning approach toward exercise adoption and maintenance. This project should add to the growing literature evaluating the validity of these two distinct psychological approaches to explaining behavior. Physical activity is the behavior of choice because there is considerable evidence that incorporating exercise into our lifestyle

on a regular basis is a feasible change that society could make with many positive implications for humans and their environment. Although other deleterious health behaviors, notably tobacco use, are more disastrous, the prevalence of inactivity is higher, with 80% of Americans being relatively sedentary, whereas less than 40% of the population smokes (Blair, 1988). This led to Blair's comment, "In theory, more may be gained in the population's health status by adoption of exercise than by smoking cessation" (1988, p. 85). At the beginning of the 20th century improved hygiene had a profound impact on the public health of our nation; by the beginning of the 21st century, lifestyle changes such as exercise may produce a comparable effect.

Before directing my attention to the theoretical underpinnings of behavior change, it seems essential to discuss the current status of the exercise movement. I will describe below who believes that exercise is beneficial, the number of people consistently acting upon these beliefs, and the evidence upon which these beliefs are founded. In light of this presentation, the discussion will be directed at past efforts to describe and explain exercise adoption and maintenance.

REVIEW OF THE LITERATURE

THE EXERCISE MOVEMENT

Throughout history, people have been encouraged to exercise the body as well as the mind. In the early ages, Plato's Dialogues contains the following comment by Timaeus, "...concerning the mode of treatment by which the body and mind are to be preserved...moderate exercise reduces to order according to their affinities, the particles and affections which are wandering about the body...." (Bury, 1929, p 241). In relatively recent times, this sentiment was echoed by Thoreau, "They are fatally mistaken who think that while they strive with their minds that they may suffer their bodies to stagnate in luxury and sloth" (1840, p.42). Today, both the medical community and the popular press (Olsen, 1988) exhort the public to increase their activity level.

There is ample evidence that such educational efforts are working and the typical person acknowledges that exercise is well-advised. No small part of people's ascription of positive values to exercise is based on anticipated health benefits. It should also be noted, however, that many people may initiate exercise programs for reasons other than health per se. This notion is captured succinctly by Haskell's assertion "During the past decade, it has become very popular to look, dress, and act as if you are either on your way to or from participating in vigorous exercise (1984, p. 409).

Not only do people think they should exercise, but many even know the recommended regimen. In 1980, the Public Health Service was charged with the task of improving physical fitness in the United States by 1990. One of eleven goals established to achieve this task was to increase to greater than 70% the proportion of adults who can accurately identify the variety and duration of exercise thought to promote cardiovascular fitness most effectively.

Attempts to assess the progress toward this goal have been made by several investigators. For example, Powell, Spain, Christenson, and Mollenkamp (1986) reported that 70% of the persons surveyed from both a Los Angeles and a Dallas community could answer accurately questions concerning minimum duration and frequency requirements. When taking both of these surveys and a national survey into account, Powell et al. (1986) concluded that 50 to 90 percent of respondents could identify minimum intensity requirements. Using more stringent requirements of accuracy, Caspersen, Christensen and Pollard (1986) reported that only 5 percent of the people can accurately answer questions about frequency, duration, and intensity. However, they noted that if they allowed "minimum" requirements or higher as correct responses, as had been done in the other surveys cited, the number of people considered to have a reasonable knowledge base would increase to approximately 64%, an estimate more consistent with the claims of Powell et al. (1986). From the above discussion, it seems safe to conclude that most people think that "one" should exercise and a sizable majority can accurately recognize the minimum duration, frequency, and intensity of regular exercise recommended by experts.

The next issue to consider is how many people are behaving in a fashion consistent with this attitude. Very general questions in the National Survey of Personal Health Practices and Consequences (National Center for Health Statistics, 1981) prompted intuitive responses to this question. Results from this representative telephone survey included the finding that over 50% of people 20 to 64 years of age reported that they "exercised less than they needed" (p. 12). Comprehensive and specific questions concerning leisure time physical activity have appeared in recent American and Canadian surveys such as the 1975 National Health Interview Survey Supplement (National Center for Health Statistics, 1978), the 1978 Perrier study (Perrier Study, 1979), the 1981 Canada Fitness survey (Canada Fitness Survey, 1983), the 1982-83 CDC-State Behavioral Risk Factor Survey (White, Powell, Hogelin, Gentry, & Forman, 1987), and the 1983 Miller Lite report (Miller Lite, 1983). These reports provide us with a more detailed account of

current exercise patterns, at least in North America. Stephans, Jacobs, & White (1985) reviewed eight such representative, national surveys which provided data on both leisure time activity and demographic characteristics of survey respondents. Before drawing conclusions across these surveys, Stephans et al. (1985) cautioned the reader about the difficulty inherent in interpreting different surveys since definitions of exercise vary so widely. With this in mind, it is not surprising that the most gross estimate of the number of people simply defined as the "active" population across all eight surveys ranged from 15% to 78%. However, a closer examination of the survey items allowed Stephans et al. (1985) to refine this estimate.

The portion of the population performing at a level comparable to the exercise regimen recommended for cardiovascular benefits (American College of Sports Medicine, 1978; Haskell, Montoye, & Orenstein, 1985) showed significantly less variance, with one report of 15% (Perrier Study 1979), a second report of 19% (Miller Lite, 1983), and a third report of 21% (White et al., 1987). Summarizing across these statistics, Stephans et al. (1985) reported that 20 percent of the population fall in this sufficiently active category; others (Dishman, 1986; Powell, 1988) have concurred with this estimate. Another group of exercise participants was classified as somewhat active; these are people who exercise at a level sufficient to attain some health benefits. They comprise approximately 40% of the population.[1] Finally, Stephans et al. (1985) estimated that the remaining 40% of the population are sedentary, essentially engaging in no conditioning exercise. These researchers' estimates are close to ones provided by Chubb and Chubb (1981) who concluded that 15 to 20 percent of the population are meaningfully active, another 35 to 40 percent engage in limited activity, and approximately 50 percent do virtually no exercise.

Evidently, health educators have had more effect on peoples' knowledge than upon their behaviors. A conscientious effort to change this situation is underway. But the

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[1] If the two categories just described were combined into one "active" category, then the proportion of people meeting this more liberal criterion would be approximately 60%.

blossoming health promotion field is not without its critics. The warning that some of the promises made by health professionals are exaggerated, or in some cases unfounded, has been emphasized (Kaplan, 1984; Lorig & Laurin, 1985). Since the potential for medical authorities to influence the public is ever present, some experts have begun to play the role of consumer advocates, encouraging health professionals to be more responsible and prudent in their recommendations. Furthermore, the concern that health promotion can be interpreted as license for health coercion has also been expressed (Koop, 1983). In light of these cautions, it seems requisite to preface the discussion of psychological determinants of exercise adoption and maintenance by reviewing the rationale behind its substantial endorsement.

THE EFFICACY OF EXERCISE

Sufficient evidence has accumulated concerning the health benefits attributed to exercise to provoke the U.S. Public Health Service to declare physical fitness and exercise an area of major importance to the health status of the people of the United States (Powell, 1988, p. 15). Specifically, as alluded to earlier, eleven physical fitness and exercise objectives to help Americans achieve health benefits were proposed (Department of Health and Human Services, 1980). This important health policy is undoubtedly based on the burgeoning literature supporting the positive association between physical activity and health (Haskell, 1984; Siscovick, Laport, & Newman, 1985; Haskell et al., 1985; Powell, 1988; Paffenbarger & Hyde, 1988).

In brief, Haskell (1984) summarized the consensus of these experts' evaluation of the exercise effect by dividing it into several categories. First, Haskell (1984) lists those benefits of exercise with the most substantial scientific basis: maintenance of optimal body weight (Epstein & Wing, 1980; Weltman, 1984), the prevention of coronary heart disease (Paffenbarger & Hyde, 1988), and the normalization of carbohydrate metabolism (Holloszy, Schultz, Kusnierkiewicz, Hagberg, & Ehsani, 1986). These relationships are

especially relevant given that (1) cardiovascular disease remains the leading cause of death (MMWR, 1986) and (2) both obesity and impaired carbohydrate metabolism have direct effects on the health of people (Holloszy et al., 1985) as well as indirect effects via an increased risk of other health problems.

The second category in Haskell's categorization scheme are those health problems for which exercise benefits are likely but the purported effects are not yet fully substantiated. In addition to physical ailments which fall into this category (e.g. hypertension, maintenance of bone density, back pain), impaired psychological status is a problem for which the efficacy of exercise is mounting at a rapid rate (Morgan & Goldstone, 1987).The latter relationship is particularly relevant in light of recent reports that during the course of any given year, 15% of the American population, some 32 million people, suffer from emotional disorders and, of these, almost 7 million receive no care of any kind (Bloom, 1985). Thus, efforts to prevent and treat psychological distress have important psychosocial and economic implications for the nation. Given the frequent criticism of drug therapy and its associated aversive side effects (deVries, 1981), it is not surprising that an alternative behavioral treatment--exercise, is being evaluated.

Haskell describes a third area of health conditions for which exercise may be therapeutic although not necessarily preventive. He included in this category: chronic obstructive pulmonary disease, kidney failure, and arthritis. Haskell (1984) also notes that the relationship between exercise and the risk of acute respiratory disease is not clear. In his review of the effects of exercise on various defenses against infectious diseases, Simon (1984) reported a transient increase in the concentration of white blood cells in the circulation. The clinical implications of this finding are not established (Powell, 1988). On the other hand, there was one report of an increase in respiratory symptoms (Hanson, 1984) for a high versus low exercise group. If exercise does prove to have an impact on these health problems, particularly the incidence or severity of acute respiratory illness, it would make a substantial impact on the public health of the nation (Powell, 1988).

Discussion continues over mechanisms, methodology, and the dose-response relationship. Quantification of the treatment (i.e., physical activity) has often not been systematic. Furthermore, it is clear that there are some adverse health effects associated with exercise (Pollock, 1988). Nevertheless, experts reviewing the literature across studies which varied widely in terms of populations, definitions of activity, and method, have concluded that the salutary effect of exercise cannot be denied (Haskell, 1984; Siscovick et al., 1985; Paffenbarger & Hyde, 1988). Powell (1988, p. 35) summarizes this sentiment as follows:

> "Although not yet well quantified, the evidence in support of the public health importance of physical activity and exercise is well enough established to deserve public support. In addition to epidemiological research to supply the needed quantitative estimates, promotional efforts to provide the knowledge, skills, and facilities are appropriate."

THE QUESTION OF ADHERENCE

Adherence to a variety of medical regimens/health behaviors has been evaluated (Sackett & Haynes, 1976; Haynes, Taylor, & Sackett, 1979; Di Matteo & Di Nicolla, 1982). Agreement has been reached over the importance of adherence as an issue; the effect of a behavior cannot be tested and/or demonstrated if adherence is not achieved (Epstein & Cluss, 1982). Yet attaining acceptable adherence rates across a variety of health behaviors has proven difficult. This is particularly true if the targeted behavior is complex (e.g., a lifestyle change) as opposed to keeping a medical appointment. Furthermore, maintenance of change, not just initiation of an individual behavior, is especially problematic.

The similarity in recidivism rates among three frequently targeted behaviors--dieting, smoking cessation, and drug abuse--has led some to suggest that the mechanisms involved in maintenance are fairly constant across lifestyle changes (Morgan, 1977;

Brownell, Marlatt, Lichtenstein, & Wilson, 1987). For instance, Brownell & Wadden (1986) reported that among participants in behavioral programs to treat obesity, at one-year follow-up, approximately one-third failed to maintain their weight loss; moreover, "patients may eventually gain back to their pretreatment weights" (p. 188). Similarly, 70 to 80% of those who quit smoking relapse within one year (U.S. Department of Health and Human Services, 1986), while approximately 50% of new participants in exercise programs will have dropped out in six months to one year (Dishman, 1988).

On the other hand, these reports, while similar, are not identical across the different behaviors. Also, recidivism rates reflect only on maintenance patterns in behavior initiation, not on adoption of new behaviors. At least one reviewer (Dishman, 1986) has suggested that there is insufficient evidence at present to assume that research evidence concerning other health behaviors is directly applicable to the question of exercise adherence. With this in mind, the following discussion will be limited to studies of adoption or maintenance of physical activities.

TO EXERCISE OR NOT TO EXERCISE

Efforts to understand, explain, and predict exercise adherence have grown by leaps and bounds over the past ten years. This focus is reflected in (1) the recent inclusion of exercise adherence as a definition area by the Behavioral Epidemiology and Evaluation Branch of the Public Health Service, (2) the number of organizations devoting workshops to this topic (Powell, 1988), and (3) the increase in participation within an individual organization; for example, Dishman (1986) notes that, whereas in 1979 forty people attended the workshop in exercise adherence at the annual meeting of American College of Sports Medicine, by 1984 four hundred people attended a comparable session. Experts' interests in exercise adherence are growing and numerous empirical studies have been conducted and repeatedly summarized (Dishman, 1982; Dishman, 1986; Dishman, 1988; Dishman, Sallis, & Orenstein, 1985; Oldridge, 1984).

In some respects, the following discussion will mirror the many reviews of the topic by tracing the empirical evidence of a multitude of factors hypothesized to be associated with exercise adherence. Also, the typical definition of aerobic exercise will be employed--dynamic, aerobic activity involving large muscle groups, engaged in on a regular basis in one's leisure time (Pollock, 1988).[2] Furthermore, following frequent criticisms by experts (Dishman, 1986; Oldridge, 1984), when possible, careful delineations will be made between studies investigating the question of adoption versus the question of maintenance, as well as the quantification of "adherence" (e.g. drop-out status versus a continuous measure of adherence).

But there is one important distinction in the review that follows. Most experts have divided research into theoretical or atheoretical efforts. If the study is cross-sectional, and primarily examines the correspondence between a variable and a measure of adherence, the research is pejoratively labeled "atheoretical." However, if the study is longitudinal, and assesses the ability of a variable to predict adherence, following an a priori conviction on the part of the researcher, it is praised as "theoretical" (Dishman, 1986).

Although it is probably undeniable that the longitudinal study is preferable in terms of demonstrating the direction of a relationship, it is not necessarily true that a theory is being tested. Many of the "models" being examined are predictive but not really explanatory; to varying degrees, the mechanisms explicating the prediction are often left vague. Accordingly, the organization of the following discussion will be based on a utilitarian categorization of the literature, dividing predictors into aspects of the individual and aspects of the environment, rather than on a model to model basis. Following the presentation of the empirical evidence, a unifying theory will be presented in an attempt to tie together the many strands of theory currently receiving support.

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2 Assessment of total energy expended, be it through work or play, is also a useful outcome measure, but beyond the scope of this discussion.

THE INDIVIDUAL

Demographics

Many investigators have approached the question of exercise adherence by "characterizing" the volunteer, the drop-out and/or the adherer (Andrew & Parker, 1979; Gale, Eckhoff, Mogel, & Rodnick, 1984; Kriska, Bayles, Cauley, Laporte, Sandler, & Pambianco, 1986; Massie & Shephard, 1971). Among the factors which have been examined most frequently, three demographic variables have been more consistently associated with exercise participation than others: age, gender, and socioeconomic status.

Age The strong negative relationship between age and exercise participation has been documented repeatedly (Canada Fitness Survey, 1983; Perrier Study, 1979; Presidents Council on Physical Fitness & Sport, 1974). Early empirical work demonstrating that older people were less likely to agree to participate in a physical activity program (Teraslinna, Partanen, Koskela, & Oja, 1969) was supported in a more recent report (Gale et al., 1984).

However, some investigators have not found a difference due to age in adherence rates, for example the study by Kriska et al. (1986) with post-menopausal women. Nor did Massie and Shephard (1971) find age to be a distinguishing characteristic of drop-outs. Although it is well established that most of the people exercising currently are under 30 (Gallup Poll, 1983), this may be a cohort effect rather than one of maturation. The relationship between age and activity level is not as strong today as more and more people in middle age and beyond join the exercise movement (Wankel, 1988). Such findings have led many researchers to question whether a sedentary life style is a "natural" consequence of aging or more a function of social and cultural influences (Harris, 1970; McPherson, 1984; Stephans et al., 1985; Wankel, 1988).

Gender The relationship between gender and activity level has also been evaluated. The consensus of most surveys is that men report engaging in more physical activity than women (Stephens et al., 1985). Recent reports, however, examined the data in more detail

and suggest caution be used in interpretation of this relationship. The position most recently adopted by the surveyors (Stephans et al., 1985; White et al., 1987) is that, if frequency and intensity are taken into account, men are more likely to fall into the active category. If the criteria are relaxed, men are somewhat more likely to engage in sports, whereas across all conditioning activities, including walk/jogging and calisthenics, the difference between gender disappears. Furthermore, an interesting point was supplied by Stephans et al. (1985) who noted that gender differences in exercise adherence seem to vary as a function of age. For example, findings from the Canada Fitness Survey (1983) show that at ages 18-19, women are more active than men, despite the opposite trend during earlier adolescence.

Socioeconomic status A third demographic variable which has received considerable support is socioeconomic status. In particular, it is generally accepted that blue-collar workers are not likely to initiate and/or continue to exercise (Cox, Shephard, & Corey, 1981; Gale et al., 1984; Oldridge, 1982; Oldridge, Donner, Buck, Jones, Andrew, Parker, Cunningham, Kavanagh, Rechnitzer, & Sutton, 1983). It has been suggested that perhaps blue-collar workers are less likely to spend their leisure time exercising because they expend more energy on the job than white-collar workers (Stephens et al., 1985). However, data from aggregated state surveys which classified the adult population into three levels of occupational physical effort (White et al., 1987), suggest that such an explanation may not be adequate (White et al., 1987). Although respondents from the heaviest effort category were more likely to report no vigorous leisure time activity, they were just as likely to be in the active category as people in the light or moderate effort occupations.

Consistent with the notion that one distinction between drop-outs and adherers may be related to social class differences, several surveys have found the inactive to have lower income and less education (Canada Fitness Survey, 1983; Perrier Study, 1979; President's Council on Physical Fitness and Sports, 1974) Some empirical studies support this trend

including the Heinzelman and Bagley (1970) finding that drop-outs had fewer credit cards and the finding by Gale et al. (1984) that non-compliers had less stability in the community. On the other hand, other studies did not find significant differences between the active and inactive in terms of education (Gale et al., 1984;), social class (Heinzelman & Bagley, 1970), or even concerning occupation (Gale et al., 1984; Oldridge, Wicks, Hanley, Sutton, & Jones, 1978).

Other demographic variables which have been studied are marital status, which is associated with physical activity, with single persons being more active (Gallup Poll, 1977; Canada Fitness Survey, 1983) and race or ethnicity, which does not appear to have an independent association with exercise participation (White et al., 1987). It should be noted that even among those demographic variables which are consistently related to exercise adherence, the evidence cited is descriptive, not prescriptive since demographic variables are essentially "impervious" to change (Pollock, 1988 p. 35). In any event, knowing the demographic profile of the volunteer, the adherer, or the drop-out does not enhance our understanding of the nature of the relationship nor guide interventions.

Relationship With Other Health Behaviors

The notion that exercise behavior is associated with other health behaviors has considerable intuitive appeal (Blair, 1988). From an epidemiological standpoint, improved understanding of these relationships would help us ferret out the direct versus indirect effects of risk behaviors on morbidity and mortality (Blair, 1988). Moreover, a logical relationship such as this one could conceivably enable us to screen and/or predict adoption and successful maintenance of exercise (or other) behaviors. It also would suggest implementing one health behavior as an intervention to effect change in others. Finally, it could point to an explanation underlying behavior change in general.

This question has been addressed from different vantage points. Some investigators have simply evaluated whether two or more health behaviors are correlated, without questioning the nature of the relationship (Gibbons, Blair, Cooper, & Smith, 1983;

Montoye, 1975). In an effort to better explicate the mechanisms involved, others have questioned whether adopting one new health behavior increases the likelihood of engaging in others (Finnegan & Suler, 1985). Still other researchers have approached the possibility of a relationship between health behaviors as being problematic, if in fact participation in one deleterious health behavior would lessen the probability of making positive changes in another.

For these reasons, and undoubtedly others, many empirical studies have evaluated the relationship between a host of health/risk behaviors including, but not limited to, weight control, smoking behaviors, exercise, substance abuse, preventive health behaviors, seat belt use, and stress management. Two reviews of the literature (Blair, 1988; Blair, Jacobs, & Powell, 1985) provide detailed accounts of the relationship of exercise in particular to many other health behaviors. The remarks in this paper will be confined to the three health areas whose relationship with exercise behavior has received sufficient attention to draw preliminary conclusions: (1) weight control, including body fat, body mass index (BMI), and weight; (2) smoking behaviors; and (3) past activity level, including past sports/conditioning participation and fitness level.

Weight Control The common sense assumption that people who are overweight are likely to be inactive has received considerable empirical support. On a purely descriptive level, several surveys testify to this relationship (Blair et al., 1985). Epstein and Wing (1985) performed a meta-analysis of 16 prospective studies examining the relationship of exercise and obesity. They concluded that overweight individuals are better characterized as underexercised rather than overfed.[3]

The question of more relevance to this paper is whether overweight individuals are less likely to adopt or maintain an exercise program. Much of the evidence supports the notion that there is a significant difference at the time of adoption in body fat, weight,

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3 That is, even though, exercise is only recommended as an adjunct treatment to dietary control for the obese, it is strongly touted for its preventive benefits.

and/or BMI between those who adhere to exercise regimens and those who do not (Dishman & Gettman, 1980; Gibbons et al., 1983; Kriska et al., 1986; Massie & Shephard, 1971). Finnegan and Suler (1985) reported that maintenance of weight control was correlated with postcoronary exercise. Yet even this widely accepted tenet has not received consistent support. Gale et al. (1984) found weight and body fat to distinguish only marginally between attendance patterns in their sample of health adults. Bruce, Frederick, Bruce, & Fisher, (1976) found a significant difference in adherence based on a ratio of observed weight to "predicted" (appropriate) weight for women, but not for men. Still others found no evidence to support the negative relationship between obesity and adherence (Blumenthal, Williams, Wallace, Williams, & Needles, 1982; Finnegan & Suler, 1985; Oldridge et al., 1978). The conclusion of investigators of the weight-exercise relationship seems to be that people who exercise are more likely to eat more and yet weigh less. The thesis that being overweight impedes exercise adherence is not as firmly established.

Smoking Behavior It is widely expected by most laymen and many professionals that people who smoke are unlikely to join or adhere to a physical activity program. Considerable, albeit somewhat unsystematic, evidence has accumulated concerning this common sense notion. In a study designed specifically to test hypotheses such as this one, Finnegan & Suler (1985) reported that smokers being followed in a post-coronary rehabilitation program were less likely to maintain participation in a programmed exercise regimen than non-smokers. Others also report that smokers tend to be early drop-outs in exercise programs (Massie & Shephard, 1971; Oldridge et al., 1978). In a community-wide health education project, Meyer, Nash, McAlister, Maccoby, & Farquhar (1980) concluded that those who smoke more cigarettes were more likely to drop out of the project. Consistent with this relationship is the evidence that fitness is negatively associated with smoking behavior (Gibbons et al., 1983; Leon, Jacobs, De Backer, & Taylor, 1981).

Again, some studies have not verified this relationship (Epstein, Miller, Stitt, & Morris, 1976; Perrier Study 1979; Sallis, Haskell, Fortman, Vrazian, Taylor, & Soloman, 1986). Gale et al. (1984) followed 110 healthy adults for a 6 month exercise program and reported that smoking status did not influence attendance. Furthermore, there is some evidence that a positive association exists between smoking and occupational physical activity (Bjartveit, Foss, & Gjervig, 1983). Finally, there are no data supporting the notion that people who exercise are more likely to give up smoking. The consensus of the experts is that the effect of smoking on leisure physical activity, if present, is not very strong (Blair, 1988; Blair et al., 1985).

Past Activity Level It is often acknowledged that the best predictor of future behavior is past behavior. With this in mind, it is not surprising that many investigators have examined the relationship between fitness level or activity status at baseline and exercise adherence. Unlike the reports concerning weight control and smoking behaviors, the association of past activity with adherence is somewhat more consistent. There is at least one report (Blumenthal et al., 1982) that drop-out status is not related to baseline physical activity or fitness level. But the majority of the evidence is in the opposite direction.

Two studies report that inactivity at baseline contributed to a discriminant function for compliance status (Kriska et al., 1986; Oldridge et al., 1978). Consistent with this relationship, Mirotznik, Speedling, Stein, & Bronz (1985) reported that fitness level was positively correlated with continued exercise participation. Gale et al. (1984) found similar results for women, but not for men. Interestingly, in an early study, Teraslinna et al. (1969) asked corporate executives hypothetically whether they would join an exercise program and the more fit were more likely to agree. However, when actually put to the test, one study found that at baseline, joiners were less fit (Mirotznik et al., 1985). It seems possible that the less fit, who perceive more need may be equally or even more likely, to join, but less likely to continue, an exercise program.

Although it would simplify matters if the relationship between other health behaviors and exercise adherence was strong and consistent, some experts have suggested that such an expectation has been somewhat naive (Blair et al., 1985). Given the complexity of making any lifestyle changes (Blair, 1988), each of which itself has more than one sufficient cause, it is not surprising that changing one's exercise behavior is neither a good predictor of, nor easily predicted from, other health behaviors.

Psychological Traits

Notwithstanding the current trend away from the construct "personality," some researchers suggest that certain relatively enduring characteristics may be useful predictors of exercise adherence (Dishman, Ickes, & Morgan, 1980). Although the label personality traits is not usually invoked, these aspects of the individual are seen as sufficiently stable to be resistant to change. Being less pliable, these traits are presumably not easily subject to intervention,[4] unlike attitudes and beliefs which will be examined below. Nonetheless, identifying people along a particular dimension may be seen as a useful screening technique, as well as possibly contributing to our understanding of behavior change. Many personality traits have been considered, including extraversion (Blumenthal et al., 1982; Massie & Shephard, 1971), ego-strength (Blumenthal et al., 1982), and the Type A behavior pattern (Oldridge et al. 1978). Two such characteristics which have shown the most promise and led to considerable research will be discussed here: locus of control and self-motivation.

Locus of Control The first construct, locus of control has an extensive history. (For a detailed review, see Lefcourt , 1976.) Original work, conducted by Rotter in 1966, suggested that people vary along an internal-external continuum, with internal locus of control being characterized as a belief in personal control of reinforcements, and external

4 It should be noted that many investigators (e.g., Levenson, 1973 and Dishman, 1982) usually imply that the trait under study may be alterable, albeit not easily.

locus of control representing one's belief that life is determined by external forces, such as chance, fate or powerful others.

This concept and the scale designed to measure it, the Internal-External Locus of Control Scale (I-E scale), have undergone numerous revisions, two of which are of importance here. Levenson (1973) thought it was more useful to divide the scale into three dimensions rather than two: internal, powerful others, and chance. This version of the scale was then further adapted to the health domain and labeled the Health Locus of Control Scale (HLC) (Wallston, Wallston, Kaplan, & Maides, 1976).

The relationship between locus of control and exercise adherence is not well established, with only one supporting empirical study. Sonstroem and Walker (1973) attempted to relate two exercise behaviors, running 600 yards and voluntary participation in exercise, to both locus of control (Rotter's scale) and a second variable, one's attitude toward physical activity (Kenyon, 1968). They split both measures, locus of control and attitude toward physical activity, at the median and compared the four groups on the outcome variables, with positive results. Both main effects and the interaction were statistically significant. The latter finding demonstrated that internally controlled subjects with more favorable attitudes toward physical activity performed better on a 600 yard run and reported engaging more frequently in vigorous physical activity.

However, efforts to predict exercise adherence with the locus of control construct have not been as fruitful. In a later study, Sonstroem and Kampper (1980) examined the effect of locus of control, measured with Bialer's scale[5] (1961) on initiation and/or adherence to voluntary participation in a junior high cross country team. In this situation, locus of control did not contribute significantly to the model. Finnegan and Suler (1985) found no effect of locus of control (HLC) on maintenance of change in exercise (or weight

[5]Bialer's (1961) work with a locus of control construct and the verbally administered locus of control scale was apparently done in conjunction with Rotter; his footnote (p. 304) acknowledges his debt to Rotter's special learning theory.

or smoking) among postcoronary patients. Similarly, Dishman & Gettman (1980) reported that HLC was not a significant predictor of exercise adherence whether quantified as dichotomous (drop-out or not) or continuous (days of exercise).

Although Strickland (1978) concluded in her review of the literature that locus of control was a useful predictor of preventive health behaviors, the consensus today is less favorable. Critics of the construct have suggested that measures must be more specific to be predictive.[6] In any event, the evidence to date discredits its association in isolation with exercise adherence.

Self-Motivation Unlike locus of control, another enduring psychological trait, self-motivation, has received considerable support as a determinant of exercise adherence (Dishman et al., 1980). Dishman et al. (1980) reported that "34 of 41 studies [of medical compliance] conducted during the past 20 years.which have.included motivation as an independent variable [have] found it to be a significant factor influencing compliance" (p.116). (See Baekland & Lundwall, 1975 for a review.)

The self-motivation construct is purportedly enduring and applicable across many situations, as indicated by the following definition, "...a single unitary trait, reflecting a general disposition to persevere" (Dishman et al, 1980, p. 117). Although individual items (e.g., "I like to set goals and work toward them") reflect the generality intended, thus far, self-motivation has primarily been applied to exercise motivation. It should be noted that Dishman acknowledges historical antecedents to the trait he labels as self-motivation (i.e., Atkinson, 1957; in McClelland, Atkinson, Clark, & Lowell, 1953).

In the initial development of the construct, the authors examined the psychometric properties of the Self-Motivation Inventory (SMI) with a sample of 399 undergraduates. After an original set of 60 items in a five-point Likert format was subjected to alpha factor

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6 That is, some recommend more specificity concerning the behavior of interest (Saltzer, 1982) and others propose that the construct "sense of control" itself is multi-dimensional (Cox, 1985).

analysis (Kaiser & Caffrey, 1965), 40 items, 21 keyed negatively and 19 keyed positively, were retained. Potential scores on the resulting scale ranged from 40 to 200; the actual range achieved by the initial sample was 84 to 184 (X = 140.5; SD=19.38). As expected, self-motivation was significantly, albeit modestly, correlated with self-report of exercise frequency (r=.23; p<.01), but not with age, weight, or grade point average. With the original sample, Dishman and Gettman (1980) reported an internal consistency of .91 on the 40 retained items; a cross-validation sample (n=48) yielded an internal consistency of .86 and test-retest reliability of .92 (one-month interval). Furthermore, with the original sample, the SMI correlated positively with an Ego-Strength measure (r=.63, p < .005), providing evidence for convergent validity. However, the moderate correlation of the SMI with the Marlowe-Crowne Social Desirability Scale (r=.36) suggested that subsequent studies should control for this construct, given its potential impact on subject reporting patterns

Early efforts to evaluate the predictive validity of the measure were successful. For example, Dishman and his colleagues examined the utility of self-motivation in predicting adherence to exercise with two samples: (1) 64 female undergraduates in a crew training program, and (2) 66 middle-aged males in community exercise programs. In the first study, SMI scores of drop-outs were significantly lower than adherers (p<.05); after controlling for ego strength and social desirability, the difference in the two group's SMI scores still approached significance (p < .07). Dishman and Icke's (1981) discussion of the latter result focused on the implication that self-motivation was a distinct construct, not just another measure of ego strength. This contention seems questionable since self-motivation correlated quite strongly with ego strength (r= .65). Yet the correlation of ego strength with adherence (r= .15) was not significant, suggesting that self-motivation may operate in a way that is distinct from ego strength.

In the second study, Dishman and his colleagues again demonstrated that SMI was significantly associated with number of days of participation in the 20-week program.

Furthermore, following a stepwise regression on participation, only three variables entered the model: body fat, SMI, and weight. In keeping with other research with biological predictors (Dishman, 1981), Dishman and Gettman (1980) proposed a psychobiological model of exercise adherence in which percent fat, self-motivation, and body weight formed a discriminant function and successfully separated adherers from drop-outs. When this linear model was used to classify actual group membership, 78.8% of all cases were correctly assigned.[7] Dishman & Gettman (1980) reported that this increase represented a 39% gain over base rate for drop-outs and a 16% gain over base-rates for adherers. Finally, a similar model was produced in the multiple regression analysis in which days of exercise participation served as the continuous dependent variable. The resulting regression equation, based on the same three variables (and the same sample) explained 45% of the variation in attendance.

The psychobiological model in its entirety has been reported in one other empirical study. Ward and Morgan (1984) employed the model in their study of 76 men and women in a university health and fitness program. Data collected at baseline were used to predict adherence at 10, 20, and 32 weeks. Ward and Morgan reported a classification accuracy for adherers of 88%. However, only 25% of the drop-outs were predicted correctly and for the female sample alone, this percentage dropped to 5%. Sonstroem (1988) suggests this is not necessarily surprising considering the equation was developed with a male sample. In fact, in this later study, under individual scrutiny, none of the three variables significantly differentiated drop-outs from adherers. Instead, the authors constructed predictive discriminant function equations from other variables (e.g., tension, age, vigor, blood pressure, etc.) that differed for the three time periods and between sexes across the 32 weeks.

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[7]This analysis provides a practical interpretation of the data but should not be viewed as "confirmation" of the model since it was not conducted on an independent sample.

Although the latter report brings the psychobiological model under question, the initial interest regarding the self-motivation construct per se and the accompanying scale has not diminished. Evidence has accumulated both in support of, and counter to, expectations of the power of self-motivation to predict exercise adherence.

Several studies have been conducted evaluating the construct validity of the SMI scale. In two investigations, Knapp, Gutman, Foster, and Pollock's (1984) work with professional ice skaters, and Freedson, Mihevic, Loucks, and Grandola's (1983) work with competitive female body builders, the average SMI scores in each case were higher (160 and 157.6 respectively) than the mean of 140 for the original sample of college students (Dishman et al., 1980). The finding by Freedson et al. (1983) was significantly different (as calculated by this author). The significance of the finding by Knapp et al. (1984) is not attainable given the brevity of their report. Similarly, Heiby, Onrato, & Sato (1986) reported that the SMI of runners training for a marathon correlated significantly with their self-reports of exercise.

Some prospective studies have also supported the construct of self-motivation. Knapp et al. (1984) did a mean-split of SMI scores obtained prior to training, and found that low motivation skaters missed more training days than high motivation skaters. Snyder, Franklin, Foss, & Rubenfire (1982) reported that low SMI subjects in a cardiac rehabilitation exercise program had been less compliant over the previous nine months. Notably the retrospective design of this study makes interpretation difficult.. Finally Thompson, White, & Craighead (1984) demonstrated that SMI scores predicted number of weeks of attendance among college students in an aerobic exercise program.

Other studies have found less consistent relationships or no association at all between SMI and exercise adherence. In an investigation of 73 healthy men and women, Gale et al. (1984) compared the SMI scores of early drop-outs, low attenders, and adherers to a walking program. Among males, SMI scores were different for drop-outs versus others, but this relationship did not hold for females. In the comparison of adherers with

the other two groups, SMI scores were not predictive for either sex. Olson & Zanna (1982) studied 60 participants at commercial exercise clubs, comparing the motivation scores of regular attendees, occasional attendees, and drop-outs. The difference between the scores of regular attendees (155.37) and the others (144.12) approached significance ($p < 0.10$). This finding should be treated with caution given the large number of analyses performed by these investigators. SMI scores also did not differ in a comparison of ultramarathoners, runners, and nonrunners (McCutchen & Yoakum, 1983). Robinson and Carron (1982) reported that SMI scores did not discriminate among starters, squad members, and drop-outs in a high school football squad. Finally, as mentioned earlier, there was no difference in SMI scores for adherers versus drop-outs in Ward and Morgan's (1984) study.

Reviewers of the exercise adherence literature (Dishman, 1986; Dishman et al., 1985; Sonstroem, 1988) are equivocal concerning the predictive power of self-motivation. There is growing consensus that given the complexity of exercise behavior and the myriad of factors influencing decisions in favor of, or against exercise, it is unlikely that any single characteristic would explain more than a small percentage of the variance. This attitude is consistent with the results cited above; with the exception of Dishman and his colleagues' original work, even the significant relationships cited above were only small to moderate in size.

Heiby et al. (1986) provide direct support for this thesis in their study of runners training for a marathon. Among twelve variables collected at baseline, adherence (participation in the marathon) was only significantly related to one measure, motivation level specific to exercise. None of the general measures employed at Time 1 including SMI, locus of control, anxiety, depression, percentage of body fat, etc. were individually predictive. Furthermore, when a factor analysis was applied to these variables, the only factor associated with adherence was composed of reports that exercise was enjoyable, being able to exercise, and being motivated to exercise. In further analyses combining

variables collected at different stages of the training process, different variables demonstrated predictive ability. Given the large number of analyses conducted, caution should be observed in interpreting these findings with no one factor receiving unequivocal support. However, clearly the general trait, self-motivation, was not a significant determinant. In fact, the authors' conclusions argue against a general trait approach to exercise adherence. They suggested that (1) a cost-benefit analysis concerning exercise behavior is helpful in making predictions, and (2) exercise adherence may be better understood as a series of stages rather than simply classifying people as active or not. These issues will be addressed in more detail below.

Psychological States

In keeping with the utilitarian approached promised at the outset of this paper, several constructs will be examined below under the label of psychological states. Concepts which are usually considered as distinct entities within models may be discussed below as if they are more alike than they are different. That is, certain psychological states may be seen as serving similar purposes under different names[8], and will be treated accordingly. Given the size of the literature, the following review should not be seen as exhaustive. The discussion will be organized around four such concepts: (1) perceived risk, (2) attitude toward the activity, (3) attitude toward the self, and (4) perceived benefits and costs.

Perceived Risk The effect of perceived risk on a plethora of health behaviors has been investigated (Haynes et al., 1979, pp. 78-109). The majority of studies which have evaluated this factor have done so as part of the application of the Health Belief Model. The Health Belief Model (HBM), originally developed by social psychologists approximately twenty-five years ago (Hochbaum, 1956; Kegeles, 1963; Rosenstock, 1960), has been repeatedly reviewed and extended (e.g., Becker & Maiman, 1975; Janz &

8 A rose by any other name would smell as sweet.

Becker, 1984). The primary premise of the HBM is that beliefs lead to behaviors. Specifically, in an early version of the HBM the probability of engaging in a health behavior depended on (1) perceived vulnerability to a disorder (i.e., beliefs about vulnerability), (2) perceived severity of the disorder, (3) a belief that compliance with a particular behavior will have an impact on that disorder, (4) a weighing of the positive benefits of the behavior against personal and environmental barriers, and (5) internal or external cues to action. In keeping with the organizational strategy described previously, only the first two components, often labeled within the model as personal readiness factors (i.e., perceived risk), will be reviewed below. In relation to exercise behavior, perceived risk typically refers to health problems that exercise is expected to mitigate (e.g., obesity, heart disease, etc.).

Initial work with the model as a whole, and perceived risk in particular, was promising. Rosenstock, Derryberry and Carriger (1959) found an association between the personal readiness factors and involvement in a vaccination program. Heinzelman (1962) also demonstrated that perceived severity and perceived susceptibility were associated with prophylactic behavior. Similarly, Becker, Maiman, Kirscht, Haefner, Drachman, & Taylor (1979) found a positive relationship between perceived readiness factors on the part of mothers and subsequent weight loss by their children as well as appointment-keeping behavior.

A closer inspection of these components of the HBM to exercise (Langlie, 1977; Slenker, Price, Roberts, & Jurs, 1984; Tirrel & Hart, 1980), however, suggests that perceived risk may not be equally useful across behaviors. In a study of members at private exercise clubs, Olson & Zanna (1982) found that susceptibility and severity to health problems that exercise is expected to prevent did correlate with adherence for men but not for women. In Tirrel and Hart's (1980) prospective investigation, only one of the HBM components, perceived barriers, was significantly related to exercise adherence; susceptibility actually tended to be negatively associated with adherence. Others (Langlie,

1977; Lindsay-Reid & Osborn, 1980) have also reported an inverse relationship between susceptibility and exercise behavior. More recently, Slenker et al. (1984) evaluated HBM in its entirety in relation to exercise adherence by comparing joggers with nonexercisers on several psychological measures. In a stepwise regression using jogging as the outcome variable, barriers entered the model first, followed by health motivation and health benefits (R^2=51%); severity only contributed 1% of the variance and susceptibility did not reach significance at all.

The sense that perceived risk influences health behaviors has also been assessed in situations not involving the Health Belief Model. It is under study, implicitly if not explicitly, in many investigations examining the effect of health knowledge or education on exercise participation. In one study (Sallis et al., 1986), researchers found that health knowledge ("Knowledge of cardiovascular health and health behaviors", p. 333) predicted adoption but not maintenance of moderate exercise in their community sample. Similarly, Godin, Disharnais, Jobin, & Cook (1987) investigated the effect of completing a home fitness test and health appraisal inventory (based primarily on age, gender, and prior medical history) on intentions to exercise and exercise behavior per se. Knowledge of these results had no significant effect regarding leisure time exercise behavior over the following three month period.

It has been suggested (Janz & Becker, 1984) that since some of the studies just cited were retrospective in nature, the relationship between perceived risk and exercise adherence is not readily interpretable. On a simplistic level, it may be that after performing a health behavior people perceive themselves (accurately) as being at less risk. Active people typically believe their health is good, not poor. Alternatively, while thoughts and beliefs concerning one's health may be associated with health behaviors, possibly even causally, they are not necessarily sufficient to predict a complex behavior pattern such as exercise (Dishman, 1986). This sentiment was anticipated as early as 1970 when Haefner and Kirscht concluded their discussion by acknowledging the following:

> "Apparently, then, effectiveness of the beliefs about health in modifying behavior is specific to the kind of behavior proposed. The medical actions required periodic behavior that would interfere only occasionally with established behavior patterns of the participants. The actions involving personal living habits, however, involved altering presumably well-established and frequently repeated patterns of action. For modifying such actions, merely changing the participants' beliefs about health was not enough." (p. 483)

Attitude Toward Activity The relationship between attitude and exercise has an extensive history. (For early efforts, see Adams, 1963 and Richardson, 1960). The first major influence was Kenyon's (1968a; 1968b) development of the Attitude Toward Physical Activity Scale (ATPA). A close reading of these early articles indicates that Kenyon was more concerned with characterizing physical activity--understanding it as a social psychological phenomenon--rather than making predictions.

After a series of steps involving initial generation of items, expert judges' assessment of these items (Kenyon's "university of content" 1968a, p.98), and empirical work with the items, Kenyon settled on six subdomains, each represented by 14 Likert-type attitude statements. One sample item provided by Kenyon was "I would enjoy engaging in those games and sports that require a defiance of danger" (1968b, p. 569). Kenyon's interest seemed to be centered around development of attitude measures in general, based on internal consistency and subdomain independence. It seems as if his consideration of physical activity as six logical subsets based on perceived instrumentality (physical activity as a social experience, for health and fitness, as the pursuit of vertigo, as an aesthetic experience, as catharsis, and as an ascetic experience) was convenient, but not of central importance to his work. This intent is attested to by Kenyon's conclusion (1968a) that although appropriate criteria were reached "...this does not imply that all the dimensions of physical activity have been accounted for, nor does it imply that this is the only approach to characterizing physical activity" (p. 104).

The ATPA has been criticized for being too vague in its definition of physical activity and not being useful in relating subjects' responses to actual performance of activity

(Shephard, 1988); that is, one's attitude toward a general object (e.g. physical activity) is not the same as one's attitude toward performing a specific behavior. It seems to this author that the charge that the exact behavior was not specified on the scale could be defended by acknowledging that this was purposeful on Kenyon's part. The charge that the question of actual performance was omitted was not directly relevant; the ATPA was not designed for the purpose of predicting exercise adherence.

Nevertheless, some researchers' efforts to examine the content validity of the ATPA scale (Biddle & Bailey, 1985), even when not employed as a determinant of exercise adherence per se, have had direct bearing on it. As part of these efforts, reports (Massie & Shephard, 1971; Sidney & Shephard, 1976) have emerged that the construct captured by the ATPA is subject to change over time, especially following actual participation in physical activity. These findings are cited as supportive of the general acknowledgement that attitudes measured at different times or in different contexts are not likely to remain the same. The inference is that every aspect of the situation must be specified in order to predict behavior. This thesis will be addressed more directly below.

Notwithstanding these criticisms, some investigators have examined the ATPA's direct relationship to exercise adherence (Dishman et al., 1980), with some investigators identifying the subdomains as motives (Mathes & Batista, 1985) rather than attitudes. Under this conceptualization, items on Kenyon's scale tap benefits ascribed to exercise, rather than attitude toward activity per se; the review of this research will be reserved for the discussion to follow of perceived benefits and costs.

In other work, attitude toward activity has been assessed directly with the sole purpose of predicting exercise adoption and maintenance; the Psychological Model of Exercise Adherence (Sonstroem, 1978) has been labeled as the first attempt to develop a psychological model expressly for exercise adherence. This model states that estimation of one's physical ability (Estimation) influences one's attraction to exercise (Attraction) which in turn has an impact on exercise participation. These factors are tapped through an attitude

inventory, Sonstroem's Physical Estimation and Attraction Scale (PEAS). The attraction component alone will be considered at this point.

Initial validation efforts and theoretical development were fruitful. The PEAS as a whole, and the Attraction subscale alone, correlated positively with fitness scores and self-reports of physical activity (Neale, Sonstroem, & Metz, 1969; Sonstroem, 1978). Attraction was also associated with interscholastic athletic participation in high school boys (Sonstroem, 1974).

Later work, however, did not support the predictive utility of attitude toward activity as measured by the Attraction subscale. Using the PEAS, investigators failed to find a significant relationship between attraction and adherence to an exercise program among prisoners (Morgan & Pollock, 1978), police officers (Morgan, 1977), or middle-aged men (nonrisk and cardiac patients) in fitness programs (Dishman & Gettman, 1980). Sonstroem and Kampper (1980) demonstrated that junior high boys who scored high on the PEAS were more likely to enroll in school sports programs but they were not more likely to continue participation. The general consensus (Sonstroem, 1988) is that as framed thus far, the PEAS predicts initial involvement, but not continued participation. It has been suggested that this limitation is in part due to the vagueness of the items on the PEAS, especially on the Attitude subscale (Dishman, 1986). In fact, Sonstroem and his colleagues themselves (Sonstroem & Kampper, 1980) recommend using items that are more specific in terms of the activity of choice.

The controversy over the utility of attitude measurement in general continues (Bagozi, 1981). Proponents of the predictive power of attitudes counter typical criticisms by noting that attitude statements are effective predictors if phrased specifically and sufficiently close in time to the behavior in question (Ajzen & Fishbein, 1969; Bagozi, 1981; Godin & Shephard, 1986). Furthermore, the attitude should be aimed at actually executing the behavior, not just the activity as an object; as noted above, neither Kenyon's

(1968a, 1968b) nor Sonstroem's (1974) scale was directed at activity performance. Early advocates of this position are Fishbein, Ajzen, and their colleagues.

The development of the Theory of Reasoned Action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1977; and Ajzen & Fishbein, 1980) is based on the premise that as one formulates positive and negative beliefs about an object, corresponding attitudes toward the implied actions develop which, when combined with subjective norms, lead to behavioral intentions, and in turn, to corresponding behaviors. Of direct relevance to this discussion is applications of the model in which attitudes are used to predict intentions which are then studied in relation to behavior; the two other components, beliefs and subjective norms, will be considered elsewhere.

Several studies are often cited in support of this model's ability to explain exercise behavior (Godin & Shephard, 1985; Pender & Pender, 1986; Riddle, 1980). For example, when Miller and her colleagues (Miller, Johnson, Wikoff, Feehan, McMahon, & Garrett, 1983) assessed the role of attitude toward adherence to medical regimens for myocardial infarction (MI) and cardiac bypass (CB) patients, they based their study "in part on the Fishbein model" (p. 541). Interestingly, despite acknowledgement of the role of intentions in the model, Miller et al. (1983) bypassed this step, examining the relationship between attitude and health behaviors directly.

Of primary interest to this discussion was the "activity" regimen prescribed for these patients. It varied from (1) some restriction to (2) no restriction to (3) some walking; over 50% of the patients fell in the restricted category. The authors report a significant relationship between attitude toward the activity and the behavior for the MI patients ($r=0.56$, $N=60$) but not for the CB patients ($r=0.10$, $N=347$). Many of the patients whose attitudes did correspond to their behaviors could have simply been cooperating with their doctor's request to restrict their activity--not a request to engage in an exercise program. In another study (Pender & Pender, 1986), consistent with Reasoned Action predictions,

attitudes were associated with intentions (r=0.18, N=377); however, no actual behavior was ever measured.

Other investigators have applied the Reasoned Action model, including intentions and behavior, in the study of exercise adherence using a traditional definition of activity (i.e., active sports, vigorous activity, jogging, etc.). A good example is the work by Godin & Shephard (1986) in which a specific attitude scale, based on Fishbein-Ajzen's theory which specified the action, target, context, and time of the behavior, was more strongly associated with recent past exercise behavior than was a more general inventory (a revised version of the ATPA scale involving 9 motives for physical activity). However, interpretation of these data are difficult given the retrospective nature of the design.

Riddle (1980) also reported support for the Reasoned Action Model. Subjects who were identified as either joggers or nonjoggers were questioned about their attitude toward jogging and intentions to jog in the following two weeks. Support for the model was claimed because intentions to jog correlated with jogging behavior over the next two weeks, and joggers differed from nonjoggers in their beliefs and attitudes about jogging. However, this study is also limited given its retrospective nature and the failure to test the predictive power of intentions over the long run, lessening its utility

Perhaps in response to such criticisms, two prospective studies were conducted to evaluate the viability of the model more rigorously. Godin, Colantonio, Davis, Shephard, & Simard (1986) worked with a sample of 62 lower-limb disabled adults to evaluate the relationships among attitude toward the activity (Aact), behavioral intentions, and exercise behavior over the following week. Intentions were significantly related to behavior over the following week but, contrary to the model's predictions, Aact was not associated with intentions or actual behavior. Rather, the authors suggest that the factor that did strongly influence intentions, and indirectly behavior, was the strength of the exercise habit as quantified by their rating on a 3-point scale of their current level of physical activity.

These conclusions are mirrored in the prospective study of university employees by Godin, Valois, Shephard, & Desharnais (1987). These investigators applied a path analysis technique (LISREL) in order to ferret out the relationship among the factors of the Reasoned Action model. In keeping with their previous findings (Godin et al., 1986), and criticisms concerning application, they included in their model three variables representing the exercise habit, and two measures of exercise behavior: proximal behavior (exercise three weeks later) and distal behavior (exercise two months later). In this study, attitude predicted intention but not actual behavior, and intentions predicted distal behavior but not proximal behavior. Interestingly, the only significant predictor of proximal behavior was the strength of the exercise habit and, in turn, proximal behavior (a proxy measure for habit), along with intentions, predicted distal behavior.

In their interpretation of these results, Godin et al. (1987) considered the moderating effect that habit strength is purported to have on the effect of behavioral intentions (Triandis, 1977). They concluded that past behavior mitigates the effect of intention more in the case of continuous activities such as smoking and exercising than for a discrete health behavior such as giving blood, because the former type is not "volitional" in the same sense (requiring less conscious awareness) because of its frequency.

On close examination then, it seems that the impact of either attitude per se or intentions, the latter presumably being a reflection of attitudes, on physical activity is not clear; in particular, the effect on long term behavior has not been established (Sonstroem, 1988). The notion that the strength of the habit seems to be of considerable importance will be returned to in later discussion.

Nevertheless, many investigators continue to support the basic tenets of the Reasoned-Action Model, while recommending some adaptations. Relatively recent extensions of the model proposed by its originators (Fishbein, 1980; Ajzen, 1985) were integrated into a "social psychological perspective" by Olson and Zanna (1987). These

revisions, including attention to attitude toward alternative behaviors and perceived control, will also have direct bearing on later remarks.

Attitude Toward Self The assertion that a person's self-perception influences his or her behavior is receiving a new surge of interest in the current focus on "self-variables" (Sonstroem, 1988). At the most global level, self-perception is usually housed under discussion of self-esteem or the ego. Although several studies support the common sense notion that many forms of exercise have a positive influence on self-esteem (Sonstroem, 1984), the reverse hypothesis, that high self-esteem leads to exercise adherence, has not been established. This is not surprising given Sonstroem's (1988) declaration that "self-esteem theory is itself so all-encompassing, so complex, and yet so vague, that it provides acute conceptual and operational problems in the study of exercise participation" (p. 141).

In light of this point of view, Sonstroem (1984, 1988) has recommended that narrower scales be implemented, containing stimuli specific to the exercise setting. Three constructs and their corresponding scales are reviewed below: (1) Estimation (subscale of the PEAS, (prior to his recommendation to make items as specific as possible) Sonstroem, 1974), (2) Perceived competence (Harter, 1983), and Self-efficacy (Bandura, 1977a; 1977b). Although these constructs will be considered separately in the following discussion, it should be noted that, in this author's opinion, they are at least strongly related, if not identical.

As mentioned earlier, physical estimation, one's estimation of his or her general physical capabilities, is one component of Sonstroem's (1974) Psychological Model of Exercise, tapped by the Estimation subscale of the PEAS. Under Sonstroem's formulation physical estimation influences one's "attraction to physical activity" component, which in turn influences one's behavior.

From the previous discussion, it was established that Estimation scores of high school students were positively associated with past athletic experience and physical fitness. Sonstroem's second study with junior high and high school students provided

further support for the construct validity of physical estimation; the Estimation score was again positively correlated with both fitness and self-esteem but, as predicted, these two factors were not correlated with each other. Also, consistent with the theory, Sonstroem and Kampper (1980) established that Estimation scores were positively associated with Attraction scores (r=.49), with Attraction being the component more directly associated with exercise adherence.

However, other attempts to use the PEAS have provided only limited support for the model as a whole, or for either component individually. The significant relationships between Estimation and exercise adoption, reported by Sonstroem and Kampper (1980), were not very large. Furthermore, estimation was not useful in predicting continued participation in the same study, even among the high school population for whom it was developed. Sonstroem's (1988) "anticipation" that such difficulties would be intensified in the more complex world of adult exercisers had already been borne out in studies documenting the lack of correlation between Estimation scores and exercise adherence with adults (Dishman et al., 1980 and Morgan, 1977). Sonstroem's (1988) suggestion that improvements of the scale and/or extensions of the model are necessary seems warranted.

A second "self" approach to exercise adherence is based on the construct of perceived competence. Perceived competence, part of a model for competence development in children (Harter, 1983), is based on White's (1959) formulation of effectance motivation. White suggested that people are motivated to engage in mastery behavior and to deal effectively with the environment, because from such behaviors people feel intrinsic pleasure. Harter (1981) extended this theory by separating the process (e.g., independent mastery attempts, challenge seeking, and curiosity) from the product, mastering the environment, since this result may or may not occur. Harter (1981) has suggested that the tendency to engage in mastery behaviors, or in White's terms, one's effectance motivation, is in large part due to perceived competence. In turn, perceived

competence is influenced through the socialization process; specifically, self-competence develops in reaction to evaluative and affective responses to our behaviors by others.

Harter (1981) suggested that perceived competence is domain-specific and consequently developed three relevant subscales: cognitive competence, social competence, and physical competence.[9] Although work is just beginning in the application of Harter's perceived competence construct (physical competence) to the question of exercise adherence, preliminary findings are promising.

Feltz and Petlichkoff (1983) found that perceived competence differentiated participants from drop-outs in junior high athletes. Similarly, Roberts, Kleiber, and Duda (1981) reported that perceived competence effectively discriminated participants in sports activities from non-participants among grade school children. Roberts et al. (1981) examined this relationship further to determine whether sports attract children higher in perception of ability, as the authors hypothesize, or whether the sport experience has the effect of elevating perception. The lack of correlation between sports involvement in the past and perceived competence was cited as support for the first interpretation. Other work (Harter, 1981; Ogilvie & Tutko, 1971) also supports this notion that individuals will seek out activities involving behaviors in which they take pride. Support for the underlying tenets of the model comes from the study with college students by Vallerand and Reid (1984). The influence of verbal feedback on intrinsic motivation (what White termed effectence motivation) was strongly mediated by perceived competence. This point will be returned to in later discussion.

A construct which has been frequently likened to perceived competence (Roberts et al., 1981; Ryckman, Robbins, Thornton, & Cantell, 1982), but which has received considerably more attention is self-efficacy. Self-efficacy is the belief in one's ability to perform a particular behavior. Although this construct was first developed in a seemingly

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9 Harter (1981) acknowledges adding a fourth scale, tapping overall self-worth, because of a "nagging feeling" that such a global construct does exist.

circumscribed research area--the treatment of snake phobias (Bandura, Adams & Beyer, 1977)--self-efficacy has taken on a life of its own. Bandura et al. (1977) have suggested that self-efficacy is the single common cognitive mechanism underlying behavioral change, independent of the psychological procedures which induced the change.

In the following discussion, it is critical to differentiate self-efficacy, one's conviction that one can execute a behavior, from a related but distinct construct, outcome expectations, the belief that effective performance of a behavior will result in a desired outcome. The latter construct, the expected benefits to be gained from the behavior, will be considered in the following section on benefits and costs. It is also important to highlight Bandura's insistence that self-efficacy is not a global perception of the self, nor an enduring tendency to persist in any behavior once begun. This point is highlighted in the following comments from a recent theoretical paper provided by Strecher, McEvoy, Becker, & Rosenstock (1986).

> "...it is important to understand that the concept of self-efficacy relates to beliefs about capabilities of performing specific behaviors in particular situations; self-efficacy does not refer to a personality characteristic or a global trait that operates independently of contextual factors. This means that an individual's efficacy expectations will vary greatly depending on the particular task and context which confronts him/her. It is therefore inappropriate to characterize a person as having "high" or "low" self-efficacy without reference to the specific behavior and circumstance with which the efficacy judgment is associated."

Thus, notwithstanding the terminology employed, continuing efforts by some investigators to develop and/or validate a global self-efficacy instrument (Sherer & Adams, 1983) or even a non-specific "physical self-efficacy" measure (Ryckman et al., 1982; Valois, Shephard, & Godin, 1986) should be evaluated on their own merits, rather than as reflections on the utility of Bandura's concept. Clearly, self-efficacy is not simply another term for the construct of self-motivation presented earlier. In fact the two constructs are quite distinct, inevitably leading to competing tests of whether general or specific measures are superior predictors of behavior. To this writer's knowledge, this comparison has been

made in only one study[10]; Edell, Edington, Herd, O'Brien, & Witkin (1987) examined the relationship in question in their investigation of adherence to a weight loss program. They found that self-efficacy was a better predictor of weight loss than was self-motivation, but neither construct was significantly related to adherence to the program (i.e., number of sessions attended).

As part of his general formulation of social cognitive theory (the successor to social learning theory), Bandura and his followers have considered self-efficacy in relation to behavior change in almost every domain imaginable. In general, the growing body of literature documenting the association of self-efficacy with a variety of psychosocial issues, such as dysphoria, motivation, career choice, and athletic attainments lends support to the generality of Bandura's contentions (O'Leary, 1985; Schunk & Carbonari, 1984).

In regard to health in particular, self-efficacy has been related in a positive fashion with determining choice behavior, length of persistence in the face of adversity, and improved emotional status (e.g. lessened anxiety). Within the realm of health behaviors, the self-efficacy construct has been applied most frequently, and generally successfully, to smoking cessation (Condiote & Lichtenstein, 1981; Di Clemente, Prochaska, & Gilbertini, 1985; McIntyre, Lichtenstein, & Mermelstein, 1983) and weight control (Chambliss & Murray,1979; Edell et al., 1987). The relationship between self-efficacy and exercise behaviors is just beginning to receive similar attention.

Evaluation of this relationship relies primarily on the work by Kaplan and others (1984) with COPD patients, Ewart and his colleagues (1983, 1985) with cardiac rehabilitation patients, and Sallis et al.'s (1986) community study. In the former study, Kaplan, Atkins, & Reinsch (1984) found that at three month follow-up, a baseline measure

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[10]One group of researchers (Weinberg, Hughes, Critelli, England, & Jackson, 1984) make reference to administration of the SMI in their report examining the relationship of self-efficacy on weight loss. However, the only mention of this factor in their results section was "... subjects were found to have uniformly high levels of task motivation.", p. 357.

of self-efficacy concerning a program of exercise (walking) was a better predictor of actual behavior among COPD patients than was a general health locus of control measure.

As part of the rehabilitation process, Ewart, Taylor, Reese, & De Busk (1983) evaluated cardiac patients on six physical activity efficacy scales and with symptom-limited treadmill exercise. They found that initial self-efficacy predicted peak heart rate achieved during the treadmill test (r= 0.36). Furthermore, self-efficacy measured after rehabilitation ended related to patients' activity level when they returned home (duration of exercise, r= 0.53; intensity of exercise, r= 0.34). Interestingly, in related work, Ewart and his associates (Ewart, Stewart, Gillilan, Kelemen, Valenti, Manley, & Kelmen, 1985) found that self-efficacy also predicted over-exertion among cardiac patients.

Most recently, Sallis et al.'s (1986) community study of 1411 California adults also supported the utility of self-efficacy. Subjects' activity patterns were assessed at baseline, accompanied by a host of psychological measures, and then reassessed one year later. Outcome variables were classified into four categories: adoption and maintenance of moderate activity and adoption and maintenance of vigorous activity. In multivariate analyses, self-efficacy predicted adoption of vigorous activity (as did age and gender) but not maintenance; on the other hand, it predicted maintenance of moderate activity (as did exercise knowledge and gender), but not adoption; the size of the effect for moderate activity was acknowledged to be "very modest". The authors did not explain these somewhat contradictory findings; the implication seemed to be that self-efficacy is a determinant of exercise behavior but not the sole influence. Sallis et al's (1987) recommendation to include measures of exercise barriers as well as exercise values in future research efforts was noteworthy given the upcoming discussion of perceived benefits and costs.

At first glance, the evidence accumulating in support of self-efficacy is impressive; certainly a relationship between self-efficacy and adherence with health behaviors seems highly likely. However, two qualifications should be noted. First, the magnitude of the

effect, as opposed to its reliability, is not as firmly established. As just mentioned, the effect size reported by Sallis et al. (1987) varied from small to moderate and the findings of Ewart et al. (1983) cited above indicate that self-efficacy's relationship to intensity of exercise was also only moderate (approximately 13% of the variance was predicted). Although effect sizes of this magnitude are respectable, it seems evident that efficacy is not the sole contributor to variance in exercise behavior. This leads us to the second point.

In the early stages of the development of the self-efficacy construct, Bandura (1977a) asserted that self-efficacy was only effective "given sufficient incentives" (p. 194). This qualification is often overlooked, as highlighted by Rosenstock, Stretcher, & Becker (1988) in the following comment:

> "While the failure to measure self-efficacy in earlier research on the HBM was certainly an important omission, it is also an error to stake as much on self-efficacy as many social learning theorists have recently attempted. Bandura's discussion seems to assume that the client who desires change possesses adequate incentives to change, feels sufficiently threatened by some potential or actual environmental event, fully believes outcomes can be influenced by behavior, and does not face major barriers to action. These are clearly important omissions." (p. 180)

Although repeated in many reviews (Dishman, 1986; Schunk & Carbonari, 1984), this point is often missed in the unquestioning surge of support for self-efficacy. For example, in the two studies described above, both COPD patients and cardiac rehabilitation patients would presumably have consistent, and strong, incentives to adhere to medical regimens. Potential benefits, especially health effects, would be especially salient for these populations. This is not necessarily true for all, or even most people. It seems that self-efficacy may be a necessary condition of exercise behaviors; it is certainly less clear that it is a sufficient condition.

Perceived benefits and costs The last of the psychological states to be reviewed, perceived benefits and costs, has been examined as part of both atheoretically based hypotheses (i.e., essentially through descriptive surveys and studies) and as components of

some of the theoretical models discussed earlier. Both of these approaches are discussed below.

One straightforward approach to discovering why people do or don't exercise is to simply ask them. In response to just such a direct question on surveys in American and Canada such as the Canada Fitness Survey (1983), the Miller Lite Report (1983), and the National Adult Physical Fitness Study (President's Council on Physical Fitness and Sport, 1974), the answers typically address the concept under discussion, perceived benefits and costs. For example, the two reasons cited most often for engaging in physical activity are health/fitness and enjoyment. To examine these two factors in more detail, we must turn to several empirical studies.

It is important to note that the responses on surveys described above do not differentiate reasons for adoption and reasons for maintenance. The importance of this distinction is highlighted in discussions by Heinzelman (1973) and Wankel (1985), and most recently by the call by many authorities to treat exercise as a dynamic, not a static, process (Dishman, 1986; Sonstroem, 1988). Empirical studies also add credence to this assertion. The beliefs of previously sedentary people, upon completion of one year of exercise, became more like those of active people (Harris, 1970). Reasons for joining are not synonymous with reasons for maintaining exercise (Wankel, 1985). Thus, when outcome expectations are under consideration, the outcome is not necessarily health-related. It seems that at the adoption stage many people stress the importance of the health benefits of exercise. As they actually engage in exercise, however, other outcomes, positive or negative, may become more salient.

Specifically, many studies have found that people typically **join** an exercise program for health and fitness reasons (Heinzelman & Bagley, 1970; Perrin, 1979; Wankel, 1985) but attribute **continuing** with the program to enjoyment (Perrin, 1979; Wankel, 1985), camaraderie of the group (Heinzelman & Bagley, 1970; Wankel, 1985), or program factors such as leadership and organization (Heinzelman & Bagley, 1970). The

latter determinants will be considered in more detail within the discussion of the environment. One exception to this trend is the finding by Olson and Zanna (1982) that people who endorsed health and fitness goals persisted longer in commercial fitness programs than people with enjoyment-oriented goals.

When people are asked what prevents them from exercising, some aspect of inconvenience usually surfaces as the top barrier to action. In the National Adult Physical Fitness Study (President's Council on Physical Fitness and Sport, 1974), the top two reasons provided for not exercising were insufficient time and being too lazy; the latter factor will be addressed in later remarks. Similarly, without even measuring behavior per se, investigators have discovered that inconvenient location may figure into people's decisions regarding exercise. For example, in the study by Teraslinna and his colleagues (Teraslinna et al., 1969), mentioned earlier, the factor most strongly related to "willingness to participate" in a hypothetical fitness program was distance to the exercise location. This finding is particularly interesting given that what was speculated to be true for a sample of 1708 respondents from Finland over twenty-five years ago appears to be consistent with more recent findings in America.

In empirical studies, when drop-outs provide the answers, rather than the adherers, reasons cited for dropping out seem to revolve around convenience factors, with no mention of their health/fitness motives. Wanzel (1977, 1978) found that 42% of drop-outs from an industrial exercise program cited distance from home as the primary reason; 40% attributed their difficulty with exercise maintenance to the interruption of their daily schedule. Andrew and Parker (1979) reported that drop-outs differed from adherers in claiming more difficulty in arriving on time, more interference from their jobs, and, a closely related factor, the interference of exercise with their work. Bruce et al. (1976) discovered that drop-outs described their poor adherence as "unavoidable" because of conflicts with time, their job, or moving out of the area. Finally, and most recently,

Wankel (1985) identified inconvenient time and location as the two most important reasons given for withdrawing from an employee fitness program.

It is important to note that some people who perceive distance as the reason for dropping out, in fact live no farther from the exercise site than people who continued to participate (Gettman, Pollock, & Ward, 1983). But, it is not the validity of peoples' statements that is at issue here. What is important is that their perception of inconvenience does appear to influence their behavior. Others (Wankel, 1988) make the same point, as in the following remarks:

> "Although lack of time is the most consistently reported obstacle in a number of studies, it may simply be a rationalization rather than a reflection of reality: The observation that there is never enough time for everything is fairly common. The problem may well be, then, a question of priorities--a question of what a person wants to make time for. Those who exercise likely have no more time than those who do not exercise; nevertheless, this factor should be treated seriously and attempts made to help individuals overcome the problem, whether real or perceived." (p. 378)

The evidence amassed in the preceding discussion suggests that people have many perceptions of what factors encourage and discourage their exercise behaviors. The actual impact of these factors, however, can best be determined through prospective studies, rather than asking the drop-out his or her reasons after the fact. As mentioned earlier in the discussion of perceived risk, many studies include interventions which directly or indirectly may have an impact on perceived benefits and barriers and thus provide answers to our questions more directly; discussion of the findings of these studies will be reserved for the section on environmental factors.

In several situations, perceived benefits and costs have been operationalized as endorsement of certain beliefs, and expected, in accordance with a particular model, to be associated with exercise behaviors. Such studies, although usually still retrospective in nature, are conceivably stronger than simply descriptive efforts that monitor these relationships in a more shotgun fashion. With this in mind, discussion of the role of perceived benefits and costs within theory-based approaches seems warranted.

As mentioned previously, perceived benefits and costs, (the latter labeled barriers), are bona fide components of the Health Belief Model. In applications of HBM to exercise adherence alluded to earlier, benefits and barriers fared better than the personal readiness factors. In the study by Langlie (1977) cited earlier, the HBM was put to the test with a variety of health behaviors that she classified as either direct prevention behaviors (e.g., smoking and driving) or indirect prevention behaviors (e.g., nutrition and exercise).[11] Langlie (1977) classified subjects as behaviorally consistent if their responses to the majority of the items tapping HBM components were similar across behaviors. For "consistent" subjects, both benefits and barriers were significantly associated with preventive health behaviors. For "inconsistent" subjects, perceived benefits, but not barriers, was significantly correlated with preventive health behaviors. It should be noted that the relationship of these factors with exercise behavior per se (defined as "choosing to walk rather than use the elevator") was not reported, but rather their relationship with either direct or indirect health behaviors in general. Tirrell and Hart's (1980) investigation also tested the components of the HBM with adherence to a walking program. They reported that the only significant predictor of exercise participation was perceived barriers.

The most recent report evaluating the utility of the HBM with exercise behavior is provided by Slenker et al.'s (1984) study of 124 joggers and 96 nonexercisers. Prior to assessing the predictive power of the various components of the HBM, Slenker et al. (1984) factor analyzed their questionnaire data to determine whether the theoretical constructs of perceived susceptibility, severity, benefits, barriers, health motivation, support, complexity and cues were sufficiently distinct to be considered different beliefs.[12] Slenker et al. (1984) concluded that the data did support the existence of distinct factors. In a stepwise multiple regression procedure, the HBM components identified above, some

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[11]It should be noted that Janz and Becker (1984) question the rationale behind this categorization scheme.

12 The last four components mentioned were not described in the summary of the Health Belief Model provided earlier because they are more recent extensions of the theory.

related concepts, and three demographic variables (modifying factors) were considered as determinants of jogging versus nonexercising behavior. Approximately 61% of the variance was predicted by a combination of these variables--susceptibility, support, health locus of control, knowledge, and education were the only factors not to enter the equation. Of primary importance to the current discussion, was the specific finding that the factor that accounted for the largest portion of the variance (40%) was barriers; benefits added an additional five percent. Barriers to action that were frequently endorsed by nonexercisers included lack of time, family or job responsibilities, or unsuitable weather.

Another attempt to assess the influence of perceived benefits on exercise behavior is provided by work with Kenyon's Attitude Toward Physical Activity Scale. As acknowledged previously, the ATPA scale, although designed to characterize physical activity, has been studied in association with exercise participation. (Dishman et al., 1980; Massie & Shephard, 1971; Mathes & Batista, 1985). The majority of the studies (Dishman et al., 1980; Godin & Shephard, 1986) support the contention cited earlier that global attitudes toward a general "object" are not particularly useful. Nevertheless, the investigation by Mathes and Batista (1985), in which the factors were redefined as motives, may prove informative.

In their study, Mathes and Batista (1985) asked 335 college students to read a written description of each of nine dimensions of physical activity (six original and three additional dimensions) and respond to these dimensions on a seven-point Likert scale, assessing the importance of that dimension in relation to their participation in physical activity. A factor analysis of these responses revealed three factors: competition, health and fitness, and social experience. Athletes were more likely to stress the importance of competition as the basis for participation than non-athletes but the two groups did not differ in their scores on social experience or health and fitness motivation. In interpreting these results, it seems that athletes may assign different instrumental values (such as providing them an outlet for competition) to exercise than non-athletes do. Perhaps, though, such

ascriptions are made after the fact, rather than acting as the force propelling one into activity in the first place. It is possible that, among sedentary people, such specific attitudes are barely formed or not even salient, especially in comparison to "known" barriers.

Perceived benefits and costs are also a component of the Reasoned Action model. Briefly again, the model asserts that behaviors are driven by intentions which are a function of our attitudes and subjective norms. But the prior cause in this model, the determinant of those attitudes, are our beliefs. For the most part, studies discussed above employing the Reasoned Action Model with exercise adherence did not explicate the role of beliefs; one exception was the work by Riddle (1980). Riddle (1980) suggests that predicting the behavior intention component indirectly, through scoring beliefs rather than attitudes and subjective norms, can be more useful in providing the researcher with more information to develop strategies for behavioral change. Accordingly, she measured the subjects' beliefs about the consequences of the behavior and the evaluation of those consequences. Out of nineteen beliefs about the consequences of exercising, all but two differed significantly between joggers and nonjoggers. Two beliefs were particularly discriminating; nonexercisers had weak positive beliefs that jogging would "require too much discipline for me" and "take up too much of my time", whereas joggers had strong, negative (highly unlikely) endorsements of those beliefs. Other discriminating beliefs concerning jogging included "makes me feel too tired", "makes me feel good mentally", "helps me work off tensions and frustrations", and "is unpleasant". In summary, beliefs about benefits and costs of exercising were able to differentiate joggers from nonexercisers. Again, however, the retrospective nature of this report limits our understanding of the direction of this relationship.

Taken as a unit, the findings cited above certainly support the notion that the benefits and costs attributed to exercise are potentially powerful. Moreover, both the HBM and the Reasoned-Action model specifically include this concept and find it to reliably account for some variance in exercise behavior. Yet each of these models has undergone

numerous revisions in response to criticism that they do not account for sufficient variance to be of clinical significance. That is, although the assertion that one's beliefs about the costs (barriers) and benefits of exercise can influence behavior, and are certainly important factors in any psychological model of exercise adherence, to be truly useful, many qualifications have been necessary.

As noted above, modifications to the Reasoned Action Model have included the concept of perceived control (Ajzen, 1985) and consideration of conflicting alternatives (Fishbein, 1980). The HBM has also been revised repeatedly; additions have included cues to action, social support, health motivation, and self-efficacy (Slenker et al., 1984). Rather than continuing to make models such as these more and more elaborate, it seems that an encompassing theory of behavior that underlies these health behavior models, should be invoked--social cognitive theory (Bandura, 1986). But it is important to focus on the theory in its entirety, not self-efficacy in isolation.

This idea is not new. The connection between the Health Belief Model and Social Cognitive Theory has been expounded by many experts (e.g. Maiman & Becker, 1974). In a very recent report, Rosenstock et al. (1988) noted the one-to-one correspondence between the basic tenets of each. Similarly, although not as explicitly, Olson and Zanna (1987) attempted to apply the Reasoned Action model to health behaviors through a "social psychological perspective".

In agreement with these efforts, it seems that attempts to understand determinants of exercise behavior, and perhaps all health behaviors, would be aided by consideration of social cognitive theory directly, rather than invoking intermediary models. According to Rosenstock et al. (1988), social cognitive theory holds that behavior is determined by expectancies and incentives. Expectancies include thoughts concerning environmental cues (e.g., cues to action of HBM), beliefs about outcomes (e.g., health/fitness consequences of exercise), and beliefs about personal efficacy (e.g., self-efficacy). Incentives (e.g., benefits, including but not limited to health improvement) and costs or barriers to action are

the consequences of our behavior, as those consequences are interpreted and understood by the individual.

I am suggesting that all of the determinants of exercise behavior can be conceptualized as either an expectancy or an incentive; this argument will be elaborated in the following sections. It should be noted that the factors considered thus far have been presented from the point of view of the individual in isolation, without taking into account his or her setting. They have primarily consisted of "expectancies". Even in the case of adoption, this categorization is inadequate because our environment is always relevant (e.g., societal and peer pressure). Nevertheless, it is conceivable that peoples' expectations provide the biggest impetus to their initial behavior. However, when all stages of exercise are being considered, especially maintenance and relapse, the impact of the environment becomes particularly salient, in part through its effect on expectations. Within a social cognition framework, environmental factors must be taken into account.

THE ENVIRONMENT

The premise that our environment influences our behavior is hardly new; consider the underlying theme of behaviorism (Skinner, 1953), as well as the many "tabula rasa" theorists that preceded him (e.g., Locke). Unlike the ongoing controversy over the attitude/belief-behavior controversy (Bagozzi, 1981), the law of effect is well established. The task of this section is to identify how the relationship between the environment--factors beyond the person--and behavior is played out in terms of exercise, a very specific type of behavior. In particular, three aspects of the environment seem to influence exercise adherence: (1) the exercise prescription, (2) the setting, and (3) other people.

The Exercise Prescription

As exercise endorsement fell into the medical realm, the notion of an "exercise prescription" became prominent. Today, at least in some segments of the population, people often ask each other if they have "exercised yet" much as they might ask if they had

taken their medication. In keeping with this trend, efforts to quantify the optimal prescription in terms of mode of activity, frequency, duration, and intensity became common. The debate over many aspects of the recommended regimen continues to reign today (Haskell, 1985), with some experts continuing to support vigorous exercise (Paffenbarger & Hyde, 1988), others encouraging more moderate levels of activity (Gossard, Haskell, Taylor, Mueller, Rogers, Chandler, Ahn, Miller, & De Busk, 1986), and some suggesting that even the most minimal level of exertion may be beneficial (LaPorte, Adams, Savage, Brenes, Dearwater, & Cook, 1984). Some of the disagreement stems from differing objectives under consideration; to be in excellent physical condition probably requires the most extreme effort, cardiovascular benefits may be realized with only moderate activity, and almost any increase in energy output may help people lose weight.

To encompass the variation in these recommendations, most experts support a rather broad exercise prescription, implying it is at least sufficient, if not absolutely necessary, to attain health benefits:

> "The guidelines recommended by most include the following: frequency of training, 3 to 5 days per week; intensity of training, 60 to 90% of maximum heart rate reserve...or 50 to 85% of maximum oxygen uptake (VO_2max); duration of training, 20 to 50 minutes; and mode of activity, aerobic activities such as running, walking, bicycling, swimming, cross-country skiing, vigorous dancing and various endurance sport activities." (Pollock, 1988, p. 259)

Although the foregoing definition is a useful starting point, it only takes into account the physiological needs of a person. Many of today's authorities (Dishman, 1982; Oldridge, 1984) place as much importance on developing the optimal psychological prescription, especially by focusing on the exercise mode, the time involved, and the intensity.

Exercise Mode The typical exercise prescription suggests that the type of activity should be one that "uses large muscle groups...[can] be maintained continuously...is

rhythmical and aerobic in nature" (American College of Sports Medicine, 1978, p. vii). As just mentioned, benefits can accrue from a wide variety of activities that don't measure up to even this general requirement; for example, to lose weight, many experts agree that given a very minimal level of exertion, duration may be the key factor, rather than the aerobic nature of the activity (Haskell, 1985). Moreover, even though most exercise programs are directed at reducing cardiovascular risk, there are still many alternative aerobic activities that would meet the specifications just cited.

Despite the wide range of possibilities, many supervised programs offer only group exercise classes, typically "progressive endurance exercise in the gymnasium with an appropriate warm up and cool down" (Shephard, 1988, p. 309). In a very recent review of exercise adherence issues in corporate settings, Shephard (1988) commented on the disparity between this typical program and what public surveys indicate that people want. For example, according to the Canada Fitness Survey (1983), the most popular current activities are walking, cycling, swimming, jogging or running, gardening, and home-exercising. Activities that were showing rapid growth were skiing, golf, and tennis. In contrast, the typical exercise class ranks sixteenth in terms of participation. Shephard (1988) concludes:

> "An increase in the number of conventional corporate fitness classes would have done little to satisfy such interests, and it could be argued that a more effective tactic would be for a company to invest in exercise testing, counseling, and shower facilities, encouraging employees to develop their current interests, and to walk, jog, or cycle to work." (p. 310)

The underlying message is that the public might be better served if instead of fitting the participant into an established program, the program could be adapted to the participant. This theme of "flexibility" and "individualized exercise plans" will be returned to repeatedly in the following discussion.

Empirical work by Thompson and Wankel (1980) speaks directly to the importance of choice. These investigators evaluated the effects of perceived activity choice upon frequency of exercise over a six week period at a private health club. Thirty-six women

were randomly assigned to either a choice condition, in which they perceived their stated preference as influencing their activity, or a no-choice control condition. Initially, there was no difference between the two groups in terms of attendance with both groups' attendance rates deteriorating over time. But by the end of the treatment, the decline in participation was significantly greater in the control group and subjects in the choice condition expressed a greater intention to continue exercising at the club than subjects in the control condition. The authors concluded that, consistent with the theory of perceived control, choice over alternatives, or even the perception of choice, has a positive influence on voluntary behavior such as exercise participation.

Time The time factor is a critical determinant of exercise adherence. This is easily understood when we recall that a leading perceived barrier to exercise was "insufficient time" (Oldridge, 1982, 1984; Wankel, 1985). Two aspects of timing are relevant here: duration and time of day.

It is not surprising that duration, the number of minutes per exercise session, has been negatively associated with exercise adherence (Pollock, 1988) since it is likely that the recommendations regarding duration outlined above have not taken into account participants' preferences. Today, in order to minimize drop-out, experts recommend that exercise programs be limited to 60 minutes at most, including warm up, muscle conditioning, the aerobic phase, and cool down (Pollock, 1988). The actual aerobic phase would typically constitute only 20 to 30 minutes. Since this is still well within the current training recommendations cited above, this criterion should be agreeable to physiologists as well. It should be noted that when exercise is used as a treatment for weight control, some subjects have been asked to be active for over an hour at a stretch (e.g., Weinberg et al., 1984) in light of Pollock's (1988) suggestions, this request may be inconsistent with the goal of adherence.

The negative effect of extended class periods seems to be a function of (at least) two factors. First, people are not able and/or willing to devote more time to exercise; that is, it

is not "convenient". Second, duration also has an impact on adherence indirectly because of increased injuries. Pollock (1988) reported that the injury rate increased from 22% to 53% when participants trained for 45 versus 30 minutes per session. Although there are some indications that injuries do not always precipitate drop-out (Godin & Shephard, 1985), they are commonly acknowledged as potential barriers.

Timing of the exercise session has also been significantly associated with attendance in exercise programs. Mann, Garret, Farhi, Murray, & Billings (1969) reported that one of the primary predictors of drop out was the time of the sessions. Similarly, Sanne, Elmfeldt, Grimby, Rydin, & Wilhelmsen (1973) also found that drop-outs attributed their lack of participation to the training hours. Experts respond to such findings by suggesting that exercise sessions be held "at convenient times" (Pollock, 1988). Clearly, however, there is no one time of day that is convenient for everyone. Again, it appears that programs that are flexible and can meet the individual scheduling needs of the participants are preferable.

Intensity The continuing debate over the optimal level of intensity, in terms of its training effect (Gossard et al., 1986; Haskell, 1985; LaPorte, et al., 1984) is intimately related to adherence (Pollock, Wilmore, & Fox, 1984). Early on, experts (Mann et al., 1969; Morris, Chave, Adam, Sirey, Epstein, & Sheehan, 1973) concluded that a moderately high exertion level (typically 70 to 85% of Max VO_2) was essential to attain cardiovascular benefits. This commonly held tenet has been challenged in recent times (Haskell, 1984; Morris, Everitt, Pollard, Chave & Semmence, 1980). It seems likely that similar benefits can be achieved at lower intensity, if the session length is increased (Pollock, 1988), or, preferably, if training is simply conducted over a longer period of time (Gossard et al., 1986).

Assuming that a lower exercise intensity does in fact provide comparable health benefits, the findings will be directly relevant to efforts to improve exercise adherence. The thesis that exercise intensity is inversely related to adherence has received considerable

support (Mann et al. 1969; Sanne et al., 1973; Wilhelmsen, Sanne, Elmfeldt, Grimby, Tibblin, & Wedel, 1978, Pollock et al., 1984). If and when recommendations to reduce intensity requirements are heeded, experts anticipate that adherence rates will improve. Meanwhile, it is still important to understand how intensity influences adherence.

Intensity seems to influence exercise participation through two mechanisms: likelihood of injury and subjective discomfort. As described in the discussion of timing, intensity of exercise is associated with injury, especially when very high levels are reached (Kilbom, Hartley, Saltin, Bjure, Grimby, & Astrand, 1969; Mann et al., 1969), or when activities with a jogging component are involved (Pollock et al., 1984; Pollock, 1988). Injuries, in turn, can prohibit exercise. First, people usually cannot and/or should not exercise if they are injured; they become forced drop-outs. Second, upon recovery, it is likely that people who have been injured will be less inclined to return to their exercise program, which is consistent with the abstinence-violation effect proposed by Marlatt and Gordon (1980). Yet some studies do not support this commonly held belief (Cox et al., 1981). In fact, it is surprising that, as alluded to earlier, injuries do not account for the large proportion of variance in exercise adherence that common sense dictates. For example, Bruce et al. (1976) reported that less than a quarter of defections (exercise drop-outs) have been attributable to musculo-skeletal or cardiac problems. It seems likely that the inverse relationship between level of exertion and exercise adherence is also strongly affected by a factor other than injuries--subjective discomfort being the most likely candidate.

Thus, one relevant determinant of exercise adherence may be a person's perception of the effort being exerted, rather than the objective aerobic level achieved. In fact, a sizable literature has developed around perceived exertion/discomfort and its relationship to adherence (Hughes, Crow, Jacobs, Mittelmark, & Leon, 1984; Ingjier & Dahl, 1979; Morgan, Peck, Buchanan, & McHardy, 1983). Evidence from the Ontario Heart Project indicates that fatigue and perceived exertion are important factors in attrition (Andrew,

Oldridge, Parker, Cunningham, Rechnitzer, Jones, Buck, Kavanagh, Shepard, & Sutton, 1981). This relationship seems to hold true whether or not the subjective ratings are accurate reflections of objective functioning.

Perceived exertion has been traditionally rated on a measure developed by Borg (1962), the RPE scale. This is a 15-point category scale ranging from 6 to 20 with descriptive verbal anchor points at every odd number. The numbers were initially chosen to correspond to the estimated corresponding heart rates of 60 to 200 beats per minute. The strong linear relationship between heart rate and ratings of perceived exertion during submaximal exercise has been demonstrated repeatedly (Borg, 1961; 1962; 1982; Skinner, Hustler, Bergsteinosa, & Buskirk, 1973), with the magnitude of the relationship ranging from 0.75 to 0.90, with an average of 0.82. However, the discrepancy that does exist, albeit small, should not be ignored.

Some investigators have examined certain psychological states which may contribute to this small, but still important, unexplained variance. For example, Morgan (1973) reported that, unlike the accurate reporting of exertion by most people, "...the depressed, neurotic, or anxious...seem to have difficulty processing perceptual information related to muscular work" (p. 102). Later, Morgan et al. (1983) demonstrated that among patients with chronic bronchitis, exercise tolerance was more closely correlated with perceived exertion than with ventilatory capacity. Hughes et al. (1984) found that men who were inactive and smoked reported more fatigue, measured in this study as perceived exertion, independent of their level of fitness. They suggested that this subjective experience of fatigue "may account for their decreased compliance to exercise programs" (p. 217). These reports support the need to take into account individual differences when prescribing the "optimal" exercise prescription.

At this point, it should be stressed that the foregoing examples are the exceptions, not the rule. In general the RPE scale does accurately reflect work level. Given this relationship, it seems important to consider the physiological cues upon which the

perceived exertion rating is typically based. Investigators have debated the relative influence on perceived exertion of local (skeletal muscle) versus central factors (Mihevic, 1981; Pandolf, 1978), temperature versus heart rate (Skinner et al., 1973), and a homeostatic perceptual system (internal receptors responsible for body regulation) versus a comfort perceptual system (experience of bodily comfort) (Bartley, 1970). Although these mechanisms are not fully explicated, there is one factor that experts agree on--whatever physiological cues are involved, they only influence subjective assessments of exertion if attended to.

The notion that attending to one's body influences perceived exertion is consistent with emerging evidence that interventions which draw subjects' attention away from internal sensations and toward environmental stimuli produce less problematic somatic symptoms among the subjects (Fillingin & Fine, 1986; Martin, Dubbert, Katell, Thompson, Raczynski, Lake, Smith, Webster, Sikora, & Cohen, 1984; Pennebaker & Lightner, 1980). In the study by Fillingin and Fine (1986), fifteen male undergraduates ran one mile under each of three conditions: attending to a target word, attending to their own breathing, and a control condition. The results indicated that participants reported significantly less symptomatology, particularly exercise-relevant symptoms, in the word-cue condition. Similarly, Martin et al. (1984, Study 5) reported that a cognitive disassociation condition (self-distraction from exercise symptoms) produced superior adherence to the cognitive association condition. One implication of these findings is that it may be possible and advantageous to lower participants' perceived exertion, whether or not it is "accurate".

One more comment should be made concerning perceived exertion. A decrease in perceived exertion may not always be associated with improved adherence. It is conceivable that the relationship between perceived exertion and adherence is curvilinear; that is, for some people, an insufficient sense of exertion might be a deterrent to exercise.

Although there is little evidence yet for this hypothesis, it may account for some peoples' preferences for vigorous activity.

Setting

The situation in which the activity is conducted has been shown to have considerable bearing on adherence. The exercise setting has been evaluated in terms of a variety of components but the two that have received the most attention are the accessibility of the exercise site, and the degree of structure or supervision.

Accessibility Several reviewers stress that participation in any physical activity is largely a function of accessibility (Dishman et al., 1985; Oldridge, 1982). These conclusions are based on both survey data and empirical investigations. Surveys from the United States (Gallup Poll, 1980), Canada (Canada Fitness Survey, 1983) and Australia (Department of Youth, Sport, and Recreation, 1978) indicate that people are more likely to participate in activities that are unstructured and easily accessible. Wankel (1988) suggests that television is a prime example. Watching TV is the most popular of all leisure activities even though the degree of enjoyment associated with it is low, compared to activities engaged in less often (Csikszentmihalyi & Larson, 1984).

The accessibility of the exercise setting can be quantified in many ways. For example, several items endorsed as barriers on surveys are tapping the accessibility issue. Twenty percent of male and female respondents in the Canada Fitness Survey (1983) reported inadequate facilities as an obstacle to exercise. A reason cited by subjects in another study (Fitness Ontario, 1983) was "no opportunity". Similarly, in studies of structured exercise programs, investigators have demonstrated that subjects' attitude toward the convenience of the facilities influences continued participation. Specifically, Andrew et al. (1981) found a twofold increase in dropout rate in those subjects who had difficulties regarding parking, ease of access, and arriving punctually at the center. Comparable findings have been reported elsewhere (Andrew & Parker, 1979; Wilhelmsen et al. 1975). Financial commitment, which can serve as a "cost" that limits access may also be a factor in

drop-out (Bruce et al., 1976; Franklin, 1988). The final, but not least important factor blocking access is the weather. In many studies, subjects report inclement weather as the reason for poor adherence (Martin et al., 1984; Slenker et al., 1984).

One aspect of accessibility that is repeatedly associated with exercise adherence is the distance to the facility (Oldridge, 1982). The report cited earlier by Teraslinna et al. (1969) provided early evidence that people who lived farther from the exercise site were less willing to participate in a suggested physical activity program. It was also noted earlier that in some studies the relevant determinant is perceived, rather than literal distance (Gettman et al., 1983). Nevertheless, there is considerable consensus (Dishman, 1988) that every effort should be made to enhance the accessibility of an exercise facility--even suggesting that corporations provide more flexible work hours for employees (Shephard, 1988). Perhaps the most innovative solution to the dilemma of the lack of accessibility, given the public's preference for exercise done outside of a class of facility (Iverson, Fielding, Crow,& Christenson, 1985), is the recent effort to offer a guided but not directly supervised home program.

Supervision In an attempt to address many aspects of the barrier of inconvenience, a new program alternative has emerged. Until approximately five years ago, exercise was typically categorized as either supervised (guided by program staff at an exercise facility) or spontaneous (unstructured activity engaged in, at will, during leisure time) (Dishman et al., 1985). But, in an effort to improve adherence rates and still attain the typical training effect, investigators have begun to compromise and provide home-based exercise programs (Gettman et al., 1983; Gossard et al., 1986).

In their study of forty-seven male police officers, Gettman et al. (1983) directly evaluated the effect of "supervision" on conditioning and adherence. After all exercisers experienced four weeks of training under the supervision of exercise leaders at a centrally located facility, the seventeen men in the unsupervised condition were allowed to train on their own at locations of their choice; the twenty men in the supervised condition continued

to meet with the exercise leaders three times a week. Support for the home-based alternative was garnered when, after sixteen more weeks of training, the two groups were compared on a variety of fitness measures and found not to differ. Furthermore, the attrition rate for the unsupervised group (35%) was lower than for the supervised group (45%). Although this difference between the groups was not significant, it was in the predicted direction. A study with a larger sample to increase power seems warranted to further test the premise that home-based programs are advantageous. It should be noted, however, that among those subjects who did drop out of the unsupervised condition, several still reported that exercise took too much time and interfered with their jobs and family life, suggesting that home-based programs are, at best, just a partial solution to the adherence problem.

King and Frederiksen (1984) also conducted exercise adherence research with a more "naturalistic, extraprogrammatic focus" (p. 7). Fifty-eight college women met at an initiation session and received general information on exercise and a jogging schedule adapted from Cooper's (1977) exercise program. All subjects were asked to jog four times a week for five weeks at the indoor university track (The participants were randomly assigned to one of four conditions, three experimental and one control; differences among the conditions will be discussed in more detail below.) Of relevance to this discussion, is the authors' conclusion that adherence in this natural context is comparable to other exercise programs conducted in traditional group programs and probably favorable to adherence rates at follow-up, which may be the more relevant comparison.

Gossard et al. (1986) suggest that their venture in the same direction, among of the first to use individually prescribed but not directly supervised home exercise training to increase functional capacity in middle-aged persons, was also successful. In this study, as in the one cited above by Gettman et al. (1983), the participants could pick the time and the place to exercise. The authors randomly assigned the subjects to one of two conditions--low-intensity or high-intensity. They discovered that VO_2 max improved significantly for

both conditions although the effect was two-fold in the high-intensity group. Of particular interest here, adherence was high in both groups, exceeding 90% at six and twelve weeks. The authors offer several explanations for such exceptional adherence rates, including the biweekly staff-initiated telephone calls to subjects regarding their exercise logs. Although this evidence must be further substantiated, and questions may arise concerning the involvement of the program staff, in terms of time and money, the study by Gossard et al. (1986) provides further support for the notion that the accessibility of the setting is both important and probably malleable.

Social Support

One of the most consistent findings in the exercise adherence literature is the importance of social contact. Several aspects of the "people connection" have been explored in terms of their effect on exercise participation. The considerable literature on social support will be treated as falling into three distinct areas: (1) the effect of program staff, (2) the effect of other exercisers, and (3) the effect of significant others. In fact there is overlap between these categories as often family members exercise with the participant.

Program Staff In a recent chapter reviewing program factors that influence exercise adherence, Franklin (1988) stressed the importance of program staff in general, and the program leader in particular. In fact, Franklin (1984, 1988) has considered the program leader to be the single most important variable affecting exercise adherence. This viewpoint is shared by Oldridge (1977), who described the exercise leader as "the pivot on which the success or failure of a program will depend" (p. 86). Program staff, especially the exercise leader, are said to be useful in educating and motivating the participants (Franklin, 1988; Wankel, 1984; Wilmore, 1974).

These conclusions and recommendations are supported by empirical studies. For example, the results of Heinzelman and Bagley's (1970) study are consistent with the idea that the program staff have a strong impact on adherence. Approximately 380 middle aged men from a metropolitan community and two university settings joined the study; 259 men

were asked to exercise for one hour, three times per week for 18 months, and the rest served as controls. Upon completion of the study, the participants were asked to identify the "best liked feature of the program". The item endorsed by the largest group of men (32%) was organization and leadership.

The study by Andrew et al. (1981) also indicates that staff support is crucial. They investigated reasons for drop-out in the seven year Ontario Exercise Heart Collaborative Study of post-coronary men engaged in exercise programs by administering a questionnaire pertaining to psychosocial and program-related variables to 728 subjects. They reported that one of three categories found to significantly differentiate adherers from drop-outs was perceptions of the exercise program; specifically, drop-outs were significantly more likely to agree that the program staff were impersonal, unreceptive, and provided little individual attention. In a series of studies evaluating different cognitive-behavioral strategies and exercise adherence (Martin et al., 1984), the authors evidence substantiated the beneficial influence of social support by the staff. Furthermore, they found that this positive effect was not enhanced by an attendance lottery technique. It seems that Franklin's (1988) emphasis on the potential importance of "well-trained, highly motivated, innovative and enthusiastic" (p. 249) leaders may well be warranted.

Fellow participants The notion that social aspects of the exercise situation enhances adherence has received wide support (Wankel, 1988). Brawley (1979) has suggested that people may prefer to exercise with others for a variety of reasons, including group identification and commitment, competitive stimulation, and social reinforcement. Another distinction is offered by Knapp (1988) who stresses that other people provide both social support and social reinforcement, which can be viewed as related, yet different, factors. Social reinforcement is usually seen as a concrete event such as verbal praise for participation, whereas social support is a more general concept, representing a favorable attitude toward the participant's exercise program. These more subtle distinctions address questions concerning the instrumental value of others, to be taken up later. Here we will

limit our comments to the evidence that social aspects of the exercise experience influence adherence.

Respondents to the Canada Fitness Study (1983) endorsed the positive influence of others on participation. Both females (25%) and males (18%) indicated that a partner would increase the likelihood of exercising and some also reported that fitness classes would encourage more participation. Wankel (1985) provided further correlational evidence that the group plays a role in exercise adherence; continuing participants displayed stronger social interests, scoring higher on the goal of going out with friends, than did the drop-outs. These reports are consistent with the endorsement of camaraderie by the subjects in the study by Heinzelman and Bagley (1970) described earlier; over one-fourth of the participants reported that this was the best liked aspect of the program. In fact, 90% of the 195 participants who responded said they liked to exercise with a group or other person. Interestingly, at initiation of the study the majority of the subjects did not feel that social aspects of the program were important.

Three more rigorous studies provide even stronger evidence that the group has a positive effect on exercise adherence. In an early study cited previously, Massie and Shephard (1971) compared adherence rates for subjects in a formal YMCA group with individuals following the Cooper (1970) Aerobics program. Their results strongly supported the group condition--47% of the individuals were still active at 28 weeks compared with 82% of the YMCA participants. Although the authors acknowledge that many factors could account for this difference, one quite viable explanation was "associated social contacts and mutual encouragement" (p. 116).

In two later studies (King & Frederiksen, 1984; Wankel, Yardley, Graham, 1985), the effect of others' presence was tested directly as social support was the "intervention" under study. As described earlier, King and Frederiksen (1984) studied the adherence rates of 58 volunteer college women in a natural setting--jogging four times per week around the university track according to their own schedule. The factors under study,

social support and relapse prevention, were evaluated both in isolation and in concert, accounting for the three experimental conditions; in the fourth group, subjects were told of basic forms of exercise and simply requested to jog, served as the controls. King and Frederiksen (1984) reported that social support alone or relapse prevention alone resulted in nearly twice the number of jogging episodes as compared to the control group.

Surprisingly, the condition that received training in both social support and relapse prevention did not perform as well. The authors suggest that this finding may be attributed to the higher level of cohesiveness reported by the social support only group versus the combined group. It seems that simply exercising with others, not by choice and with individuals with whom one may not be compatible, may not produce a beneficial effect. Furthermore, only the relapse prevention alone group continued to demonstrate an advantage at the two month follow-up assessment. This finding is difficult to interpret since it is not clear whether participants who received social support training continued to jog with other people during the follow-up period. In any event, the authors concluded that given the lack of supervision provided to the subjects, and the relatively high requirement of four days of exercise versus three, the results are still encouraging, suggesting that interventions directed at social support are appropriate for promoting adherence.

The investigation by Wankel et al. (1985) supports this recommendation. They compared the adherence rates of subjects in 16 aerobic classes, nine experimental and seven control. The experimental intervention was a structured social support program consisting of family, friend, buddy, group, and leader support. This social support program facilitated attendance ($p = 0.06$), although the effect was only moderate in size. Given the nature of this intervention, it is not possible to isolate out the effect of "other participant" from "significant other" support. However, the evidence provided above, in combination with the review which follows of social support from significant others, suggests that both of these factors may independently, and in combination, enhance exercise adherence.

One qualification should be added here. These findings do not demonstrate that exercising with others is sufficient or even necessary for all people to ensure adherence. For example, experts agree that some people prefer to exercise alone (Wankel, 1988). Also, as described earlier, adherence rates have been comparable (or even superior) when participants are allowed to exercise in a less supervised situation. Unfortunately, this comparison confounds the effect of place, time, supervision and other participants, making interpretation difficult, to say the least. Notwithstanding these qualifications, for many, if not most people, adding a social component to the exercise experience seems to strengthen the probability of participation.

Significant others As with a variety of health behaviors, many investigators are examining the role significant others play in exercise behavior. In general, the evidence suggests that a favorable attitude on the part of significant others, especially the spouse, is positively associated with exercise adherence (Franklin, 1988; Wankel, 1988). Significant others seem to affect adoption as well as maintenance of exercise. In the Canada Fitness Survey (1983), many respondents endorsed the items indicating that family interest or friends' interest would increase their activity level. Kavanagh, Shephard, Doney, and Pandit (1973) reported that one of the main reasons for not taking up exercise was family opposition.

For people who have already started exercise programs, social support from the family, particularly the spouse, and friends appears to have a strong impact on adherence (Franklin, 1988; Knapp, 1988). Several investigators (Andrew & Parker, 1979; Knapp, Guttman, Squire, & Pollock, 1983) have demonstrated that family support contributes to continued involvement in post cardiac exercise programs. The results provided by Andrew et al. (1981) partially supported this work with cardiac exercise programs in that spousal support significantly differentiated drop-outs from adherers; other family related questions, however, did not prove significant. Consistent with this emphasis on the spouse, Mann et al. (1969) found that the men who completed the program had more spousal support (96%)

than did the drop-outs (72%); as calculated by this author, this difference is statistically significant.. Perhaps the most dramatic indication of the importance of the spouse was provided by Heinzelman and Bagley's work (1970) cited earlier. Among the 143 men whose wifes' attitudes toward the program was positive, 80% had good adherence, whereas among the 39 men whose wives' attitudes were neutral or negative, only 40% had good adherence.

The evidence supporting the role of significant others in exercise adherence is not entirely unqualified (Knapp, 1988). As noted above, Wankel and his associates (Wankel, 1984; Wankel et al., 1985) evaluated the impact of a program of structured support including, but not limited to, family and friends, and found it to be effective. However, Wankel (1988) reports that it was in-class support (staff and fellow participants) that proved to be the most valuable components of the program. Other seemingly negating evidence comes from research involving the subjective norm component of the Reasoned Action Model described earlier. In some investigations employing the model, evidence has supported the importance of the values that others place on behavior in relation to exercise intentions (Pender & Pender, 1986) or past exercise behavior (Riddle, 1980). However, in the more rigorous prospective studies (Godin et al., 1986; Godin et al., 1987), the subjective norm component was not predictive of intentions or behavior.

This evidence brings the impact of social support under question, suggesting that important people's opinions may have little influence on exercise behavior. However, another interpretation seems plausible. Perhaps, people have a general sense of other's opinions regarding exercise prior to actual adoption which corresponds fairly well with initial exercise efforts. But attitudes of significant others, and especially the spouse, may change as the actual exercise experience becomes more salient, positively or negatively, for both the participant and his or her social support system. If this is the case, investigations involving assessment of others' attitudes at initiation of exercise and exercise behavior several weeks later would not be addressing the question of how important others influence

one's exercise efforts on a day to day basis. That is, the opinion of others, such as the spouse, may change, and it is these current values which conceivably influence behavior, rather than values held prior to exercise adoption. In any event, the beneficial influence of significant others, especial spouses, has acquired sufficient support for some experts to recommend it as an important component of an exercise program (Franklin, 1988).

IMPLICATIONS

The presentation thus far has been, as promised, utilitarian. That is, I have provided a relatively comprehensive list of the determinants of exercise behavior and accompanying summary comments regarding their usefulness. Intentionally, no particular model of health behavior was identified as capable of encompassing these various, and often linked, components, although many have been briefly described when necessary to provide context for a particular factor. Needless to say, this is not because no one has attempted to tie together the many factors contributing to exercise, or health behavior in general; in fact, in the past ten years, a plethora of models has emerged.

LEVEL OF ANALYSIS

A few models have been developed for the express purpose of explaining exercise behavior. A prime example is the Psychological Model of Exercise, described earlier (Sonstroem, 1984). Models such as these have not been very good predictors of exercise and are, by definition, not applicable to other behaviors and therefore of potentially limited use. Other models, including but not limited to the Health Belief Model (Rosenstock, 1974), the Preventive Behavior Model (Murdaugh & Hinshaw, 1986) and the Health Compliance Model (Heiby & Carlson, 1986) have broader goals; they purport to explain and predict all health behaviors. To varying degrees, these models have met with success, but as I have attempted to show, are either incomplete and/or frequently overlap with each other. At the last level of analysis (for all practical purposes), are the different psychological theories of behavior change underlying all of these formulations. As noted earlier, it seems more parsimonious to examine exercise behavior at this level of analysis, rather than invoking intermediary models.

Before considering the determinants of exercise at this level of analysis, it should be noted, that most recently some authorities (Dishman & Dunn, 1988; Kersell & Milsum, 1985) are advancing a systems approach to the problem. In acknowledging the complexity inherent in explaining behavior, they are attempting to integrate all potential determinants.

Their models attempt to be all encompassing but then, as a result, due to their complexity and eclectic nature, are not easily testable. A complete treatment of these comprehensive models is beyond the scope of this paper.

BEHAVIOR CHANGE

Psychological theories of behavior can be divided into four different approaches: (1) Hullian drive-reduction learning theories, (2) static, global trait, (3) strict S-R variant of behaviorism, and (4) social-learning (Mischel, 1977). The first of these theories, epitomized by the psychoanalytic orientation, has seldom, if ever, been applied to the question of adherence and will not be considered here. The "static, global trait" approach may be viable, however, given the qualified success of the self-motivation construct (Dishman et al., 1980, Dishman & Gettman, 1980). A trait theory such as this one views the main determinant of our behavior as internal, a broad enduring disposition to behave in consistent ways across situations. This approach (as well as drive-reduction theory) employs what Bandura (1986) terms autonomous agency. External forces, such as one's environment, are minimized. Also, the origins and mechanisms of such traits are rarely considered.

Radical behaviorism (Skinner, 1953), often labeled S-R theory, typifies Bandura's concept of mechanical agency, through its focus on external causes. From this perspective, behavior is driven by environmental stimuli, which typically serve either a cueing function or a reinforcing function. Behaviorism has been an influential force in psychology, not just for its contribution to theory but for its application in a variety of treatment situations (Martin & Dubbert, 1982), including exercise adherence. However, the enthusiasm which greeted the behavioral treatment of disorders has diminished with the realization that the efficacy of such purely behavioral treatments is not as strong or as consistent as initially conceived (Brownell & Wadden, 1986).

In recent years, attempts to account for behavior are most likely to invoke a third type of agency, labeled by Bandura (1987) as interactive. Interactive models of human

nature, typified by social learning theory[13] , incorporate both internal and external forces and are, by definition, not unidirectional. Similar perspectives have been advanced as separate and distinct psychological theories. For example, Mahoney (1977) describes cognitive theory as "transcending" the limitations of both traditional psychodynamic and behavior approaches. But, it is generally argued (e.g., Wilson, 1986) that the new emphasis on cognitions in general, and cognitive behavior therapy in particular, is not a "recent conceptual breakthrough of paradigmatic significance ... [but rather a]...more complex cognitive formulation of behavior ...formally ushered in by Bandura's (1969) influential text" (p.4).

It should be noted that not all advocates of social-learning theory abandon the notion of traits altogether, although they may argue as to their origin and/or role as causal factors (Mischel, 1973). However, at least one version of the social-learning perspective, as espoused by Mischel (1973), acknowledges that people do show some consistency across situations. Mischel (1973) insists that no general call to abandon the study of individual differences was intended by the critics of trait theories. Rather, he suggests

> The relative importance of individual differences will depend on the situation selected, the type of behavior assessed, the particular individual differences sampled, and the purpose of the assessment (p.255).

In summary, to account for health behavior (or any behavior) with a social learning approach, the environment is not ignored; rather it is studied vis-a-vis its relation with cognitions and the behavior itself. The basic tenets of behaviorism (Chesney, 1984) are held intact--especially the discriminant cues and the reinforcing or aversive stimuli of operant conditioning. What is added is the mediational component, cognitions, which serve as both stimuli and responses under the principle of reciprocal determinism (Bandura, 1977b).

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13 Although Bandura's most recent formulation (1986) is labeled social-cognitive theory, given the similarity of the two, the more familiar term will be employed.

SOCIAL LEARNING THEORY AND EXERCISE ADHERENCE

Many of the efforts to understand and predict exercise behavior reviewed below have built, implicitly or explicitly, upon this social learning foundation. Unfortunately, however, several of the models presented in the past 25 years contained serious omissions, catalyzing many theorists (Heiby & Carlson, 1986; Sonstroem, 1988; Wankel, 1985) to reconsider such efforts. Experts today are making serious attempts to invoke social learning theory in its entirety to understand and explain lifestyle changes. Although these authors have approached the problem independently, similar criticisms of the exercise adherence literature seems to be guiding many of their formulations.

Specifically, it seems that a consensus has formed regarding two important omissions in previous work; these omissions deserve elaboration. First, experts often agree that models that focus only on one of the three components--the individual's thoughts, the environmental contingencies, or the behavior itself--are inadequate to explain behavior acquisition and maintenance. A corollary of this assertion is the acknowledgement that these factors must be treated as mutually interdependent, not unidirectional. Several of the current theories can be criticized on these grounds. One of the models (HBM) accused today (Heiby & Carlson, 1986) of only focusing on one component (cognitions) of the triad may have done so in keeping with a mini-theory; that is, perhaps no attempt to draw from social learning theory as articulated by Bandura was suggested at the outset. The Health Belief Model was based in part on a value-expectancy framework (Tolman, 1955; Atkinson, 1957) which attempts to describe behavior or decision making under conditions of uncertainty. Briefly, theories based on this foundation state that, if a behavior can be expected to result in a valued outcome, it is more likely to occur. Such theories of motivation, drawn mainly from Lewin (1935), although not inaccurate per se, may be too static as they focus primarily on beliefs about incentives rather than on actual consequences of the behavior. This is attested to by the many

refinements of the model described above. Despite the intentions of the model's initiators, additions, such as "cues to action" and "incentive to behave" began the trend of adapting the model, until it became a special case of social learning theory (Rosenstock et al., 1988), applied only to health-related behaviors. In becoming so elaborate, it no longer simplifies predictions and thus seems to add little to our understanding of exercise that was not already provided by an appropriate application of social learning theory itself.

Even the Reasoned Action Model (Fishbein & Ajzen, 1975), the model of health behavior that currently seems to receive the most support (Sonstroem, 1988), also does not improve on social learning theory. It has been praised as comprehensive and sufficiently general (Sonstroem, 1988) to encompass any relevant beliefs, with no need to specify them within the model. Again, however, this accounting of the relationship between attitudes and behaviors may be inadequate in situations when the goal is to explain distal behavior. Also, there is no attempt to include the behavior's influence on the attitude, a requirement of the interactionist position.

The current enthusiasm for self-efficacy and its predictive utility is part of and thus would seem to be directly supportive of social learning theory. As conceptualized, and frequently tested, self-efficacy influences our behavior, and in turn, is influenced, avoiding the criticism of "unidirectionality". Ironically, however, an important qualification, made first by Bandura (1977a), is that self-efficacy only becomes the mechanism of change when sufficient incentives exist. As mentioned previously, this caveat has been frequently ignored. That is, investigators have begun to concentrate solely on self-efficacy, to the exclusion of basic learning principles, such as reinforcing and punishing consequences. It seems that it has been difficult to apply the social-learning model in its entirety.

The second note of disapproval consistently made in the literature is in some ways even more crucial to understanding behavior change. It is frequently suggested that behavior change must be viewed as a dynamic, not a static process; determinants influential at one point in the change process are not necessarily effective later (Dishman, 1982).

Moreover, the process is not irreversible; people can go through the same stages more than once (Marlatt & Gordon, 1980).

The first comment, essentially a call for a "stage" approach, comes from many disciplines. This notion has just recently begun to be addressed in the exercise adherence literature (Dishman, 1982; Oldridge, 1984). In 1982, Dishman provided evidence concerning two related points to support his assertion that distinct behavioral events or stages do exist. First, he noted that exercise adherence across time can be depicted as a "negatively accelerating function" (p. 238) with a characteristically rapid 50% dropout rate within three to six months of adoption; second, the adherence rate subsequently stabilizes. Thus he concluded that at the very least a distinction between short-term (e.g., 1-6 months) and long-term (after 6 months) adherence should be made. Unfortunately, Dishman (1982) noted, it is difficult to evaluate the mediating influence of time because

> "few exercise studies have even addressed temporal distinctions ...most studies have viewed adherence in dichotomous terms of adherers and drop-outs or as a continuous variable based on the total time period...or on behavior volume...Thus findings which bear on stage and interaction issues [thus far] must largely be inferred from cross-sectional comparisons." (p. 256)

Dishman's request for appropriate longitudinal studies, implicit in this footnote, is made explicit in the "research priorities" section at the end of his review. Today, most authorities agree with this request, acknowledging that adoption and maintenance are distinct.

Experts today not only assert that there are multiple stages of behavior change, but also the need to address repeated travel through these stages. Indeed, it is common knowledge that some people who adopt a behavior don't maintain it, and of those who have reached "maintenance", some still quit. Thus it is important to think of behavior change as a series of steps, which, for many people, have to be repeated more than once.

In recent years this thinking has become quite explicit, especially in the area of addiction; for example, Brownell et al(1986) highlight this point in their review of the "lapse-relapse" process for three addictive behaviors--obesity, smoking, and alcoholism.

Others have also acknowledged that there are stages of change as in Prochaska and DiClemente's (1983) integrative model of change for smoking cessation involving five steps: pre-contemplation, contemplation, action, maintenance, and relapse.

In response to acceptance of this "relapse" process, a treatment has been developed and applied to a variety of behaviors, including exercise. This relatively new technique, the relapse prevention approach, has received considerable attention in recent years that cannot be included here (see Marlatt & Gordon, 1980; Marlatt & Gordon, 1985). Suffice it to say that the model addresses directly the long term maintenance of new health behaviors. The focus of the technique is to help people focus on coping strategies designed to reduce the risk of an initial lapse and prevent a lapse from escalating into total relapse. In the exercise situation, the model is further extended as the behavior under consideration is one of adoption rather than abstinence. The significant, albeit moderate, effect provided by application of this technique in exercise settings (Belisle, Roskies, & Levesque, 1987; King & Fredericksen, 1984; Martin et al., 1984) provides preliminary support for the advantage of approaching exercise as an ongoing process that varies from situation to situation and time to time.

Given the preceding analysis, an updated application of social learning theory to exercise (or any health behavior) seems warranted. To understand and predict exercise adherence, several considerations have emerged. First, although the person's expectancies regarding benefits and barriers should not be ignored, neither should they be considered in isolation, ignoring the performance of the behavior itself and the immediate consequences. Second, all three factors--cognition, behavior, and the environment--are interactive and thus mutually determining. Finally, exercise behavior must be viewed as a dynamic process with determinants that vary across people, situations, and the current stage of behavior change. At first glance, these factors seem so global and vague as to be unmanageable. However, a closer examination of the exercise literature provides a possible solution.

Consistent with the previous discussion, many investigators (Heiby & Carlson, 1986) have agreed that no one specific factor, such as the type of activity, or even set of factors, such as the entire exercise prescription, can explain exercise behavior across people, situations, and times. But the one principle that does seem to be consistent across all of these domains is the law of effect. That is, aspects of the exercise experience that are rewarding increase the probability of exercise whereas those that are aversive, decrease the likelihood. For different people or at different times, the reinforcing stimulus can be internal, as in pleasure, or external, as in goal accomplishment, and it can be effective during adoption but not during the maintenance stage or vice versa. Without having to specify what factor is or is not reinforcing for all persons a priori, a general cost/benefit analysis should prove fruitful.

The concept of applying cost/benefit analysis to exercise behavior has been suggested, both implicitly and explicitly, in the recent literature. Several of the theoretical developments described above incorporated barriers and benefits, indirectly invoking at least a partial cost/benefit analysis to the question of adherence. This would include the perceived benefits and barriers of the HBM, many of the beliefs that form attitudes in Reasoned Action Theory, and the benefit and barrier scales in Murdaugh and Hinshaw's (1986) prevention behavior model. As noted in the preceding review of the literature, it was often these components of the models that were the best predictors of exercise adherence. More formally, several investigators are directly approaching the problem of adherence by essentially establishing the importance of weighing the pros and cons.

Heiby and her associates (Heiby & Carlson, 1986; Heiby, Onrato, & Sato, 1985) present a theoretical formulation that exemplifies the approach advocated here. Notwithstanding the label that they apply to their work ("Health Compliance Model"), Heiby and Carlson's (1986) conceptualization was framed within a social learning perspective and in many ways mirrors the organization of factors presented in this paper.

Components of their model are divided into the "individual" (internal) and the "environment" (external). Within the external category, Heiby and Carlson (1986) identify some factors as serving a situational-cueing function (e.g., accessibility of the facility) and others serve as one of two types of consequences--rewarding ones (e.g., social support) or punishing ones (e.g. discomfort during exercise).

Although the examples just provided are specific to exercise, Heiby and Carlson (1986) make the point that the "Health Compliance Model" (read here as social learning theory) is general enough to be applied across behaviors.

> "It is reasonable to assume that specific conditions relevant to one type of compliance may not be relevant to another...Underlying these factors, however, are the subjective and objective punishing and rewarding aspects of compliant behavior." (p. 134)

The authors suggest that their approach to the adherence problem differs from strict functional analysis (Melamed & Siegel, 1980) because of its acceptance of subjective perceptions of antecedents and consequences to one's behavior. It seems that this is the demand to acknowledge the mediating influence of cognitions, a tenet of social learning theory. They also contrast their approach to the HBM, noting the lack of attention to environmental consequences as a serious omission; again, this is in agreement with social learning theory's rejection of a simplistic model, in which attitudes impact behavior, but are not in turn influenced by the consequences of the behavior.

Thus, to Heiby and Carlson, an appropriate cost/benefits analysis involves a weighing of both the objective and subjective antecedents and consequences of the health behavior. With this formulation in mind, the exercise adherence literature just reviewed should be reassessed. Each of the individual determinants previously discussed can be reframed according to its potential reinforcing or punishing effect; some of the factors will now be considered as either a cost or a benefit.

Costs

As alluded to earlier, a variety of factors, both objectively and subjectively, act as barriers to exercise. The following list of possibilities, offered by Knapp (1988), although quite lengthy, is undoubtedly not exhaustive.

> "New exercisers are subject to boredom, discomfort, fatigue, muscle soreness and injuries; to shame and embarrassment at bodily exposure; to anxiety about time taken away from work or family; to foregoing pleasurable activities; to real and imagined negative attention from those more fit than they; to ridicule, harassment, hostility, and even fears for their personal safety." (p. 212)

This description is consistent with many of the empirical findings cited above. Knapp (1988) asserts that to build the activity habit, it is essential to eliminate or reduce these naturally-occurring punishing consequences of exercise. Notwithstanding the past emphasis on individual and situational differences, it is probably safe to say that three general classes of these natural barriers exist: inconvenience, discomfort, and, a third category that, for lack of a better term, I will label disinterest.

The inconvenience issue has surfaced repeatedly in the literature. As noted earlier, interventions designed to make exercise more accessible in terms of location and time are clearly indicated. This barrier to action seems to affect both adoption and maintenance of exercise. The recent effort to provide a structured but not directly supervised (i.e., not face to face during the exercise period) program is an innovative technique that seems to be meeting with success. Nevertheless, experts acknowledge that providing a convenient program, although usually necessary, is still not sufficient to ensure adherence (Wankel, 1988).

The second general barrier to exercise is the discomfort that is often linked with it. Some people associate exercise with pain and fatigue, either based on their own exercise history or from their perception of others. This subjective assessment of the aversive qualities of exercise may be sufficient to prevent initiation. Additionally, independent of their anticipations, people may directly experience exercise as difficult, painful, or tiring, and/or they may experience continued discomfort for the 24 to 48 hour period following an

exercise bout. These factors are likely to be more salient for many than the long-term health benefits, promised by experts.

Lees and Dygdon's (1988) learning theory conceptualization bears directly on the likelihood that the immediate proprioceptive consequences of exercise are potentially aversive. In accordance with common sense, these authors acknowledge that negative feedback from the muscle, tendons, and joints involved in exercise can be perceived as punishing; however, they assert that this is not inevitable. They interpret the work of Dulany (1968) as evidence that aversive stimuli can function as positive reinforcers, under certain conditions. For example, if the mild aversive stimulus indicates that the "task" of exercise had been done correctly, it may function as a reinforcer. Lees and Dygdon (1988) go on to argue against the social learning interpretation of this effect, that "the information a stimulus carries overrides its reinforcement or punishment value" (p. 249) and offer a more "parsimonious" explanation--the aversive stimulus, muscle fatigue for example, becomes a conditioned reinforcer as it is tacted (No pain, no gain) with improvement in physical condition. Independent of the mechanism, the authors note that either explanation rapidly loses its appeal as the intensity of the aversive stimuli increases. They comment, "Consistent with this would be the prediction that new exercisers who meet with extreme discomfort, either immediately after exercising or some short time afterwards, will most likely discontinue" (p. 349). It seems that mild to moderate discomfort can be tolerated, and even reinterpreted as positive, but when the pain is too intense, (a subjective perception, by definition), adherence is curtailed.

The last class of barriers to action is lack of interest. That is to say, exercise may be made optimally convenient and not aversive and still not exert any pull on the individual. Considerable evidence for the importance of this point emerged in the preceding review of the literature. Many investigators reported that a primary reason for dropping out of an exercise program was lack of interest (Bruce et al., 1976; Oldridge et al., 1978), lack of desire (Slenker et al., 1984), or lack of enthusiasm (Gettman et al., 1983). Another line of

research also supports this notion, albeit less directly. Investigators (Fishbein, 1980) have begun to examine the importance of competing alternatives to exercise, as opposed to examining physical activity in isolation. This admonishment to focus on the influence of competing activities can be interpreted as evidence that for many, exercise, even if not negative, does not have sufficient appeal. With this in mind, it becomes important to identify the potential reinforcing consequences of exercise, many of which seem to go untapped.

Benefits

The benefits typically attributed to regular exercise are quite extensive. One convenient way of classifying them is to consider them along two dimensions. First, positive consequences of exercise can be categorized as natural reinforcers or as artificial. Natural, here, should be interpreted as all primary or innate reinforcers (e.g., fun) and also some secondary, or learned, reinforcers, (e.g., improved looks), if they occur naturally following the exercise experience. Artificial reinforcers, here, encompass reinforcers that are contrived by the exercise staff, significant others, and/or the person doing the exercising. Second, reinforcers vary along a time continuum from distal to proximal. The argument that will be made here is that proximal, primary reinforcers are probably most effective to achieve optimal exercise adherence.

The positive outcomes most commonly attributed to exercise are distal, the associated health and fitness benefits. As noted earlier, it is well accepted that exercise is effective as a preventive as well as therapeutic measure, especially in terms of cardiovascular risk. Independent of the health association are other physical and natural reinforcers associated with exercise, some more distal than others, such as cosmetic benefits (e.g., improved skin, better muscle tone, weight loss) and improved overall functioning (e.g. more efficient performance of daily and/or leisure activities). As indicated earlier, many people who initiate an exercise program list the above reasons as their impetus (Heinzelman & Bagley, 1970; Wankel, 1985). However, evidence cited earlier

indicates that such distal rewards are insufficient to maintain the behavior. This is especially true if there are extensive associated "costs" of exercise as just described.

In an effort to lessen the distance between the behavior and the reinforcer, many investigators have designed a variety of interventions aimed at enhancing exercise adherence by providing more proximal, but typically artificial, reinforcers. A very common technique that has been successful has been to reward exercise behavior with money (Turner, Polly, & Sherman, 1976), sometimes through attendance lotteries (Epstein, Wing, Thompson, & Griffin, 1980), tokens (Libb & Clements, 1969), or smiley faces (Kau & Fischer, 1974). Alternatively, aerobic points could be spent to earn back prized possessions or assure that they were not taken away (Turner et al., 1976; Wysocki, hall, Iwata, & Riordan, 1978) (technically, these last mentioned procedures invoked negative, not positive, reinforcement). In some interventions, the reinforcement technique has been controlled by the subject. That is, a client self-administers freely-accessible reinforcers contingent upon requisite performances (Bandura, 1976).

The techniques described above often enhance activity levels and, in some cases (Libb & Clements, 1969) this improvement was maintained. Nevertheless, it is difficult to generalize from these studies since many were based on a very small sample size (e.g., Turner et al.'s often referenced study involved only one participant), and some did not include a control group, or failed to assess the participants during a follow-up phase. Moreover, many experts today (Wankel, 1988) advocate the use of more "naturally occurring" reinforcers (primary) so that the activity will be maintained even after termination of the program.

In response to such criticisms, some investigators began assessing the effect of social support. The support provided by the spouse, clearly important, as indicated earlier, may fall into this category of primary or natural reinforcers. Unfortunately, the studies evaluating spousal support and exercise have typically not quantified the spouse's contribution, making it difficult to assess the mechanism involved. Other work, evaluating

the effect of supportive staff or fellow participants, however, can be considered as a reinforcing consequence of exercise. The investigations reviewed earlier (King & Frederiksen, 1984; Wankel et al., 1985) found that companionship from others or structured support from the staff and other participants did seem to have a positive impact on adherence. Whether these reinforcers would occur naturally without being manipulated by the researchers remains to be seen.

In a series of controlled studies in which verbal praise alone was evaluated, Martin et al. (1984) reported successful enhancement of activity; furthermore, a lottery reinforcement strategy did not add to the effectiveness of an individualized-feedback strategy. Unfortunately, this latter comparison confounded the timing of the reward (short-term versus immediate) with the type of reward, money (artificial) versus praise (natural). In a separate study, however, holding quality of the reward constant (praise), the immediate individualized reinforcer was more effective than a general short-term reinforcer. Martin and Dubbert (1982) report these findings as follows:

> "praise during exercise resulted in superior program attendance...than standard group-based feedback/praise following exercise. Three-month follow-up revealed that 54% of the individualized praise/feedback group were still jogging whereas only 17% of those in the standard group had continued to exercise." (p.1010)

Interpretation of this comparison should be qualified since the difference in adherence could be attributed to individuality of the praise as opposed to the timing of it. Notwithstanding this flaw in the design, it seems undeniable that social aspects of the exercise session per se may be positively reinforcing.

One way in which such social contact may reinforce behavior is by making it more enjoyable. The importance of this enjoyment factor cannot be overstated. It has been repeatedly demonstrated that drop-out is often attributed to lack of enjoyment (Martin et al., 1984; Wankel, 1985). Studies cited earlier demonstrated that drop-outs could be differentiated from adherers on the basis of enjoyment. In fact, there is a strong movement

afoot to motivate people to exercise because of recreational benefits (Wankel, 1985), attested to by articles such as "Let's put the fun back into fitness" (Ferris, 1985).

The question at hand is what makes exercise enjoyable? Whether there is a biological explanation for the pleasure associated with exercise (e.g. endorphin hypothesis; Colt, Wardlaw, & Frantz, 1981) or whether it is purely "psychological" is not clear. Experts (Shephard, 1988) however, are fairly certain that the level of exertion necessary to achieve biological benefits is not easily achieved; certainly it is unlikely for the novice exerciser. Nevertheless, many maintain that there are several immediately reinforcing consequences of exercise, even without invoking the endorphin hypothesis. Dishman (1982) describes the many reasons that people may be "addicted" to exercise as follows:

> "...adherence might be explained regardless of the source of particular reinforcements for staying with exercise. An exerciser might become dependent on interpersonal relationships within the exercise setting; dependent on subjective feeling states corresponding to reduced tension, anxiety, or mood elevations; or dependent on direct biochemical changes such as elevations in endorphins." (p. 253)

Thus, some of the determinants of exercise adherence described above, such as social contacts and reinforcement, can be seen as naturally-occurring reinforcers, contributing to the "fun" of the activity.

One last reinforcer deserves attention; for some, the exercise experience in and of itself is enjoyable--it may be the most immediate and intrinsic reinforcer of all. Intrinsic reinforcement, briefly mentioned before, has an extensive history (Csikszentmihalyi, 1975; Deci, 1975) that can only be touched upon here. White (1959) asserted that effectance motivation is defined as the urge to perform an activity simply to produce the desired effect. Harter's work (1981) modified this principle; the process of striving to achieve the goal, regardless of whether it is achieved, may be seen as intrinsically rewarding. In her formulation, perceived competence was an effective predictor of behavior specifically because it made the activity more intrinsically enjoyable. For people who benefit from a

sense of accomplishment, i.e., setting exercise goals and working to achieve them, White and Harter's concepts seem directly relevant.

Deci (1975) also made several contributions to our understanding of intrinsic motivation. He maintains that humans have a basic need to experience themselves as self-determining and competent which results in seeking out challenging situations. A major contention of Deci's (1972; 1975) of direct relevance here is that the provision of secondary reinforcers following a behavior that was intrinsically reinforcing is problematic. According to Deci, a person no longer sees value in an activity (i.e., no longer sees it as self-determined) if someone deemed it necessary to add extrinsic reinforcement. Although Deci's focus was on academic achievement, the principle has been applied by many scholars to a variety of activities. In fact, an entire book (Lepper & Greene, 1978) has been devoted to the topic--"The hidden cost of reward; new perspectives on the psychology of human motivation". If this reasoning is correct, recent suggestions to wean people from secondary reinforcers before program termination is probably justified.

The subject of intrinsic motivation has also received considerable attention from Csikszentmihalyi (1975). He maintains that intrinsic enjoyment of a behavior is derived by attainment of "flow"-the optimal level of challenge from the engaging experience.Although this elusive "flow" experience may not be sought and/or accessible to all people, the suggestion to maximize the naturally reinforcing qualities of exercise seems worthy of attention. As opposed to the other targets of lifestyle change, such as dieting and smoking cessation that are typically aversive initially, making secondary rewards the only proximal reinforcement possible, exercise behavior has the advantage of providing immediate reinforcement. Wankel (1988) made a similar point with the comment "The fact that optimum challenge and immediate feedback are intrinsic in most sport situations makes sport an excellent source of enjoyment and intrinsic motivation" (p. 385). The challenge then is to increase the probability of realizing the potential inherent in exercise.

The foregoing discussion of the potential costs and benefits of exercise has direct applicability to efforts to understand and improve adherence. In keeping with social learning theory, by focusing on the immediate consequences of the exercise experience and designing interventions that maximize benefits and minimize costs, objective or subjective, exercise maintenance should be enhanced. On the other hand, as mentioned before, other conceptualizations have been considered, notably the trait approach, typified by Dishman's construct, self-motivation. Advocates of this approach suggest that further research efforts are necessary to enhance our understanding of this potential determinant of exercise adherence. They recommend its use both as a prediction and screening device with subjects identified as low in self-motivation being provided with additional extrinsic reinforcement, such as group support. Furthermore, other investigations could be carried out to examine how this factor interacts with other personal and setting variables (Sonstroem, 1988). To date, there has been only limited comparison of these two theories.

STATEMENT OF THE PROBLEM

From a trait perspective, enduring qualities of the person, drive his or her behavior. A general measure such as the Self-Motivation Inventory (Dishman et al., 1980) captures aspects of the individual that are purportedly applicable across situations and across time. Whether Dishman and his colleagues have demonstrated that the construct exists may be debated as they have only applied their inventory to the same people across time, but not across situation. Nevertheless, the inventory seems to represent a trait-like approach in its generality and some nomological validation was presented (Dishman et al., 1980).

In contrast, social learning theory views behavior as a function of ever changing circumstances, including cognitions and the environment. According to this approach, the effect of enduring qualities that motivate us, if they do exist, are not strong enough to overcome the idiosyncrasies of the situation, making global measures of personality for prediction of future behavior not very useful (Mischel, 1973). To this author's knowledge, there has been no prospective study comparing these two competing theories in the effort to predict exercise adherence. However, two previous investigations do bear on this question.

As alluded to earlier, Edell et al. (1987) compared the predictive power of self-motivation with self-efficacy in a weight loss program. Neither of the constructs was related to number of sessions attended. Self-efficacy was significantly associated with weight loss, both actual (32% of the variance) and adjusted (8% of the variance); however, self-motivation was not related to either of these outcomes. The authors suggest that the inability to predict attendance could be due to the lack of variance in this variable; 95% of the subjects attended 70 to 100% of the meetings. This study provides tentative support for social learning theory as opposed to a trait approach. However, these interpretations are limited because only one component of social-learning theory (self-efficacy) was examined

and no actual dieting behaviors were measured so the power of either determinant to test adherence to a health behavior per se was not evaluated.

The study most directly relevant to the current research was reported by Wankel et al. (1985). These authors compared three approaches to explain exercise behavior--a person perspective, a situationist perspective, and the combination of the two, termed the interactionist perspective. This comparison in many ways mirrors the present goal of comparing a trait theory with social learning theory. According to Wankel et al. (1985), stable, enduring characteristics, such as self-motivation, clearly fall within the person perspective. Environmental consequences, positive or negative, belong to the situationist camp. Social learning theory, however, treats cognitions in general--attitudes, thoughts, beliefs--as also pliable and therefore neither stable enough to be part of the person perspective nor external enough to be a situational determinant. Apparently the comparison of interest to these authors was to gauge the relative impact of internal variables (state or trait) with external variables (environmental) and the interaction of the two. This classification makes it difficult to directly compare the effect of a trait approach with a pure social learning approach. Nevertheless, Wankel et al.'s (1985) work is similar enough to the proposed research to warrant examination of their results.

In the first of the two studies reported by these authors, the 52 subjects were adult females who had voluntarily registered for a community based physical fitness program. Wankel et al. (1985) represented the person perspective by administering the Self-Motivation Inventory to these subjects after the first class meeting. Subjects were dichotomized into high and low SMI levels and then within each group, subjects were matched and randomly assigned to a treatment or a control condition. The treatment consisted of administration by telephone call of a balance sheet grid following a basic procedure suggested by Hoyt and Janis (1975). The subjects in this treatment condition were asked to record anticipated gains and losses (i.e., perceived costs and benefits) by identifying instrumental gains and losses to the self and to significant others, and approval

or disapproval from the self or others. This balance-grid sheet approach had been found to produce significantly better attendance at a fitness club than a standard telephone call condition and was comparable to a self-persuasion (gains only) condition (Wankel & Thompson, 1977). Consistent with these results, Wankel et al. (1985) reported a significant effect due to the balance-sheet but no main effect of SMI or significant interaction of the balance sheet with SMI.

In their second study, the investigators enhanced their power by increasing the sample size (N=186) and trichotomizing the SMI inventory. The subjects were females who attended the first session of a 10 week community based aerobic dance program. The treatment consisted of a structured social support program highlighted by a booklet instructing participants on how to structure their social environment, including family, friend, buddy, group, and leader support, to facilitate regular adherence to the exercise program. Participants were also provided with charts to monitor their attendance and social support. Again, the treatment, in this case social support, facilitated attendance but there was not a significant main effect of SMI level or the interaction of the two. The authors interpreted the findings from the two studies, with some qualifications, as support for the situationist perspective.

This interpretation deserves reassessment. Although the manipulation of social support does constitute an environmental effect, the balance-grid could be perceived as a technique that made cognitions, perceived benefits and costs, more salient for the participants. Either interpretation, however provides support for social learning theory. It seems safe to say that both types of situational features, thoughts and the environment, positively influenced adherence. It is less clear that the self-motivation concept received an equally fair test. It is surprising that the authors chose to categorize the subjects by self-motivation level (a continuous variable) since it is generally not good practice given the inevitable attenuation of the relationships being examined.

Other limitations of the study should be noted. First, it is generally recommended (Martin & Dubbert, 1982) that adherence be measured in terms of the proportion of the exercise prescription that was achieved, rather than a simple attendance count. In fact, Wankel et al. (1985) noted that the significant differences notwithstanding, the treatment effect was weak, with none of the groups attending very frequently. Second, the exercise programs in the two studies were relatively short in duration (5 and 10 weeks respectively). Third, no follow-up was provided. Finally, the test of the social learning model, in terms of reciprocal determinism, was not complete. In the first study, the authors only evaluated the effect of the subjects' perceptions of anticipated costs and benefits of exercise. They did not then measure the actual consequences of the exercise experience and how these consequences, in turn, influenced the subjects' perceptions and subsequent exercise behavior.

The present research study is intended to address several research questions prompted by the discussion above. First, on an applied level, it seems important to establish the size of the effect of self-motivation and self-efficacy as independent predictors of exercise adherence. Interventions designed to have an impact on either or both of these constructs are only warranted given sufficient effect size. Relevant analyses would allow us to compare the predictive power of these two constructs simultaneously. This comparison addresses the theoretical question of the efficacy of general traits in predicting behaviors, as opposed to Bandura's contention that specific and time-limited aspects of the environment and one's cognitions are more powerful in predicting subsequent behavior.

Second, it can be argued that cognitive-behavioral interventions are not "lacking" because they are based on an inadequate model (social learning theory), but rather may represent incomplete applications of the model. That is, self-efficacy may be a necessary condition of exercise behavior, but it is not sufficient, given inadequate incentives. Reinforcers which occur after the bout of exercise may have been too distal to be effective (i.e., the positive consequences of exercise may need to be immediate.) Moreover,

potential aversive stimuli, such as perceived exertion and/or inconvenience, must be minimized. To the degree that perceived exertion, enjoyment, and convenience (PEEC) are related to exercise adherence, after holding "self-motivation" constant, the social learning theory of human nature is supported.

Finally, by carefully measuring exercise adherence at several points in time as a continuous variable, the present study can examine the question of differential effects of PEEC, individually and combined, across time or exercise stage. Furthermore, the influence of PEEC at different stages of the adherence process, for individuals with varying levels of self-motivation, can also be evaluated.

The research hypotheses driven by the preceding discussion are as follows:

(1) Is self-efficacy, a situationally-defined construct, a better predictor of exercise adherence than the general construct, labeled by Dishman as "self-motivation"?

(2) Will more immediate aspects of the exercise experience (PEEC) contribute significantly to explaining the variance in exercise adherence, independent of the variance explained by self-motivation?

(3) Will the effect of self-motivation and/or "PEEC" on exercise adherence vary as a function of time (months of participation)?

METHODS

CONTEXT

This study has been carried out in collaboration with researchers at the Stanford Center for Research in Disease Prevention. They are conducting a community-based randomized controlled trial investigating the effects of different exercise regimens on coronary heart disease risk factors with subjects recruited from a northern California community, (Sunnyvale). Thus the larger project of which this study is but a part, is referred to as the Stanford-Sunnyvale Health Improvement Project (SSHIP). Only data from the first year of this two -year project are reported here.

SUBJECTS

RECRUITMENT

To be eligible for this study, subjects had to be sedentary, healthy (i.e., no diagnosed CVD) residents of Sunnyvale, male or female, age 50 to 64. Two strategies were employed to recruit subjects: a random digit-dial telephone procedure and a city-wide promotional campaign. The numbers for the telephone procedure were obtained from a computer-generated random list of available numbers in the Sunnyvale community. From the original list of approximately 50,000 numbers, commercial and nonfunctioning numbers (approximately 30,000) were eliminated. The remaining numbers were contacted to determine if any resident, age 50 to 64, was living in the household. When an age-eligible person was identified, he or she was requested to participate in a 20 minute survey (See Appendix A) regarding health habits. If more than one age-eligible person resided in the household, one person was initially selected to be interviewed through a random allocation procedure based on gender.

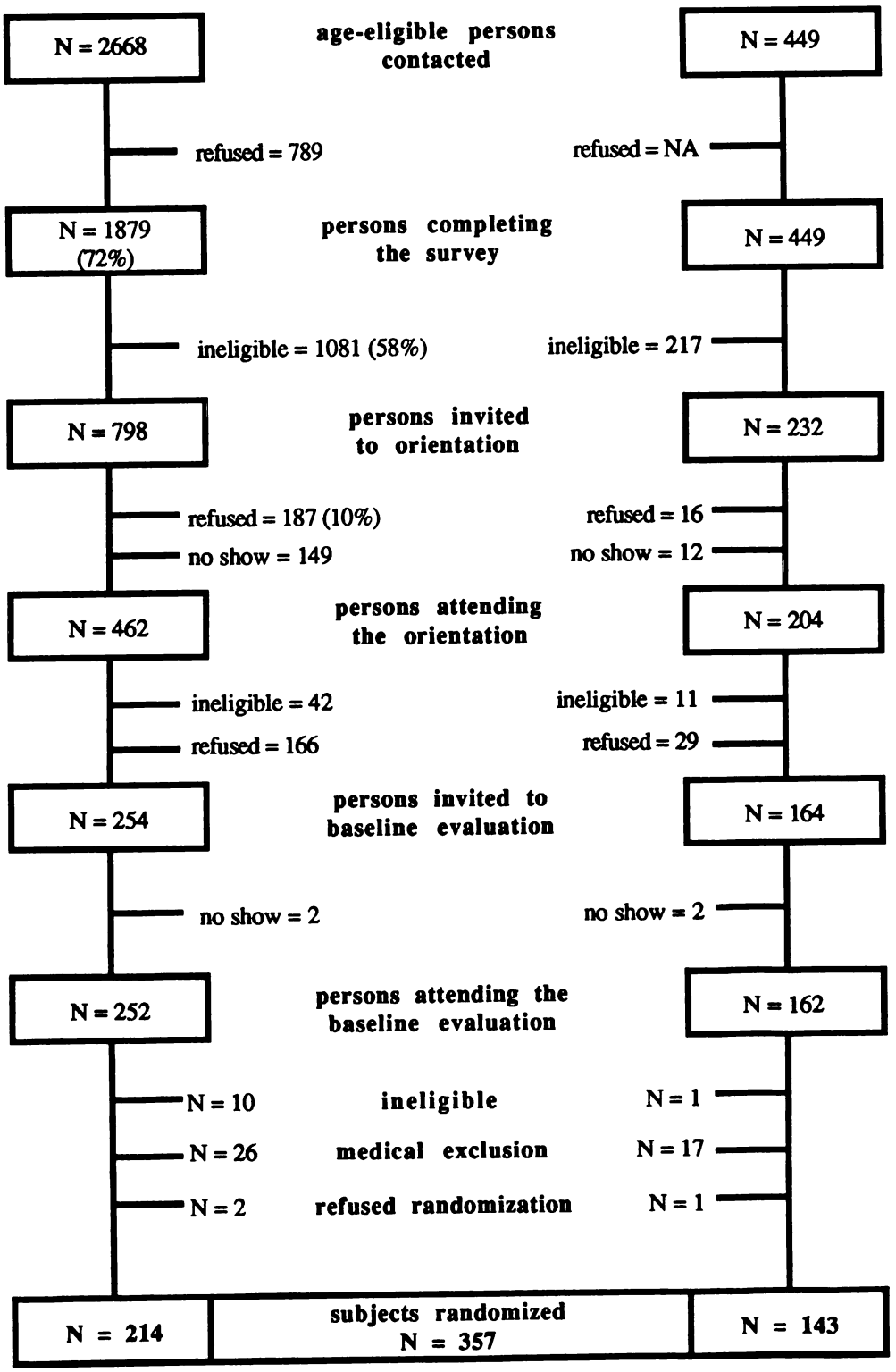
At the completion of each telephone interview, a preliminary decision was made concerning the eligibility of the subject based on medical history, medication use, post-

menopausal status in women, and current activity status. Eligible subjects were invited to attend an orientation session conducted weekly in Sunnyvale where the project was explained in more detail. Of those subjects who completed the survey through this recruitment strategy, approximately 50% were found to be ineligible and approximately 10% declined further participation. Despite the large number of calls (approximately 20,000) that were made, the rate of recruitment was slower than anticipated (see Figure 1), making a second recruitment strategy necessary.

Additional male and female volunteers were sought through a city-wide promotional campaign. The multi-media campaign (newspapers, posters, presentations, etc.) solicited eligible persons based on the same criteria as the random telephone procedure. Volunteers who responded to this strategy were interviewed with the same survey as the telephone sample and, through the same process, eligible applicants were invited to the orientation sessions. Of the individuals ultimately randomized into the clinical trial, 214 (60%) were initially contacted through the telephone survey and 133 (40%) were reached through the city-wide promotion. Analyses of these data indicated that there were no major demographic differences between the two groups and the procedures for subjects recruited by both approaches were the same for the remainder of the study. Therefore, the following discussion will treat the subjects as a single group; the breakdown by recruitment strategy is available in Figure 1.

Of the 1030 subjects deemed eligible for the study, 666 attended the weekly orientations held from October of 1986 until September of 1987 where both the project and the eligibility requirements were discussed more thoroughly. Following orientation, 53 more participants were ruled ineligible and an additional 195 subjects chose not to participate, bringing the sample size to 418. All but four of the subjects who agreed to be in the project attended the baseline evaluation, explained below. At the baseline evaluation, eleven more subjects were ruled ineligible, forty-three were excluded for medical reasons, and two refused to be randomized, resulting in the final sample size of 357.

Figure 1: Recruitment of Study Participants for SSHIP



DEMOGRAPHICS

In the final sample of 357 participants randomized into the clinical trial, 55% (197) were male and 45% (160) were female. The average age for both sexes was 56.6 (SD = 4.25). The majority of the sample were married (65%), 18% were separated or divorced, 8% were widowed, 6% were single, and 3% were missing this data point. The subjects were primarily Caucasian, with only 12% indicating a different ethnic background, and fairly well-educated, with the average years of education being over 15 (three years of college). Approximately 75% of the subjects were employed. Eighty percent of the subjects reported an average annual household income of $25,000 or higher. In general, the subjects appear to be a representative sample of the community from which they were drawn i.e., primarily white, older adults of a relatively high socio-economic status. Generalizations of the findings of this report should be limited to the corresponding population.

PROCEDURES

OVERVIEW

The SSHIP researchers focused on two general objectives: (1) questions concerning the efficacy of exercise in terms of physical health and (2) questions concerning biological, social, and psychological determinants of exercise adherence. The two determinants of particular interest in terms of both health and adherence outcomes were the exercise intensity and the exercise setting (i.e., a traditional exercise facility versus a home-based program). To make the relevant comparisons, four conditions for the first year of this clinical trial were established: (1) Assessment-only control, (2) High intensity group condition, (3) High intensity home-based program, and (4) Low intensity home-based program. Randomization was performed using a computerized version of the procedure described by Efron (1971). This approach insured a reasonably equal sample size in each condition. Subjects were stratified by gender and smoking status, with randomization for

each subject recruited by the two procedures performed separately. The subjects were randomized to condition following baseline evaluation. As the interventions are not of central interest to the study reported here, they are described only briefly below. Participants were followed for one-year with evaluations (described below) at baseline, six months, and twelve months. During the first year, eight subjects discontinued participation in all aspects of SSHIP including six month and twelve month evaluations; thus, the analyses performed for this report were based on a working sample of 349 subjects.

EVALUATIONS

At baseline, six months, and one-year, the subjects came into the clinic and completed a battery of tests. The physiological measures are listed in Figure 2 and the relevant ones (i.e., those involved in the data analyses) are described in detail in Appendix B. It should be noted that while on the treadmill, the subject gave a continuous rating of his or her perceived exertion described below. Among the twelve psychological measures administered at baseline (e.g., The Beck Depression Inventory; The Perceived Stress Scale, etc.) the two of particular relevance to the current study were the Self-Motivation Inventory (Dishman et al, 1980) and a self-efficacy scale. Following the guidelines set by Bandura (1977), the items for the latter scale were developed specifically for this study. Both of these measures were administered again at one year.

Figure 2: Physiological Measures at Baseline, Six-Months, and Twelve-Months

Procedure	Baseline	Six-Months	Twelve-Months
Informed Consent	X		
Medical Examination	X	X	X
Resting Blood Pressure	X	X	X
Anthropometrics[1]	X	X	X
Hydrostatic Weighing	X		X
Expired Air Carbon Monoxide	X	X	X
Plasma Thiocyanate[2]	X	X	X
Treadmill Exercise Test	X	X	X
Type A Interview[3]	X		X
Physical Activity Questionnaires	X	X	X
Food Frequency Questionnaire	X		X
Health Habits Questionnaires	X	X	X
Psychological Questionnaires	X	X	X
Total-C, HDL-C, LDL-C, Tg	X	X	X
HDL_2-C and HDL_3	X		X
Post-Heparin Lipase Activity[3]	X		X
Apoproteins A-I, B	X		X
Sex Hormones	X		X
Insulin and Glucose[4]	X		X
Vitalog Recorder[5]	X	X	X

1 = body height, weight, skinfolds, waist/hip ratio
2 = after baseline, only on subjects reporting smoking
3 = only on female participants
4 = only on male participants
5 = representative 50% of sample (men and women)

INTERVENTIONS

Assessment-Only Control

The subjects in this condition were assessed at baseline, six-months, and one-year but no intervention was provided. They were asked not to change their activity habits over the next 12 months and were given monthly activity logs to complete to assess their cooperation with this request. At one year, an exercise program was available to the control subjects and they were then followed for year two of the project. Very few of the analyses included in this report involve the control subjects.

Higher Intensity Group Condition

Arrangements were made with a local community college and nearby senior center to have exercise training classes held that would meet the specifications designated by SSHIP, but still be similar to well-designed, supervised exercise programs available in many communities. Instructors were selected and provided with specific instructions on the class curriculum required for this project. Morning and evening classes were available six days per week and subjects in this condition were asked to attend three of them. Each session lasted one hour and included a 45-minute aerobic period. The exercise prescription was individualized, based on each subject's baseline treadmill test. After a period of four weeks at lower intensities, each subject was assigned an exercise prescription (see Appendix C) that entailed exercising at 73% to 88% of his or her peak heart rate. After a ten to fifteen minute warm-up period, the subjects moved into the major endurance activity, typically walking or jogging, with some use of stationary cycles and treadmills.

Following completion of each class, the subjects were asked to record on a monthly log (See Appendix D) information reflecting their experience of that day's exercise bout. Data collected at this time included the maximum heart rate achieved during the aerobic period, ratings of perceived exertion (familiar to the subjects from the baseline treadmill test), enjoyment, and convenience and endorsement of uncomfortable symptoms and/or injuries that occurred during the exercise session.

Higher Intensity Home-Based Condition

Subjects assigned to this condition were provided with an exercise prescription virtually identical, in terms of frequency, duration, and intensity, to the one used for the group condition (see Appendix C). In this condition, however, each subject was expected to jog or walk on his or her own, independent of a formal class or group. Before initiating the exercise program, a 40 to 60 minute instruction session was conducted during which a project staff member provided a recommended approach to their exercise program as well as instructions on monitoring of pulse. Monthly logs (Appendix E) similar to those completed by the group condition were provided, designed to be easily returned through the mail at the end of each month of participation in SSHIP. Thus, these subjects were also instructed to provide information concerning their rating of that day's exercise bout in terms of perceived exertion, enjoyment, and convenience as well as the duration of the exercise bout. An arrangement was made for the staff member to call the subject one week following the instruction session to check on his or her progress. Telephone contact was maintained for the remainder of the project, starting with weekly calls during the first four weeks, once every two weeks for the following four weeks, and then an average of once every four weeks until the one-year evaluation. The telephone calls were used to monitor progress, answer questions, and to provide feedback to the subjects. The monthly logs enabled the staff to track adherence patterns and, when necessary, discuss specific problems encountered by the subject.

Lower Intensity Home-Based Condition

The same general instructions and approach used for the higher intensity home-based program were used for this condition except that the exercise prescription (Appendix C) was set at 60% to 73% of maximal heart rate and these subjects were asked to exercise five times per week for approximately 30 minutes each time so that the estimated total caloric expenditure per week was comparable for the three exercise programs

SUMMARY SCORES

Adherence Scores

Each subject's monthly adherence score was based on the amount of exercise performed relative to his or her prescription. For the home based conditions, the total number of minutes of exercise reported for that month was divided by the number of minutes prescribed. In the group condition, the number of sessions attended that month was divided by the number of sessions required (typically 12 or 13). The average adherence scores, across all three conditions, calculated for each of the four successive three-month periods were 86.01% (SD = 30.1%, N = 248), 73.45% (SD = 38.9%, N = 243), 66.5% (SD = 42.3%, N = 249), and 60.6% (SD = 42.3%, N = 249), respectively. For some analyses adherence scores across months one through six ($\bar{X}$ = 80.12%, SD = 30.9, N = 242), across months seven through twelve ($\bar{X}$ = 64.5%, SD = 39, N = 243), and for the entire year ($\bar{X}$ = 73%, SD = 32, N = 241) were necessary. The pattern of adherence across the entire year is presented in Figure 3.

Validation of Adherence: Given the ongoing debate concerning self-reported data in general, and the feasibility of home-based programs in particular (DeBusk, Convertino, Hung & Goldwater, 1983; Mueller, Gossard, Flay, Adams, Taylor, Haskell, Kraemer, Ahn, Burnett, & DeBusk, 1986), several measures were undertaken to insure the validity of the responses from the subjects in the home-based conditions. First, the telephone calls provided an informal check as the project staff were able to compare the subjects' verbal reports of activity with their written documentation. Second, analyses were conducted to compare adherence data with improvement in three physiological measures: Max VO_2, submaximal heart rate, and time on the treadmill. After controlling for their scores at baseline, the partial correlations of adherence and the three measures of the effects of training at six months and one year were calculated (Table 1).

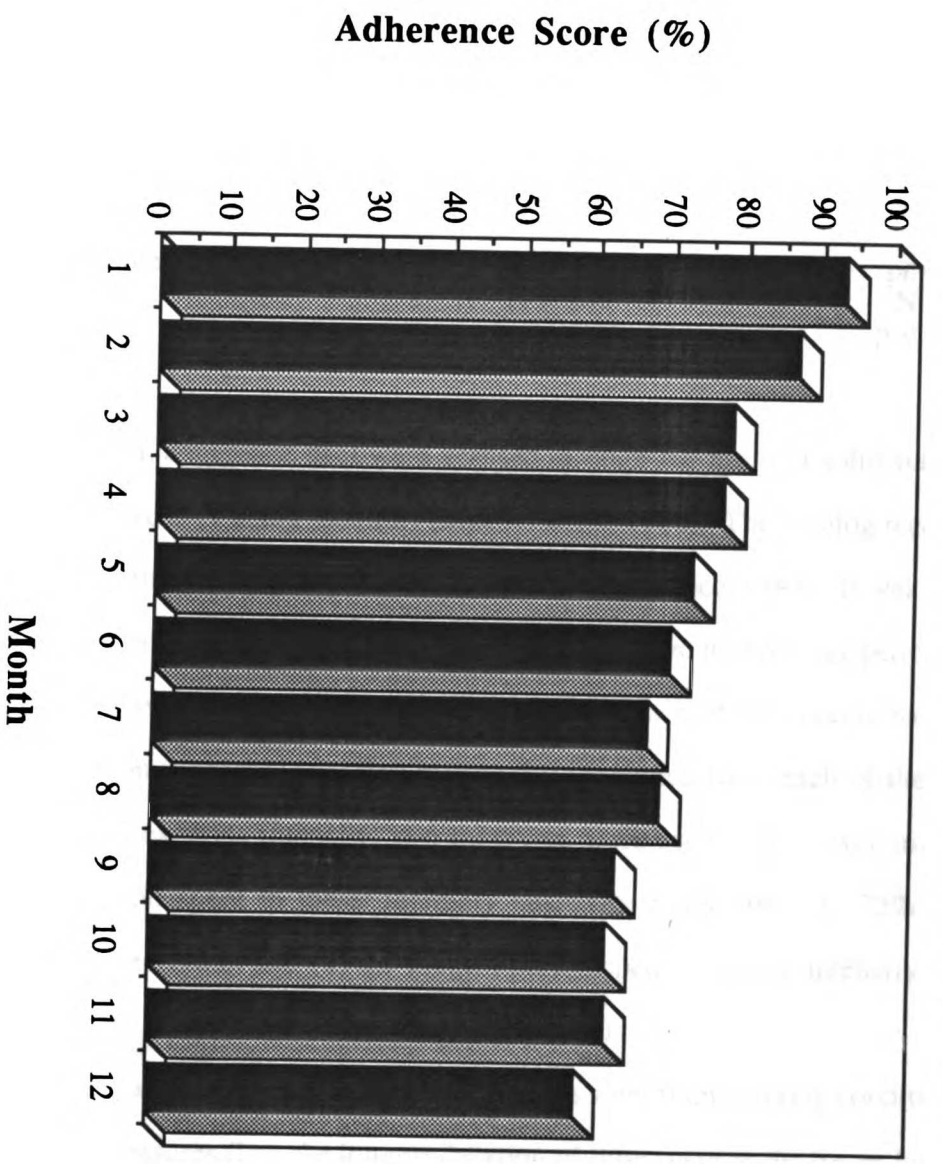


Figure 3: Adherence for the First Year of SSHIP

Table 1: Partial Correlations of Adherence Scores and Physiological Measures, Controlling for Baseline Scores

	Adherence Scores	
	months 1-6	months 1-12
Max VO_2	pr = 0.32 N = 207 p < 0.0001	pr = 0.30 N = 190 p < 0.0001
Submaximal Heart Rate	pr = -0.16 N = 204 p < 0.05	pr = -0.16 N = 189 p < 0.05
Exercise Time on Treadmill	pr = 0.25 N = 209 p < 0.001	pr = 0.30 N = 193 p < 0.0001

Third, adherence data were verified through the use of a solid state heart rate and activity recorder (Vitalog monitor) (Mueller et al., 1986). The Vitalog recorder, measuring 4 x 8 x 12 cm and weighing 0.5 kg, is worn on the subject's belt. It was used to measure and sequentially store average heart rate values for a two to three day period at baseline and six months for a random half of the subjects from each of the conditions. Analyses were performed on forty subjects, five men and five women from each of the conditions. To characterize exercise intensity, two measures were used in this validation step: (1) the longest period spent in lower intensity heart rate range (60% to 72% of the subject's maximum heart rate) and (2) the longest period spent in higher intensity heart rate range (70% to 85% of the subject's maximum heart rate).

At baseline, as expected, no differences were found among conditions for either of these two measures (i.e., the longest duration of time spent in the lower intensity or higher intensity heart rate ranges). At six months, subjects in the lower intensity home-based condition spent significantly longer uninterrupted periods of time in their lower intensity heart rate range than either of the two higher-intensity conditions or the control condition ($F = 7.46$, $p < 0.0005$). Subjects in the higher intensity home-based condition spent

considerably longer uninterrupted periods of time in their higher-intensity heart rate range than either the group or control conditions ($F = 2.91$, $p < 0.04$). Corresponding means and standard deviations are presented in Table 2.

Table 2: Vitalog Data

Variable	Group	HI-Home	LI-Home	Control
Longest Bout (mins) in Lower Intensity Range	8.6 ± 5.0	17.3 ± 15.1	37.8 ± 22.9	12.2 ± 11.7
Longest Bout (mins) in Higher Intensity Range	3.5 ± 3.4	15.7 ± 13.3	10.9 ± 16.3	3.8 ± 5.1

Self-Motivation Inventory (SMI)

As described earlier, the SMI , a paper-pencil measure with a 5-point Likert format contains 40 items (See Appendix F). Nineteen of the items are positively keyed such as "I can persist in spite of pain or discomfort" and "I like to set goals and work toward them", and twenty-one of the items are negatively keyed such as "I change my mind about things quite easily". The score for the SMI is the sum of the 40 items, after the twenty-one negatively phrased items have been reverse-coded,so that the maximum score possible is 200. To minimize the number of missing data points, subjects' scores were computed by calculating the average score and then multiplying by 40, providing at least 35 of the items had been completed. Only six subjects failed to complete the SMI at baseline. One of these subjects said the items were "too repetitive", and two failed to complete the back page; it is not clear why the other three did not finish this inventory.

The average score at baseline ($N = 343$) was 147.46 and the standard deviation was 20.43, which are comparable to the norms presented by Dishman and his colleagues (140.5 and 19.4 respectively)in their initial sample of 399 male and female undergraduates. As in past reports (Dishman et al, 1980) the internal consistency for this scale was very high, with a Cronbach's alpha of 0.92 both at baseline and at one-year. Consistent with

the notion that self-motivation is an enduring quality, the test-retest correlation for this sample was very high ($r = 0.79$, $N = 240$, $p < 0.0001$)

Self-Efficacy Scale

According to recommendations by self-efficacy theorists, the 14 items on this scale (See Appendix G) were specific to the behavior under study. Subjects were asked to rate from 0 to 100% how confident they were that they would exercise under a variety of potentially conflictual situations (e.g., while on vacations, when busy at work, etc.). The summary score for this scale was the average of these ratings, if at least 11 of the items were completed.

In an effort to insure realistic answers from subjects concerning their expectations concerning exercise behavior, the self-efficacy scale was not administered until approximately four weeks following the baseline clinic visit. Unfortunately, the return rate through the mail was considerably lower than for the other inventories that were completed by the subjects at the clinic. Furthermore, through clerical errors, many inventories were misplaced. In total, only 78 questionnaires were received. Four of these were incomplete, resulting in 74 acceptable self-efficacy scores. At one year, it was possible to assess self-efficacy in the clinic for the experimental subjects as they were well acquainted with the exercise experience by then. At this time, 199 completed forms were collected.

The average self-efficacy score at baseline was 74.3% with a standard deviation of 16.72 ($N = 74$). At one year, the average self-efficacy score was 62.80% with a standard deviation of 18.96 ($N = 199$). The internal consistency of this scale was high, both at baseline (Cronbach's alpha = 0.90) and at one-year (Cronbach's alpha = 0.93). The test-retest correlation was fairly high ($r = 0.67$, $N = 62$, $p < 0.0001$). According to self-efficacy theory, there should be a positive correlation between adherence and self-efficacy at one year. The partial correlation between average adherence over the 12 months (defined below) and self-efficacy at one year, after controlling for self-efficacy at baseline was 0.37, $N = 60$, $p < 0.005$.

PEEC (Perceived Exertion, Enjoyment, and Convenience)

As described above, subjects in all three conditions were asked to rate each exercise bout in terms of perceived exertion, enjoyment, and convenience (See Appendix H). Perceived exertion was rated on a scale from 6 to 20 to have these ratings correspond roughly to heart rate (Borg (1962) reported that most people assigned a score of 6 to a pulse rate of 60, 7 to 70, etc.). Enjoyment and convenience were rated on scales of one to ten. The scores for each of the three month intervals were created by calculating an average of the scores for each month of the period, weighted by the number of days reported per month. If a subject attended fewer than 25% of the sessions for a particular three month epoch, these summary scores were treated as missing. The average scores for each component of PEEC for the three month intervals are provided in Table 3.

Table 3: Average PEEC Scores for Three Month Intervals

		months 1-3	months 4-6	months 7-9	months 10-12
Perceived Exertion	$\bar{X}$	12.72	12.92	12.74	12.66
	SD	1.82	2.29	2.37	2.34
	N	228	197	178	162
Enjoyment	$\bar{X}$	7.19	7.40	7.57	7.47
	SD	1.68	1.77	1.73	1.80
	N	233	202	186	172
Convenience	$\bar{X}$	7.77	7.78	7.87	7.84
	SD	1.77	1.90	1.85	1.92
	N	233	203	186	172

RESULTS

PRELIMINARY ANALYSES

Before testing the main hypotheses of this study, initial analyses were conducted to determine the relationships between variables not of primary interest to the current report and exercise adherence. On the basis of previous research, three categories were selected: demographics, health status, and the exercise prescription. These variables were examined for three reasons. First, considering the mixed results described in the preceding review of the literature, it was deemed as important to examine the effect of these variables with a large sample over an extended period of time. Second, the main analyses were adjusted for those variables that contributed appreciably to the variance in exercise adherence in order to reduce the error term. Finally, those variables that exerted a significant main effect were evaluated to determine whether they had a moderating influence on the variables of direct interest to this study.

DEMOGRAPHICS

Analyses were conducted to test the relationship between several demographic variables--gender, age, employment, education, and income--and exercise adherence for each of the four three-month intervals. Since none of the results[14] reached statistical significance, demographic variables will not be considered in the analyses of the main hypotheses.

HEALTH STATUS

In a similar fashion, correlational analyses were conducted to evaluate the relationship between health status at baseline and subsequent adherence across each of the

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[14] One exception was the relationship between employment and adherence for one epoch, months one through three, which was small but significant ($r = 0.19$, $p < 0.05$).

three-month periods. In the initial set of analyses, the health status factors considered included body composition (weight and percentage of body fat), fitness level (Max VO_2, Max VE, submaximal heart rate, and exercise time on the treadmill,), lipid levels (HDL, LDL, total cholesterol), and smoking status. These data were obtained during the baseline clinic visit. Due to the high intercorrelations among several of these variables, only one variable per factor is reported in Table 4. In each case the variable that generally exhibited the highest correlation with exercise adherence across the four time periods was chosen to represent that category. It should be noted that, given the number of analyses conducted (40), the likelihood of obtaining a significant correlation by chance alone was fairly high.

As indicated in Table 4, Max VO_2 , body fat, and smoking status exhibited small, but significant, correlations with adherence during one or more of the intervals, suggesting that they be considered as covariates in subsequent analyses. Since Max VO_2 and body fat were highly correlated with each other ($r = -0.74$, $N = 323$, $p < 0.0001$), it seemed appropriate to choose only one (Max VO_2 was selected) to represent the construct these two variables presumably have in common--overall fitness. Thus, two factors to be taken into account in testing the main hypotheses were identified--smoking status and Max VO_2.

Table 4: Correlations of Adherence with Baseline Health Status

		Adherence			
		months 1-3	months 4-6	months 7-9	months 10-12
Body fat	r	0.02	-0.17	-0.17	-0.07
	N	204	235	339	241
	p†	NS	< 0.01	< 0.01	NS
Smoking status	r	-0.10	-0.17	-0.13	0.03
	N	187	184	184	186
	p	NS	< 0.05	NS	NS
Max VO_2	r	0.07	0.15	0.22	0.16
	N	237	232	237	238
	p	NS	< 0.05	< 0.01	< 0.05
LDL	r	-0.04	-0.01	-0.02	-0.08
	N	246	241	245	247
	p	NS	NS	NS	NS

(† - Tests of significance are two-tailed.)

EXERCISE PRESCRIPTION

As mentioned earlier, subjects had been randomized to one of three experimental conditions (the fourth condition was the control group) that varied in terms of intensity and/or location. Although the effect of group assignment (i.e., the exercise prescription) is of more direct interest to the larger SSHIP project, it will be mentioned briefly here in light of its potential effect as a moderating variable.

An analysis of variance revealed that in three of the four periods there was a significant difference among the mean adherence scores for the three experimental conditions (months 1-3, $F = 9.64$, $p < 0.0001$; months 4-6, $F = 1.93$, $p = 0.15$; months 7-9, $F = 7.64$, $p < 0.001$; and months 10-12, $F = 6.25$, $p < 0.01$). Based on the protected *t* procedure (Cohen & Cohen, 1983), a comparison of means was possible (except for the interval encompassing months four through six) without risking high experimentwise Type I error. Accordingly, two a-priori contrasts were examined. As indicated in Table 5, the mean adherence score for the group condition was significantly lower than the mean adherence scores for the two home-based conditions. There was not a main effect of intensity, however, since the difference between the lower and higher intensity home-based conditions was not significant. The effect of group assignment was included in the tests of the main hypotheses.

Table 5: Relationship between adherence scores and group membership

		Adherence			
		months 1-3	months 4-6	months 7-9	months 10-12
Group 2	$\bar{X}$	74.20*	66.53	51.93*	46.86*
	SD	21.88	27.65	31.20	33.70
	N	76	71	77	78
Group 3	$\bar{X}$	93.58	73.73	72.26	66.41
	SD	33.75	45.18	43.61	44.98
	N	90	90	89	89
Group 4	$\bar{X}$	88.64	78.84	73.91	67.32
	SD	29.42	39.36	41.48	43.90
	N	82	82	81	82

* Significant difference between Group 2 and Groups 3 & 4, $p < 0.001$.

HYPOTHESIS 1

"Is self-efficacy, a situationally-defined construct, a better predictor of exercise adherence than the general construct, self-motivation?"

To examine this question, Pearson correlations were conducted between self-motivation and exercise adherence and between self-efficacy and exercise adherence for all four three-month intervals. With listwise deletion (deletion of all cases for which any one of the variables is missing), the sample size was reduced to 68. As seen in Table 6, self-efficacy was positively correlated with adherence in all four periods, but no relationship was discovered between self-motivation and adherence. Using the formula provided by Steiger (1980) to calculate the t for comparing a pair of correlations from dependent samples, a significant difference ($p < 0.05$) was discovered in all four time periods[15]. Since an analysis based only on the cases who completed both questionnaires was, by definition, less powerful, correlations were also conducted with pairwise deletion (number of cases based on the pair of variables involved). However, the pattern did not change, with self-motivation still showing no relationship with adherence (Pearson r's ranged from 0.01 to 0.08) whereas self-efficacy again showed a modest relationship with adherence (Pearson r's ranged from 0.31 to 0.50).

Table 6: Correlations of adherence with self-motivation versus self-efficacy

		Adherence			
		months 1-3	months 4-6	months 7-9	months 10-12
Self-motivation	r	0.00	-0.02	-0.02	0.19
	N	68	68	68	68
	p†	NS	NS	NS	NS
Self-efficacy	r	0.31	0.44	0.35	0.51
	N	68	68	68	68
	p	< 0.01	< 0.001	< 0.01	< 0.001

(† - Tests of significance are two-tailed.)

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[15] For the first three-month interval, the test was actually significant at $p < 0.07$).

HYPOTHESIS 2

"Will more immediate aspects of the exercise experience (PEEC) contribute significantly to explaining the variance in exercise adherence, independent of the variance explained by self-motivation and/or self-efficacy?"

A series of multiple hierarchical regressions were conducted to test this hypothesis. Initially, as mentioned earlier, smoking status and Max VO_2 were included as covariates. The proportion of variance explained by these variables was minimal (less than 1%) when the full sample was evaluated. Interaction terms involving these covariates were also not significant. As these variables did not exert a direct or moderating effect, they were dropped from the model.

Three-month Analyses

According to the original design, hierarchical regression analyses were conducted to test the effect of PEEC, adjusted for self-motivation and self-efficacy, during a three-month period on exercise adherence for the subsequent three-month period (e.g., the effect of PEEC averaged across months one through three on adherence averaged across months four through six, etc.). The first question that arose was sample size. The test of the complete social learning model, as formulated in this study, called for inclusion of self-efficacy as well as PEEC. However, due to the small number of efficacy scores, the power of such analyses (listwise deletion resulted in sample sizes of 63, 55, and 54 for the corresponding three month intervals) was limited.

Initially, consideration was given to performing the analyses on two distinct samples, those who had completed the self-efficacy scale and those who had not. First, it was necessary to test whether these samples might differ in terms of adherence as a function of completing the self-efficacy questionnaire. Adherence scores across all four time periods were compared for those subjects who did obtain a valid self-efficacy score and those who did not. Not one of these analyses was statistically significant, suggesting that multiple hierarchical regressions could be conducted on these independent samples.

However, examination of the correlations between the first two three-month intervals (see Table 7) suggested that the relationships of interest, if present, were quite modest, requiring the largest N possible to maximize power. Power would be enhanced by conducting the analyses with the sample of subjects who did not complete self-efficacy, versus those who had,as this would essentially double the sample size. However, by dropping self-efficacy from the analyses but not those subjects who had completed it, the sample size was tripled. Therefore, all of the analyses were conducted twice: once with a "small sample", only the subjects who had completetd information on all of the forms of interest, including self-efficacy, and again for a "large sample", almost the entire sample, once the variable self-efficacy was dropped from the model.

Small sample In the first set of analyses involving three-month intervals, group membership was included in the model to determine whether the effect of PEEC (entered as a set), adjusted for self-motivation and self-efficacy, varied as a function of the subject's exercise prescription. In all three analyses, the order of entry was (1) self-motivation, (2) self-efficacy, (3) group assignment, (4) PEEC (all three variables, averaged across the relevant three-month interval, entered as a set, and (5) Interactions of group assignment with the other factors. Although, as reported earlier, the main effect of group assignment was highly significant in all three analyses, the interactions involving this factor were not significant with this subsample so it was removed in the subsequent set of analyses. Consistent with the test of hypothesis one, self-motivation was not significantly related to adherence during any of the three time periods (R^2 = .01, .002, and .02, respectively). In contrast, self-efficacy contributed 19% of the variance in exercise adherence for months four through six ($F = 13.97$, $p < .0001$), 9% of the variance in exercise adherence for months seven through nine ($F = 5.16$, $p < .05$), and 15% of the variance in months ten through twelve ($F = 9.27$, $p < 0.01$). The contribution of PEEC

Table 7: Correlation between adherence months 1-3 and 4-6 with predictor variables

		Adherence Months 1-3	Adherence Months 4-6	Self motivation	Self efficacy	Perceived exertion 1-3	Enjoyment 1-3	Convenience 1-3
Adherence Months 1-3	r	*	0.62	0.03	0.31	-0.05	0.09	0.14
	N	*	243	243	72	227	232	232
	p	*	0.000	NS	<0.01	NS	NS	<0.05
4-6	r	0.62	*	0.01	0.44	-0.03	-0.01	0.00
	N	243	*	238	71	223	228	228
	p	0.000	*	NS	<0.001	NS	NS	NS
Self motivation	r	0.03	0.01	*	0.10	-0.14	0.12	0.03
	N	243	238	*	72	225	230	230
	p	NS	NS	*	NS	<0.05	NS	NS
Self efficacy	r	0.31	0.44	0.10	*	0.07	0.18	0.10
	N	72	71	72	*	67	68	69
	p	<0.01	<0.001	NS	*	NS	NS	NS
Perceived exertion (1-3)	r	-0.05	-0.03	-0.14	0.07	*	-0.07	-0.01
	N	227	223	225	67	*	226	227
	p	NS	NS	<0.05	NS	*	NS	NS
Enjoyment (1-3)	r	0.09	-0.01	0.12	0.18	-0.06	*	0.73
	N	232	228	230	68	226	*	232
	p	NS	NS	NS	NS	NS	*	<0.001
Convenience (1-3)	r	0.14	0.00	0.03	0.10	-0.01	0.73	*
	N	232	228	230	69	227	232	*
	p	<0.05	NS	NS	NS	NS	<0.001	*

during each of the preceding three month periods was small (.03, .02, and .07 respectively) and did not reach statistical significance with this subsample.

Large sample Two identical sets of analyses were conducted without self-efficacy in the model resulting in a markedly larger sample size (N = 218, 193, and 175 respectively). First, group assignment and the corresponding interaction terms were again initially included in the model. Since group assignment did not exert a moderating effect on the relationship of self-motivation and/or PEEC with exercise adherence during any of the time periods, it was again removed from the analyses. Despite the increased power of these three analyses, self-motivation failed to contribute significantly to the variance in adherence. Furthermore, even with this larger sample, there was not a statistically significant relationship between PEEC and adherence for any of the three month periods.

As PEEC failed to predict adherence on a three-month basis, alternative relationships were considered. It seemed possible that the effect of PEEC, if it does exist, could be more easily detected from one six month period to the other, as this time point is described in the literature (Dishman, 1986) as crucial in terms of adherence. Thus, the analyses were repeated across this longer time period. Subjects' adherence in months seven through twelve was assessed as a function of their exercise experience during months one through six.

Six Month Analyses

In the following analyses, new summary scores for PEEC and adherence were created by calculating weighted averages across months one through six and and across months seven through twelve for those subjects with at least 5 months of complete data and who had attended at least 25% of the prescribed sessions. The variables were entered into the equation in the same order as during the analyses conducted for three month intervals: self-motivation, self-efficacy, and then PEEC.

Small sample For this smaller sample (the 55 subjects who completed the efficacy scale as well as the other variables of interest), two multiple hierarchical (forced entry)

regressions were performed. The first one included the effect of group assignment and the corresponding interaction terms. In this analysis of exercise adherence during months seven through twelve, self-motivation explained 3% of the variance, a result that did not reach statistical significance. Self-efficacy explained an additional 14% of variance ($F = 8.65$, $p < 0.01$). The main effect of group membership was significant over this longer time period, accounting for 12% of the variance in exercise adherence, over and above the effect of self-motivation and self-efficacy ($F = 4.30$, $p < 0.05$). As mentioned earlier, this effect was based primarily on the distinction between the group condition and the two home-based conditions. The variables comprising PEEC contributed an additional 4% of variance, which was not statistically significant. None of the interaction terms involving group membership were significant, allowing the analysis to be repeated without this variable.

Since self-motivation and self-efficacy were entered in the same order in this second analysis, they again contributed 3% and 14% of the variance respectively. When PEEC scores across months one through six were entered at this point in the analysis, without partialling group membership first, they contributed an additional 10% of the variance in exercise adherence over months seven through twelve, an effect that approached statistical significance ($F = 2.37$, $p = 0.08$).

Large sample The final set of multiple regression analyses involved the two six-month intervals for the larger sample. First, as seen in Table 8, group membership was included to check for interaction effects. The pattern of relationships revealed in analysis of the smaller sample was replicated, with no main effect of self-motivation, a strong main effect due to the exercise prescription and PEEC exerting only a small influence.

Table 8: Multiple regression analysis of adherence months seven to twelve including group membership for the larger sample.

Source	df (factor, error)	Increment in R^2	F	p
Self-motivation	1, 180	0.001	0.29	NS
Group membership	2, 178	0.11	10.95	< 0.0001
Supervised group vs home-based	1, 178	0.10	20.73	< 0.0001
High intensity vs low intensity	1, 178	0.01	1.30	NS
PEEC	3, 175	0.03	2.35	NS (p = 0.07)
Perceived exertion	1, 175	0.0002	0.055	NS
Enjoyment	1, 175	0.0002	0.03	NS
Convenience	1, 175	0.009	1.99	NS
Interaction terms				
Group membership with self-motivation	2, 173	0.004	0.42	NS
Group membership with PEEC	6, 167	0.05	1.75	NS

Since the two sets of interactions were not statistically significant, the analysis was repeated without group membership (See Table 9). As shown in Table 9, subjects' perception of their exercise experience (PEEC) during months one through six contributed slightly over 4% of the variance in exercise adherence over months seven through twelve. This significant relationship can be attributed primarily to one of the PEEC variables, convenience; the unique contribution of convenience to adherence, after partialling out the other variables was significant (partial $r = 0.18$, $p < 0.02$). The unique aspects of the other components of PEEC, perceived exertion and enjoyment, did not contribute to the variance in exercise adherence.

Table 9: Multiple regression analysis of adherence months seven to twelve without group membership for the larger sample.

Source	df (factor, error)	Increment in total R^2	F	p
Self-motivation	1, 180	0.002	0.29	NS
PEEC	3, 177	0.045	2.79	< 0.05
Perceived exertion	1, 177	0.002	0.31	NS
Enjoyment	1, 177	0.005	1.04	NS
Convenience	1, 177	0.03	2.44	< 0.05

Clearly, some portion of the variance in adherence explained by PEEC was due to some overlap among the three components. Specifically, perceived exertion was not associated with enjoyment or convenience,but the latter two variables were highly correlated with each other (r = 0.795). It is well documented (Cohen & Cohen, 1983) that such a strong relationship between predictor variables, typically labeled as multicollinearity, can present problems in terms of interpretation, sampling stability and computation . When the set as a whole is significant, but not any of the unique contributions of the variables, the first of these difficulties is encountered. A typical solution is to combine the relevant variables. However, this option was rejected, given the purported distinction between the two concepts maintained by this author and supported in the literature. Moreover, since convenience did make a significant, albeit small, unique contribution, despite its considerable overlap with enjoyment, interpretation is relatively straightforward. The lack of confidence in the sampling stability is more problematic given the concomitant decrease in power, but the sample size was probably large enough to detect any relationships that did exist. Finally, the potential computational problem was kept in check by the tolerance limits set during the analyses (SPSSX provides a warning and/or discontinues analyses if the determinant is too close to one).

In general, the contribution of PEEC in its entirety as measured in this study appears to be so small that even if it is replicable, it seems unlikely to be of clinical

significance. Based on the preceding analyses, only convenience seems to exhibit a meaningful, admittedly also small, relationship with exercise adherence.

To test the assumptions of linear regression--normality, linearity, and homogeneity of variance--the residuals of the analyses presented in Tables 8 and 9 were inspected. In both analyses, the distribution of the dependent variable was basically normal, with no standardized residuals larger than 2.75. A plot of the predicted variables against the residuals revealed an essentially horizontal (albeit wide) band, reflecting no violations of the assumptions of linearity or constant variance despite the relatively poor fit of the model.

HYPOTHESIS 3

"Will the effect of self-motivation and/or PEEC on exercise adherence vary as a function of time (months of participation)?"

To test this question, the effects of self-motivation, PEEC, and their interaction in each of the three month analyses were compared to determine if their contributions to variance in adherence changed over time. As described above, in each of the three-month intervals examined, none of these variables contributed to the variance in exercise adherence, suggesting that these relationships, or lack thereof, did not vary with time. It is difficult to know whether to attribute the one significant effect of convenience, a component of PEEC, within the six month analysis, to an interaction with time since the corresponding three month analysis (PEEC across months four to six with adherence seven to nine) was not significant.

To assess the possibility that such a relationship exists, a multivariate analysis of variance was conducted for the four three-month adherence scores with convenience only (the four convenience summary scores from each of the three-month intervals) as a repeated varying covariate. No differences in adherence across the four time periods were detected

(Wilks lambda = 0.92, approximate F = 1.5, p = 0.14) except those that could be directly attributable to time itself as seen earlier in Figure 1.

EXPLORATORY ANALYSES

PEEC

To better understand the nature of PEEC in this study, both in relation to adherence and to the other variables, it was examined further with both univariate and multivariate methods.

Univariate Analyses

First, it should be noted that, as seen in Table 1, there was little change in any of the three components of PEEC across time. In fact, they seemed close to "optimal " over the course of the study, averaging between 12 and 13 for perceived exertion, and between seven and eight for enjoyment and convenience across the entire year. Furthermore, the variance for these scores was relatively small, with standard deviations averaging slightly over 2 for perceived exertion and slightly under 2 for enjoyment and convenience, possibly attenuating the relationship of PEEC with adherence.

Interestingly, when the set of PEEC variables is regressed on adherence, without first partialling self-motivation and/or self-efficacy, the effect of PEEC is further reduced. For example, the zero-order correlation of convenience, months one through three, with adherence, months four through six, for the small sample was 0.15, but its unique relationship, after partialling out self-efficacy (as well as the other two components of PEEC), was 0.19. This effect, referred to in the literature as supression (Cohen & Cohen, 1983, p. 94), is difficult to interpret. It seems, however, that efficacy may overlap with some aspect of convenience (r = 0.13 in this analysis), unrelated to adherence. For example, the correlation may represent a common, but irrelevant, reporting style such as

optimism or social desirability. When this common variance is removed, the impact of convenience on adherence is more apparent.

Multivariate Analysis

To further explore the relationship of convenience with adherence, a canonical correlational analysis was conducted. The two sets, each comprised of four variables, were the adherence scores for each of the three-month periods (dependent variables) and the corresponding convenience scores (covariates). Based on the recommendations of experts (Tabachnick & Fidell, 1983), the intercorrelations within and between the two sets were examined to determine the feasibility of this technique (see Table 10). Although not substantial,there appeared to be sufficient correlations within each set and between the two sets to justify this approach.

The multivariate test to detect a relationship between the two sets was significant (Wilks lambda = .84, approximate F = 1.76, $p < 0.05$). The first two canonical correlations were .34 (11.5% of the variance) and .21 (4.6% of the variance) respectively. The remaining two canonical correlations were effectively zero. Presented in Table 11 are the canonical correlations, the pairs of canonical variates, the correlations between the variables and the canonical variates, the standardized canonical variate coefficients, the within-set variance accounted for by the canonical variates,and the redundancies (the amount of variance of one set of variables explained by the canonical variate of the other set.)

Based on the Roy-Bergman stepdown F test, after the first canonical variate pair was removed, the variance explained by the remaining covariate pairs was not significant. Furthermore, interpretation of a relationship that explains less than 10% of the variance is discouraged (Tabachnick & Fidell, 1983). Consequently only the first covariate pair is considered for interpretation. Examination of the loadings of the four variables with this first pair suggests that the variance the two sets have in common is mostly a function of their relatively strong relationship during the first three months. Apparently convenience

Table 10: Correlation matrix for convenience and adherence

		Adherence Months				Convenience Months			
		1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12
Adherence Months									
1-3	r	*	0.62	0.54	0.48	0.14	0.09	0.05	0.01
	N	*	243	243	243	232	203	186	172
	p	*	0.000	0.000	0.000	0.019	0.101	0.249	0.433
4-6	r	0.62	*	0.80	0.67	-0.00	0.07	0.06	0.04
	N	243	*	241	239	228	202	186	171
	p	0.000	*	0.000	0.000	0.491	0.159	0.209	0.323
7-9	r	0.54	0.80	*	0.81	0.04	0.07	0.03	0.01
	N	243	241	*	243	228	202	185	169
	p	0.000	0.000	*	0.000	0.293	0.177	0.332	0.460
10-12	r	0.48	0.67	0.81	*	0.10	0.13	0.06	0.11
	N	243	239	243	*	229	202	185	172
	p	0.000	0.000	0.000	*	0.059	0.036	0.204	0.082
Convenience Months									
1-3	r	0.14	-0.00	0.04	0.10	*	0.86	0.81	0.82
	N	232	228	228	229	*	201	185	170
	p	0.019	0.491	0.293	0.059	*	0.000	0.000	0.000
4-6	r	0.09	0.07	0.06	0.13	0.86	*	0.90	0.91
	N	203	202	202	202	201	*	180	166
	p	0.101	0.159	0.177	0.036	0.000	*	0.000	0.000
7-9	r	0.05	0.06	0.03	0.06	0.81	0.90	*	0.94
	N	186	186	185	185	185	180	*	165
	p	0.249	0.209	0.332	0.204	0.000	0.000	*	0.000
10-12	r	0.01	0.04	0.01	0.11	0.82	0.91	0.94	*
	N	172	171	169	172	170	166	165	*

became less relevant as the adoption stage was passed which is consistent with the suggestion noted earlier that there may be an interaction of convenience with time.

Table 11: The first two canonical variates: Relationships between and within the sets

	First canonical variate pair		Second canonical variate pair	
	Correlation	Standardized Coefficient	Correlation	Standardized Coefficient
Convenience				
Months 1-3	0.52	1.63	-0.16	0.94
Months 4-6	0.16	-0.55	-0.46	-0.11
Months 7-9	0.20	1.38	-0.65	-2.51
Months 10-12	0.02	-2.13	-0.42	1.27
Percent of variance	0.08		0.21	total = 0.29
Redundancy	0.001		0.019	total = 0.02
Adherence				
Months 1-3	0.98	1.12	-0.14	0.52
Months 4-6	0.49	-0.15	-0.83	-1.34
Months 7-9	0.45	-0.02	-0.25	0.48
Months 10-12	0.30	-0.08	-0.33	-0.26
Percent of variance	0.37		0.22	total = 0.59
Redundancy	0.04		0.01	total = 0.05
Canonical correlation	0.34 (11.5% of variance)		0.22 (4.6% of variance)	

ADHERENCE SCORES

As the variance in exercise adherence was not generally accounted for by the variables in the model of interest (the one significant predictor, self-efficacy, only explained 10% to 15% of the variance), it seems important to question other factors that could have been relevant. As reported earlier, group membership was significantly related to adherence, reflecting the impact of the exercise prescription, specifically type of supervision, on exercise behavior. However, even after taking this variable into effect, a significant portion of the variance was still left unexplained.

Consideration of Table 10 may provide part of the answer to this question. In all four of the intervals, adherence in the preceding three-month period was significantly

related to subsequent adherence. Furthermore, the size of this relationship grew stronger over time as indicated by the change scores across the three analyses. The first three-month period accounted for 38% of the variance in the second period, the second three-month period accounted for 62% of the variance in the third period,and the third three-month period accounted for 65% of the variance in the fourth three-month period. It seems that there is little variance in exercise behavior once maintenance has begun, that is not explained by past behavior.

DISCUSSION

Given the complexity of a behavior such as exercise participation, it is perhaps not surprising that the relationship between the predictor variables and exercise adherence was relatively small. There are two issues of interest. First, consideration of those aspects of the model that were supported is warranted. Second, discussion is provided concerning what portion of the negative results may be due to inadequate theory and what portion may be due to design limitations.

SELF-MOTIVATION VERSUS SELF-EFFICACY

The analysis comparing the predictive power of these two constructs indicated clearly that self-efficacy beliefs were related to exercise adherence whereas self-motivation, as measured by the SMI, was not. Self-efficacy is conceptualized as one's beliefs, at a particular point in time, that one can perform a specific behavior. In this study, self-efficacy was quantified as the subject's rating of the likelihood that he or she would engage in exercise behavior, averaged across fourteen specific, and presumably difficult, situations. This paper-pencil scale, requiring estimation of confidence on a scale from one to one hundred, seems the most straightforward way of tapping efficacy cognitions, providing face validity to the measure.

Further support of the self-efficacy construct was also apparent from the analyses testing the influence of self-efficacy on adherence and vice verse. According to the interactionist position described earlier, efficacy beliefs influence behavior, which in turn influences subsequent efficacy beliefs. Several implications of this relationship follow accordingly. Self-efficacy beliefs presumably can change over time. Therefore, it was somewhat surprising that the test-retest correlation was fairly high ($r = 0.67$), since this level of correlation has been traditionally cited as evidence of a trait-like quality. However, two points should be made here. First, it is currently acknowledged that simple

correlations are not sufficient indicators of change or lack thereof. Strong correlations can reflect either no change at all or considerable change, as long as the pattern of the scores is consistent. Second, even evidence that self-efficacy had not changed for some subjects would not necessarily contradict theory. Efficacy beliefs can change, but it is not inevitable that they will change. In fact, according to the theory, a sufficient, although not necessary, catalyst of change in efficacy beliefs is the relevant behavior.

Accordingly, one's efficacy concerning exercise behavior should change as a function of adherence. Consistent with this logic, there was a drop in average efficacy scores (from 74.3% to 62.80%), apparently corresponding to the decline in adherence depicted in Figure 3. Furthermore, a test of this purely descriptive analysis was provided in the analysis of covariance mentioned before; the partial correlation (.34) of adherence with efficacy at one year, after controlling for efficacy at baseline, was highly significant. It appears that the evidence supports a social-learning approach to behavior change in general, and the predictive power of self-efficacy theory in particular.

However, one slight inconsistency should be noted. It was expected that self-efficacy at baseline would correlate more with adherence in the months immediately following completion of the questionnaire, than with adherence at the end of the year. But the results displayed in Table 6 show that the relationship between initial self-efficacy and adherence seems to become stronger over time. Perhaps people with the highest efficacy initially are more likely to adhere, raising their efficacy even further and this positive cycle results in the strengthening of the relationship. One question that arises is how to achieve a sufficiently high level of self-efficacy initially to adopt an exercise regimen.

In contrast to the positive influence of self-efficacy, self-motivation scores and exercise adherence were not associated. The first question raised by this finding is whether a trait identified as self-motivation might exist (i.e., as an individual difference) but was simply not predictive, in the current sample, of exercise adherence. The data provided in this study seem to provide contradictory answers. On the one hand, despite the generality

of the items in the self-motivation inventory, the internal consistency of this scale was extremely high. This suggests that subjects were able to position themselves along a continuum of some common construct that underlies this measure, however it is labeled. On the other hand, several subjects spontaneously qualified their ratings and/or omitted responses because their answer "depended on the situation".

One explanation of these seemingly mixed messages was offered by Mischel (1977). As he pointed out, individual differences may exist, but depending on the design of the study, go undetected and/or be of little predictive utility. Thus, to assert that the inventory did not predict adherence does not prove that the inventory does not tap a trait-like quality, self-motivation, or that such a construct does not exist. On the other hand, neither are these two ideas supported. Empirically however, this inventory, given its broad generality, did not prove to be a useful tool in discerning who would adhere to an exercise regimen and who would not.

The current findings raise questions concerning the feasibility of the SMI as a screening device for predicting exercise adherence. Although, support for this inventory was reported in past research efforts, several of these studies were methodologically unsound due to a retrospective design (e.g., Snyder et al, 1982), a small sample size (e.g., Freedson et al, 1983) or the limited time period under study (Thompson et al., 1984). The data provided by this study, assessing exercise adherence for one year with a large sample, does not support the predictive utility of self-motivation, at least as measured by the SMI, with older adults.

THE INFLUENCE OF PEEC

Despite the support from surveys, correlational evidence, and the intuitive appeal of the PEEC components, these three factors, jointly and individually, were not found to correlate with exercise adherence. Even the statistically significant association between convenience and adherence was not strong enough or consistent enough to generate

confidence in the relationship. Three explanations, not necessarily mutually exclusive, may account for these negative findings.

First, the measures of these three factors may have been inadequate in a psychometric sense. In the effort to insure that some data concerning PEEC was collected without adding to the considerable demands already placed on the SSHIP subjects, simple ratings on a one-point scale were chosen. In the context of the larger study, this decision was a practical decision. However, one-point scales are often criticized as unreliable (Cohen & Cohen, 1983) and thus may not have adequately captured the intended concepts. Moreover, given the large number of forms of all types completed by these subjects over the course of the year, and the fact that the subjects provided PEEC data over 100 times, it is possible that completion of these ratings was not always carried out in a conscientious fashion.

Evidence to support this conjecture is provided by the extremely high correlations between enjoyment and convenience, conceptualized as distinct qualities. Of course, it is possible that these concepts do overlap. For example, perhaps enjoyment for some, if not all, of the subjects is a function of convenience. Nevertheless, since these concepts are potentially distinct, the parallel ratings may simply reflect a lack of thoughtfulness on the part of the subjects as rating PEEC became almost automatic. The small within-subject variance on these measures is also consistent with the latter interpretation. In future tests of PEEC, as a set or individually, multiple-item scales, administered less frequently, but requiring more attention on the part of the subjects, seem warranted.

Second, the correlation between PEEC and adherence may have been attenuated because of the lack of between-subject variance in the three components: perceived exertion, enjoyment, and convenience. It must be remembered that the overriding goal of SSHIP was to assess the impact of exercise on health status. Consequently, at the onset of the study, efforts were made to make each subject's exercise experience as positive as possible, given the restraints of the exercise prescription to which he or she was

randomized. In particular, it was unlikely that any subject would have experienced undue exertion, as even the "higher" intensity condition only required moderate intensity in an absolute sense. Furthermore, convenience was presumably maximized for subjects in the home-based conditions and somewhat enhanced in the group condition by choosing facilities that were within a few miles of the subjects' homes. Perhaps it is not surprising that subjects reported consistently moderate levels of perceived exertion and high levels of enjoyment and convenience. The relative lack of variation in these three scores could impede detection of a relationship between them and exercise adherence.

A third explanation for the lack of significant results is that the hypothesized relationship did not exist. Clearly, this is possible. The question that then arises is whether such negative findings are generalizable to other populations. The subjects who were recruited into this study were initially contacted via a survey composed of questions concerning their health status in general, and their health habits in particular. Conceivably those subjects who volunteered were ones for whom health motives were especially important. Furthermore, it seems possible that, given the considerable commitment required by subjects who agreed to participate, the final group of volunteers (see Figure 1) was a very determined group. Assuming salient health motives and the initially strong commitment on the part of the subjects and continued contact and support from the staff, it seems possible that the PEEC factors did not have any further influence on adherence for this population. Further testimony to the difficulty of detecting an effect of PEEC is provided in Figure 3; notwithstanding the traditional decline in adherence rates, there were relatively high levels of adherence achieved throughout the year (e.g., over 60% for the total group even during the last three months). In summary, although the importance of PEEC was not supported by the data from this study, it is possible that this was due, at least in part, to limitations noted above.

THE IMPACT OF PAST BEHAVIOR

As mentioned earlier, the best predictor of exercise adherence in this investigation was recent exercise adherence (i.e. the exercise pattern occurring during the previous three-month interval). This assertion, although not particularly novel, may still prove to be interesting. The pattern of this relationship over time presented in Table 10 seems informative. With each new three month period, the size of the relationship increased. It may be that situational aspects of the exercise experience are of more relevance during the adoption stage. (In this study only convenience exhibited this pattern and at that, the effect size was minimal. However, as previously discussed, this may have been due to design limitations.) Then, during maintenance, as the habit becomes stronger, exercise becomes increasingly likely to continue and less susceptible to outside influences. This thinking is consistent with the following comment by Triandis:

> ...when the behavior is old, well-learned, or overlearned and has occurred many times before in the organism's life span, it is very likely to be under the control of the habit component (p. 205)

This interpretation also receives preliminary support from the canonical correlational analysis reported earlier in which convenience seemed to exert its effect only during months one through three. To the degree to which this is true, certain questions arise: (1) what factors, situational or otherwise, influence the "adoption" stage?, (2) how long does adoption last (i.e. is it finite?), and, (3) despite the presumably dominant influence of "habit", can the remaining variance in maintenance of exercise be further explained .

CONCLUSIONS

Regular exercise is well regarded by professionals and laypeople, both in terms of its health benefits and its social value. Nevertheless, many people remain sedentary. Extensive efforts to uncover the determinants of exercise adoption and maintenance reviewed in this paper are testimony not only to the difficulty in explaining this single behavior, but also the problems encountered in investigations of all complex behaviors which are multi-determined. Nevertheless, some information was revealed in this study.

In the comparison of two models of behavior change, a trait approach versus the social-learning model, the superior predictive power of self-efficacy as opposed to self-motivation, provides strong support for the latter. It seems that peoples' beliefs concerning the likelihood of engaging in specific, well-defined behaviors is more strongly related to the enactment of those behaviors than their rating of a global, presumably generalizable, trait. However, further test of the social learning model did not provide comparable support. Three variables, perceived exertion, enjoyment and convenience, designed to capture immediate aspects of the exercise experience, did not contribute to the explanation of exercise adherence, over and above the effect of self-efficacy. In fact, effectively,none of these components was found to be related to exercise behavior even prior to partialling self-efficacy and/or self-motivation. The discussion highlighted the aspects of the design which may have precluded detection of their effects. Finally, it was noted that past exercise behavior predicted future exercise behavior at an ever increasing rate.

Two recommendations for further studies are offered. First, it seems important that the test of PEEC be optimized in a controlled study, designed for this purpose. Specifically, that would entail a common exercise prescription (controlling for the effect of intensity, location, etc) and better measurement of the variables through multiple-item scales, less frequent administrations, and standardized instructions concerning the definition of the three concepts. In particular, to improve external validity, subjects should be exercising in as natural setting as possible, minimizing any influence on the part of the

experimenter, unrelated to the test of PEEC per se. Second, studies should be planned to examine the reciprocal aspect of social learning theory, to test how engagement in exercise, or any behavioral habit, is not only effected by certain determinants, presumably situational, but also in turn influences the situations that follow. Such investigations, although admittedly difficult, are necessary before a true understanding of the exercise process is possible.

REFERENCES

Adams, R.S. (1963). Two scales for measuring attitude toward physical education. *Research Quarterly, 34,* 91-94.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action control: From cognition to behavior* (pp.11-39). New York: Springer-Verlag.

Ajzen, I., & Fishbein, M. (1969). The prediction of behavioral intentions in a choice situation. *Journal of Experimental Social Psychology, 5,* 400-416.

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin, 84,* 888-918.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, New Jersey: Prentice Hall.

American College of Sports Medicine. (1978). Position statement on the recommended quantity and quality of exercise for developing and maintaining fitness in health adults. *Medicine and Science in Sports, 10,* vii-x.

Andrew, G.M., & Parker, J.O. (1979). Factors related to dropout of post myocardial infarction patients from exercise programs. *Medicine and Science in Sports and Exercise, 11,* 376-378.

Andrew, G.M., Oldridge, N.B., Parker, J.O., Cunningham, D.A., Rechnitzer, P.A., Jones, N.L., Buck, C., Kavanagh, T., Shephard, R.J., & Sutton, J.R. (1981). Reasons for dropout from exercise programs for the postcoronary patients. *Medicine and Science in Sports and Exercise, 13,* 164-168.

Atkinson, J.W. (1957). Motivation determinants of risk-taking behavior. *Psychological Review, 64,* 359-372.

Baekland, F., & Lundwall, L. (1975). Dropping out of treatment: A critical review. *Psychological Bulletin, 82,* 738-783.

Bagozi, R.P. (1980). Attitudes, intentions, and behaviors: A test of some key hypotheses. *Journal of Personality and Social Psychology, 41,* 607-627.

Bandura, A. (1969). *Principles of behavior modification.* New York: Holt, Rinehart, & Winston.

Bandura, A. (1976). Self-reinforcement: Theoretical and methodological considerations. *Behaviorism, 4,* 135-155.

Bandura, A. (1977a). Self-efficacy: Toward a unifying theory of behavior change. *Psychological Review, 84,* 191-215.

Bandura, A. (1977b). *Social learning theory.* Englewood Cliffs, New Jersey: Prentice Hall.

Bandura, A. (Ed.). (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, New Jersey: Prentice Hall.

Bandura, A., Adams, N.E., & Beyer, J. (1977). Cognitive processes mediating behavior change. *Journal of Personality and Social Psychology, 35*, 125- 139.

Bartley, S.H. (1970). The homeostatic and comfort perceptual systems. *Journal of Psychology, 75*, 157-162.

Becker, M.H., & Maiman, L.A. (1975). Sociobehavioral determinants of compliance with health and medical care recommendations. *Medical Care, 13*, 10-23.

Becker, M.H., Maiman, L.A., Kirscht, J.P., Haefner, D.P., Drachman, R.H., & Taylor, D.W. (1979). Patient perceptions and compliance: Recent studies of the health belief model. In R.B. Haynes, D.W. Taylor, & D.L. Sackett (Eds.), *Compliance in health care* (pp. 78-109). Baltimore: John Hopkins University Press.

Belisle, M., Roskies, E., & Levesque, J. (1987). Improving adherence to physical activity. *Health Psychology, 6*, 159-172.

Bialer, I. (1961). Conceptualization of success and failure in mentally retarded and normal children. *Journal of Personality, 29*, 303-320.

Biddle, S.J.H., & Bailey, C.I.A. (1985). Motives for participation and attitudes toward physical activity of adult participants in fitness programs. *Perceptual and Motor Skills, 61*, 831-834.

Bjartveit, K., Foss, O.P., & Gjervig, T. (1983). The cardiovascular disease study in Norwegian countries: Results from first screening. *Acta Medica Scandinavica, 675* (Supplement), 95-130.

Blair, S.N. (1988). Exercise within a healthy lifestyle. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp.75-89). Champaign, Illinois: Human Kinetics Books.

Blair, S.N., Jacobs, D.R.Jr., & Powell, K.E. (1985). Relationships between exercise or physical activity and other health behaviors. *Public Health Reports, 100*, 172-180.

Blanchard, E. B. (1982) Behavioral medicine: Past, present, and future. *Journal of Consulting and Clinical Psychology, 50*, 795-796.

Bloom, B.L. (1985). Focal issues in the prevention of mental disorders. In H.H. Goldman & S.E. Goldston (Eds.), *Preventing stress-related psychiatric disorders* . (DHHS Publication No. ADM 85-1385). Washington, DC: U.S. Government Printing Office.

Blumenthal, J.A., Williams, S., Wallace, A.G., Williams, R., & Needles, T.L. (1982). Physiological and psychological variables predict compliance to prescribed exercise therapy in patients recovering from myocardial infarction. *Psychosomatic Medicine, 44*, 519-528.

Borg, G. (1961). Perceived exertion in relation to physical work load and pulse rate. *Kungliga Fysiografiska Sallskapets Lund Forhandlingar, 31,* 105-115.

Borg, G. (1962). A simple rating scale for use in physical work test. *Kungliga Fysiografiska Sallskapets Lund Forhandlingar,32,* 7-15.

Borg, G. (1982). Psychophysical bases of perceived exertion. *Medicine and Science in Sports and Exercise, 14,* 337-381.

Brawley, L.R. (1979). Motivating participation in the fitness group. *Recreation Research Review, 6,* 35-39.

Brownell, K.D., & Wadden, T.A. (1986). Behavior therapy for obesity: Modern approaches and better results. In K.D. Brownell & J.P. Foreyt (Eds.), *Handbook of eating disorders* (pp. 180-187). New York: Basic Books, Inc.

Brownell, K.D., Marlatt, G.A., Lichtenstein, E., & Wilson, G.T. (1986). Understanding and preventing relapse. *American Psychologist, 41,* 765-782.

Brozek, J., Grande, F., Anderson, J.T., & Keys, A. (1963). Densiometric analysis of body composition: Revision of some quantitative assumptions. *Annals of the New York Academy of Sciences, 110,* 113-140.

Bruce, E.H., Frederick, R., Bruce, R.A., & Fisher, L.D. (1976). Comparison of active participants and dropouts in CAPRI cardiopulmonary rehabilitation programs. *American Journal of Cardiology, 37,* 53-60.

Bury, R.G. (1929). *Plato: With an English translation. (Vol. 7: Timaeus),* p. 241.

Canada Fitness Survey (1983). Fitness and lifestyle in Canada. Ottawa, Ontario: Fitness and Amateur Sport, Government of Canada.

Caspersen, C.J., Christenson, G.M., & Pollard, R.A. (1986). Status of the 1990 physical fitness and exercise objectives--evidence from NHIS, 1985. *Public Health Reports, 101,* 587-592.

Centers for Disease Control (1980). *Ten leading causes of death in the United States, 1977,* Atlanta.

Chambliss, C.A., & Murray, E.J. (1979). Efficacy attribution, locus of control, and weight loss. *Cognitive Therapy and Research, 3,* 349-353.

Chesney, M. (1984). Behavior modification and health enhancement. In J.D. Matarazzo, S.M. Weiss, J.A. Herd, N.E. Miller, & S.M. Weiss (Eds.), *Behavioral health: A handbook of health enhancement and disease prevention* (pp. 338-350). New York: John Wiley & Sons.

Chubb, M., & Chubb, H.R. (1981). *One third of our time? An introduction to recreation behavior and services.* (p. 95). New York: John Wiley and Sons.

Colt, E.W.D., Wardlaw, S.L., & Frantz, A.G. (1981). Effect of running on plasma beta-endorphins. *Life Sciences, 28,* 1637- 1640.

Condiote, M.M., & Lichtenstein, E. (1981). Self-efficacy and relapse in smoking cessation programs. *Journal of Counseling and Clinical Psychology, 49,* 648-658.

Cooper, K.H. (1977). *The aerobics way.* New York: Basic Books.

Cox, M., Shephard, R.J., & Corey, P. (1981). Influence of an employee fitness programme upon fitness productivity and absenteeism. *Ergonomics, 24,* 795-806.

Cox, M.H. (1984). Fitness and lifestyle programs for business and industry: Problems in recruitment and retention. *Journal of Cardiac Rehabilitation, 4,* 136-142.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety: The experience of play in work and games.* San Francisco: Jossey-Bass.

Csikszentmihalyi, M., & Larson, R. (1984). *Conflict and growth in the teenage years.* New York: Basic Books.

Deci, E.L. (1972). Intrinsic motivation, extrinsic reinforcement and inequity. *Journal of Personality and Social Psychology, 22,* 113-120.

Deci, E.L. (1975). *Intrinsic motivation.* New York: Plenum.

Department of Health and Human Services. (Fall, 1980). *Promoting health/preventing disease: Objectives for the nation..* Washington, D.C.: U.S. Government Printing Office.

Department of Youth, Sports, and Recreation. (1979). Life be in it: National evaluation study. Melbourne: Department of Youth, Sport, and Recreation, Government of Victoria.

deVries, H.A. (1981). Tranquilizer effects of exercise: A critical review. *The Physician and Sports Medicine, 9,* 46-53.

Di Clemente, C.C., Prochaska, J.O., & Gilbertini, M. (1985). Self-efficacy and stages of self-change of smoking. *Cognitive Therapy and Research.*

DiMatteo, M.R., & DiNicola, D.D. (1982). *Achieving patient compliance.* New York: Pergamon Press.

Dishman, R.K. (1981). Biological influences on exercise adherence. *Research Quarterly of Exercise and Sport, 52,* 143-159.

Dishman, R.K. (1982). Compliance/adherence in health-related exercise. *Health Psychology, 1,* 237-267.

Dishman, R.K. (1986). Exercise compliance: A new view for public health. *The Physician and Sports Medicine, 14,* 127- 145.

Dishman, R.K. (Ed.). (1988). *Exercise adherence: Its impact on public health* (p.1). Champaign, Illinois: Human Kinetics Books.

Dishman, R.K., & Dunn, A.L. (1988). Exercise adherence in children and youth: Implications for adulthood, In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health,* (pp. 155-200). Champaign, Illinois: Human Kinetics.

Dishman, R.K., & Gettman, L.R. (1980). Psychobiological influences on exercise adherence. *Journal of Sport Psychology, 2,* 295-310.

Dishman, R.K., & Ickes, W. (1981). Self-motivation and adherence to therapeutic exercise. *Journal of Behavioral Medicine, 4,* 421-436.

Dishman, R.K., Ickes, W., & Morgan, W.P. (1980). Self- motivation and adherence to habitual physical activity. *Journal of Applied Social Psychology, 10,* 115-132

Dishman, R.K., Sallis, J.F., & Orenstein, D.R. (1985). The determinants of physical activity and exercise. *Public Health Reports, 100,* 158-171.

Dulany, D.E. (1968). Awareness, rules, and propositional control: A confirmation with S-R behavior theory. In T.R. Dixon & D.L. Horton (Eds.), *Verbal behavior and general behavior theory* (pp. 340-387). Englewood Cliffs, New Jersey: Prentice-Hall.

Edell, B.H., Edington, S., Herd, B., O'Brien, R.M., & Witkin, G. (1987). Self-efficacy and self-motivation as predictors of weight loss. *Addictive Behaviors, 12,* 63-66.

Efron, B. (1971). Forcing a sequential experiment to be balanced. *Biometrika, 58,* 403-417.

Epstein, L.H., & Cluss, P.A. (1982). A behavioral medicine perspective on adherence to long-term medical regimens. *Journal of Consulting and Clinical Psychology, 50,* 950-971.

Epstein, L.H., & Wing, R.R. (1980). Aerobic exercise and weight. *Addictive Behaviors, 5,* 371-388.

Epstein, L.H., Miller, G.J., Stitt, F.W., & Morris, J.N. (1976). Vigorous exercise in leisure time, coronary risk factors, and resting electrocardiogram in middle-aged civil servants. *British Heart Journal, 38,* 403-409.

Epstein, L.H., Wing, R.R., Thompson, J.K., & Griffin, W. (1980). Attendance and fitness in aerobics exercise: The effects of contract and lottery procedures. *Behavior Modification, 4,* 465-479.

Ewart, C.K., Stewart, K.J., Gillilan, R.E., Kelemen, M.H., Valenti, S.A., Manley, J.D., & Kelemen, M.D. (1986). Usefulness of self-efficacy in predicting overexertion during programmed exercise in coronary artery disease. *American Journal of Cardiology, 57,* 557-561.

Ewart, C.K., Taylor, C.B., Reese, C.B., & DeBusk, R.F. (1983). Effects of early post-myocardial infarction exercise testing on self-perception and subsequent physical activity. *American Journal of Cardiology, 51,* 1076-1080.

Feltz, D.L., & Petlichkoff, L. (1983). Perceived competence among interscholastic sport participants and dropouts. *Canadian Journal of Applied Sport Sciences, 8,* 231-235.

Ferris, B. (1985). Let's put some fun back into fitness. *Recreation Canada, Special Issue,* 16-20.

Fillingin, R.B., & Fire, M.A. (1986). The effects of internal versus external information processing on symptom perception in an exercise setting. *Health Psychology, 5,* 115-123.

Finnegan, D.L., & Suler, J.R. (1985). Psychological factors associated with maintenance of improved health behaviors in postcoronary patients. *The Journal of Psychology, 119,* 87-94.

Fishbein, M. (1980). A theory of reasoned action: Some application. In H. Howe & M. Page (Eds.), *Nebraska Symposium on Motivation 1978.* Lincoln: University of Nebraska Press.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading, Massachusets: Addison-Wesley.

Fitness Ontario (1983). *Physical activity patterns in Ontario II.* Toronto: Ministry of Tourism and Recreation, Government of Ontario.

Franklin, B. (1984). Exercise program compliance: Improvement strategies. In J. Storlie & H. Jordan (Eds.), *Behavioral management of obesity* (pp. 105-135). New York: Spectrum.

Franklin, B.A. (1988). Program factors that influence exercise adherence: Practical adherence skills for the clinical staff. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 237-258). Champaign, Illinois: Human Kinetics Books.

Freedson, P.S., Mihevic, P.M., Loucks, A.B., & Grandola, R.N. (1983). Physique, body composition, and psychological characteristics of competitive female body builders. *The Physician and Sports Medicine, 11,* 85-93.

Gale, J.B., Eckhoff, W.T., Mogel, S.F., & Rodnick, J.E. (1984). Factors related to adherence to an exercise program for healthy adults. *Medicine and Science in Sports, 16,* 544-549.

Gallup Poll. (1977). Exercise, pp. 1200-1202.

Gallup Poll. (1980). Sports, pp. 109-111.

Gallup Poll. (1983). Jogging/Exercise, 16-17.

Gettman, L.R., Pollock, M.L., & Ward, A. (1983). Adherence to unsupervised exercise. *The Physician and Sports Medicine, 11,* 56-66.

Gibbons, L.W., Blair, S.N., Cooper, K.H., & Smith, M. (1983). Association between coronary heart disease risk factors and physical fitness in health adult women. *Circulation, 67,* 977-983.

Godin, G., & Shephard, R.J. (1986). Importance of type of attitude to the study of exercise behavior. *Psychological Reports, 58,* 991-1000.

Godin, G., Colantonio, A., Davis, G.M., Shephard, R.J., & Simard, C. (1986). Prediction of leisure time exercise behavior among a group of lower-limb disabled adults. *Journal of Clinical Psychology, 42,* 272-279.

Godin, G., Disharnais,R., Jobin, J., & Cook, J. (1987). The impact of physical fitness and health-age appraisal upon exercise intentions and behavior. *Journal of Behavioral Medicine, 10,* 241-250.

Godin, G., Valois,P., Shephard, R.J., & Desharnais,R. (1987). Prediction of leisure-time exercise behavior: A path analysis (LISREL V) Model. *Journal of Behavioral Medicine, 10,* 145-158.

Gossard, D., Haskell, W.L., Taylor, C.B., Mueller, J.K., Rogers, F., Chandler, M., Ahn, D.K., Miller, N.H., & De Busk, R.F. (1986). Effects of low- and high-intensity home-based exercise training on functional capacity in healthy middle-aged men. *American Journal of Cardiology, 57,* 446-449.

Haefner, D.P., & Kirscht, J.P. (1970). Motivational and behavioral effects of modifying health beliefs. *Public Health Reports, 85,* 478-484.

Hanson, P. (1984). Illness among athletes: An overview. In R.H. Strauss (Ed.), *Sports medicine* (pp 79-90). Philadelphia: W.B. Saunders.

Harris, D. (1970). Physical activity history and attitudes of middle-aged men. *Medicine and Science in Sports, 2,* 203-208.

Harter, S. (1981). The development of competence motivation in the mastery of cognitive and physical skills: Is there still a place for joy? In G.C. Roberts & D.M. Landers, (Eds.), *Psychology of motor behavior and sport, (*pp. 3-29). Champaign, Illinois: Human Kinetics Books.

Harter, S. (1983). Developmental perspectives on the self-system. In E.M. Hetherington (Ed.), *Handbook of child psychology* , (pp.275-385). New York: John Wiley.

Haskell, W. (1984). Overview: Health benefits of exercise In J.D. Matarazzo, S.M. Weiss, J.A. Herd, N.E. Miller, & S.M. Weiss (Eds.), *Behavioral health: A handbook of health enhancement and disease prevention* (pp. 409-423). New York: John Wiley & Sons.

Haskell, W.L. (1985). Physical activity and health: Need to define the required stimulus. *American Journal of Cardiology, 55,* 4D-9D.

Haskell, W.L., Montoye, H.J., Orenstein, D.R. (1985). Physical activity and exercise to achieve health-related components of physical fitness. *Public Health Reports, 100,* 202-212.

Haynes, R.B., Taylor, D.W., & Sackett, D.L. (Eds.) (1979). *Compliance in health care.* Baltimore: Johns Hopkins University Press.

Heiby, E.M. (1986, August). *A paradigmatic behavioral perspective of noncompliance to health regimens.* Paper presented at the convention of the American Psychologist Association, Washington, D.C.

Heiby, E.M., & Carlson, J.G. (1986). The Health Compliance Model. *The Journal of Compliance in Health Care, 1,* 133-150.

Heiby, E.M., Onrato, V.A., & Sato, R.A. (1985, August). *A cognitive-behavioral model of adherence to health related exercise.* Poster presentation at the 1985 Convention of the American Psychologist Association, Los Angeles.

Heiby, E.M., Onrato, V.A., & Sato, R.A. (1986). *Adherence to marathon training.* Unpublished manuscript.

Heinzelman, F. (1962). Factors in prophylaxis behavior in treating rhematic fever: An exploratory study. *Journal of Health and Human Behavior, 3,* 73-81.

Heinzelman, F. (1973). Social and psychological factors that influence the effectiveness of exercise programs. In J. Naughton & H.K. Hellerstein (Eds.), *EXercise testing and exercise training in coronary heart disease* (pp. 275-287). New York: Academic Press.

Heinzelman, F., & Bagley, R.W. (1970). Response to physical activity programs and their effects on health behavior. *Public Health Reports, 86,* 905-911.

Hochbaum, G.M. (1956). Why people seek diagnostic X-rays. *Public Health Reports, 71,* 377-380.

Holloszy, J.O., Schultz, J., Kusnierkiewicz, J., Hagberg, J.M., & Ehsani, A.A. (1986). Effects of exercise on glucose tolerance and insulin resistance. Brief review and some preliminary results. *Acta Medica Scandinavica, 711* (Supplement), 55-65.

Hoyt, M.F., & Janis, I.L. (1975). Increasing adherence to a stressful decision via a motivational balance-sheet procedure: A field experiment. *Journal of Personality and Social Psychology, 35,* 833-839.

Hughes, J.R., Crow, R.S., Jacobs, D.R., Jr., Mittelmark, M.B., & Leon, A.S. (1984). Physical activity, smoking, and exercise- induced fatigue. *Journal of Behavioral Medicine, 7,* 217-230.

Ingjier, F., & Dahl, H.A. (1979). Dropouts from an endurance training program. *Scandinavian Journal of Sports Sciences, 1,* 20-22.

Iverson, D.C., Fielding, J.E.,Crow, R.S., & Christenson, G.M. (1985). The promotion of physical activity in the United States population: The status of programs in medical worksite, community and school settings. *Public Health Reports, 100,* 212-224.

Janz, N.K, & Becker, M.H. (1984). The health belief model: A decade later. *Health Education Quarterly, 11,* 1-47.

Kaiser, H.F., & Caffrey, J. (1965). Alpha factor analysis. *Pychometrika, 30,* 1-14.

Kaplan, R. M. (1984). The connection between clinical health promotion and health status. *American Psychologist, 39,* 755-765.

Kaplan, R.M., Atkins, C.J., & Reinsch, S. (1984). Specific efficacy expectations mediate exercise compliance in patients with COPD. *Health Psychology, 3,* 223-242.

Kau, M.L., & Fischer, J. (1974). Self-modification fo exercise behavior. *Journal of Behavior Therapy and Experimental Psychiatry, 5,* 213-214.

Kavanagh, T., Shephard, R.J., Doney, H., & Pandit, V. (1973). Intensive exercise in coronary rehabilitation. *Medicine and Science in Sports, 5,* 34-39.

Kegeles, S.S. (1963). Why people seek dental care: A test of a conceptual formation. *Journal of Health and Human Behavior, 4,* 166-173.

Kenyon, G.S. (1968a). A conceptual model for characterizing physical activity. *The Research Quarterly, 39,* 96-105.

Kenyon, G.S. (1968b). Six scales for assessing attitude toward physical activity. *The Research Quarterly, 39, 566-674.*

Kersell, M.W., & Milsum, J.H. (1985). A systems model of health behavior change. *Behavioral Science, 30, 119-126.*

Kilbom, A., Hartley, L., Saltin, B., Bjure, J., Grimby, G., & Astrand, I. (1969). Physical training in sedentary middle-aged and older men. I. Medical evaluation. *Scandinavian Journal of Clinical and Laboratory Investigation, 24,* 315-322.

King, A.C., & Frederiksen, L.W. (1984). Low-cost strategies for increasing exercise behavior. *Behavior Modification, 8,* 3-21.

Kirscht, J.P. (1983). Preventive health behavior: A review of research and issues. *Health Psychology, 2,* 277-301.

Knapp, D., Guttman, M., Foster, C., & Pollock, M. (1984). Self-motivations among 1984 Olympic speedskating hopefuls and emotional response and adherence to training. *Medicine and Science in Sports and Exercise (abstract), 16,* 114.

Knapp, D., Guttman, M., Squires, R., & Pollock, M. (1983). Exercise adherence among coronary artery bypass surgery (CABS) patients. *Medicine and Science in Sports and Exercise, 15,* 120.

Knapp, D.N. (1988). Behavioral management techniques and exercise promotion. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 203-235). Champaign, Illinois: Human Kinetics Books.

Koop, C.E. (1983). Perspectives on future health care. *Health Psychology, 2,* 303-312.

Kriska, A.M., Bayles, C., Cauley, J.A., LaPorte, R.E., Sandler, R.B., & Pambianco, G. (1986). A randomized exercise trial in older women: Increased activity over two years and the factors associated with compliance. *Medicine and Science in Sports, 18,* 557-562.

Langlie, J.K. (1977). Social networks, health beliefs, and preventive health behavior. *Journal of Health and Social Behavior, 18,* 244-260.

LaPorte, R.E., Adams, L.L., Savage, D.D., Brenes, G., Dearwater, S., & Cook, T. The spectrum of physical activity, cardiovascular disease, and health: An epidemiological perspective. *American Journal of Epidemiology,120,* 507-517.

Lees, L.A., & Dygdon, J.A. (1988). Initiation and maintenance of exercise behavior: A learning theory conceptualization. *Clinical Psychology Review, 8,* 345-353.

Lefcourt, H.M. (1976). *Locus of control: Current trends in theory and research.* Hillsdale, New Jersey: Erlbaum.

Leon, A.S., Jacobs, D.R., De Backer, G., & Taylor, H.L. (1981). Relationship of physical characteristics and life habits to treadmill exercise capacity. *American Journal of Epidemiology, 113* 653-660.

Lepper, M.R., & Green, D. (Eds.) (1978). *The hidden costs of reward: New perspectives on the psychology of human motivation.* Hillsdale, New Jersey: Erlbaum Associates.

Levenson, H. (1973). Multidimensional locus of control in psychiatric patients. *Journal of Consulting and Clinical Psychology, 41,* 397-404.

Lewin, K. (1935). *A dynamic theory of personality.* New York: McGraw-Hill.

Libb, J.W., & clements, C.B. (1969). Token reinforcement in an exercise program for hospitalized geriatric patients. *Perceptual and Motor Skill, 28,* 957-958.

Lindsay-Reid, E., & Osborn, R.W. (1980). Readiness for exercise adoption. *Social Science and Medicine, 14A,* 139-146.

Lorig, K., & Laurin, J. (1985). Some notions about assumptions underlying health education. *Health Education Quarterly, 12,* 231-243.

Mahoney, M. (1977). Reflections on the cognitive-learning trend in psychotherapy. *American Psychologist, 32,* 5-13.

Maiman, L.A., & Becker, M.H. (1974). The health belief model: Origins and correlates in psychological theory. *Health Education Monographs, 2,* 336-353.

Mann, G.V., Garrett, H.L., Farhi, A., Murray, H., & Billings, F.T. (1969). Exercise to prevent coronary heart disease: An experimental study of the effects of training on risk factors for coronary disease in men. *American Journal of Medicine, 46,* 12-27.

Marlatt, G.A., & Gordon, J.R. (1980). Determinants of relapse: Implications for the maintenance of behavior change. In P.O. Davidson & S.M. Davidson (Eds.), *Behavioral medicine: Changing lifestyles* (pp. 410-452). Elmsford, New York: Pergamon.

Marlatt, G.A., & Gordon, J.R. (1985). *Relapse prevention: Maintenance strategies in addictive behavior change.* New York: Guilford.

Martin, J.E., & Dubbert, P.M. (1982). Exercise applications and promotion in behavioral medicine: Current status and future directions. *Journal of Counseling and Clinical Psychology, 50,* 1004-1017.

Martin, J.E., Dubbert, P.M., Katell, A.D., Thompson, J.K., Raczynski, J.R., Lake, M., Smith, P.O., Webster, J.S., Sikora, T., & Cohen, R.E. (1984). Behavioral control of exercise in sedentary adults: Studies 1 through 6. *Journal of Counseling and Clinical Psychology, 52,* 795-811.

Massie, J.F., & Shephard, R.J. (1971). Physiological and psychological effects of training. *Medicine and Science in Sports, 3,* 110-117.

Matarazzo, J.D., Weiss, S.M., Herd, J.A., Miller, N.E., & Weiss, S.M. (Eds.) (1984). *Behavioral health: A handbook of health enhancement and disease prevention.* New York: John Wiley & Sons.

Mathes, S.A., & Batista, R. (1985). College men's and women's motives for participation on physical activity. *Perceptual and Motor Skills, 61,* 710-726.

McClelland, D.C., Atkinson, J.W., Clark, R.A., & Lowell, E.L. (1953). *The achievement motive.* New York: Appleton-Century-Crofts.

McCutcheon, L.E., & Yoakum, M.E. (1983). Personality attributes of ultramarathoners. *Journal of Personality Assessment, 47,* 178-180.

McIntyre, K.O., Lichtenstein, E., & Mermelstein, R.J. (1983). Self-efficacy and relapse in smoking cessation: A replication and extension. *Journal of Counseling and Clinical Psychology, 51,* 632-633.

McPherson, B.D. (July, 1984). *Sport, health, well-being, and aging: Some conceptual and methodological issues and questions for sport scientists.* Paper presented at the Olympic Scientific Congress, Eugene, Oregon.

Melamed, B.G., & Siegel, L.J. (1980). *Behavioral medicine: Practical applications in health care.* New York: Springer

Meyer, A., Nash, J., McAlister, A., Maccoby, N., & Farquhar, J. (1980). Skills training in a cardiovascular health education campaign. *Journal of Consulting and Clinical Psychology, 48,* 129-142.

Mihevic, P. M. (1981). Sensory cues for perceived exertion: A review. *Medicine and Science in Sports and Exercise, 13,* 150-163.

Miller Lite report on American attitudes toward sports. (1983). Milwaukee: Miller Brewing Company.

Miller, P., Johnson, N.L., Wikoff, R., McMahon, M.F., & Garrett, M.J. (1983). Attitudes and regimen adherence of myocardial infarction and cardiac bypass patients. *Journal of Cardiac Rehabilitation, 3,* 541-548.

Mirotznik, J., Speedling, E., Stein, R., & Bronz, C. (1985). Cardiovascular fitness program: Factors associated with participation and adherence. *Public Health Reports, 100,* 13-18.

Mischel, W. (1973). Toward a cognitive social learning reconceptualization of personality. *Psychological Review, 80,* 252-283.

Montoye, H.J. (1975). *Physical activity and health: An epidemiologic study of an entire community (p. 95).* Englewoods Cliff, New Jersey: Prentice Hall.

Morbidity and Mortality Weekly Report (MMWR). (1986). Years of life lost from cardiovascular disease, 35 654-655.

Morgan, V.D., Peck, D.F., Buchanan, D.R., & McHardy, G.J.R. (1983). Effect of attitudes and beliefs on exercise tolerance in chronic bronchitis. *British Medical Journal, 286,* 171-173.

Morgan, W.P. (1973). Psychological factors influencing perceived exertion. *Medicine and Science in Sports, 5,* 97- 103.

Morgan, W.P. (1977). Involvement in vigorous physical activity with special reference to adherence. In L.I. Gedvilas & M.E. Kneer (Eds.), *National College Physical Education Proceedings* (pp. 235-246). Chicago: University of Illinois at Chicago Circle, Office of Publications Service.

Morgan, W.P., & Goldston, S.E. (Eds.). (1987). *Exercise and mental health..* Washington: Hemisphere Publishing Corporation.

Morgan, W.P., & Pollock, M.L. (1978). Physical activity and cardiovascular health: Psychological aspects. In F. Laundry & W. Orban (Eds.), *Physical activity and human well-being* (pp. 163-181). Miami: Symposium Specialists.

Morris, J.N., Chave, S.P.W., Adam, C., Sirey, C., Epstein, L. & Sheehan, D.L. (1973). Vigorous exercise in leisure time and the incidence of coronary heart disease. *Lancet, 1,* 333-339.

Morris, J.N., Everitt, M.G., Pollard, R., Chave, S.P.W., & Semnence, A.M. (1980). Vigorous exercise in leisure time: Protection against coronary heart disease. *Lancet, 2,* 1207-1210.

Murdaugh, C., & Hinshaw, A.S. (1986). Theoretical model testing to identify personality variables effecting preventive behaviors. *Nursing Research, 35,* 19-23.

National Center for Health Statistics (1978). *Exercise and participation in sports among persons 20 years of age and over, United States, 1975.* (Advanced data No. 19). Washington, DC: U.S. Government Printing Office.

National Center for Health Statistics (1981). *Highlights from Wave 1 of the National Survey of Personal Health Practices and Consequences: United States, 1979.* (DHHS Publication No. (PHS) 81-1162). Washington, DC: U.S. Government Printing Office.

Neale, D.C., Sonstroem, R.J., & Metz, K.F. (1969). Physical fitness, self-esteem, and attitudes toward physical activity. *The Research Quarterly, 40,* 743-749.

O'Leary, A. (1985). Self-efficacy and health. *Behavioral Research and Therapy, 23,* 437-451.

Ogilvie, B.C., & Tutko, T.A. (1971). If you want to build character try something else. *Psychology Today, 5,* 61-63.

Oldridge, N. (1977). What to look for in an exercise class leader. *The Physician and Sportsmedicine, 5,* 85-88.

Oldridge, N.B. (1982). Compliance and exercise in primary and secondary prevention of coronary heart disease: A review. *Preventive Medicine, 11,* 56-70.

Oldridge, N.B. (1984). Adherence to adult exercise fitness programs. In J.D. Matarazzo, S.M. Weiss, J.A. Herd, N.E. Miller, & S.M. Weiss (Eds.), *Behavioral health: A handbook of health enhancement and disease prevention* (pp. 467-487). New York: John Wiley & Sons.

Oldridge, N.B., Donner, A., Buck, C., Andrew, G., Jones, N.L., Parker, J.O., Cunningham, D.A., Kavanagh, T., Rechnitzer, P., & Sutton, J.R. (1983). Predictors of dropout from the Ontario Exercise-Heart Collaborative Study. *American Journal of Cardiology, 51,* 70-74.

Oldridge, N.B., Wicks, J.R., Hanley, C., Sutton, J.R., & Jones, N.L. (1978). Non-compliance in a post-myocardial infarction exercise rehabilitation program. *Canadian Medical Association Journal, 118,* 361-364.

Olsen, E. (1988). Putting fun back into fitness. *Readers Digest,* p.53.

Olson, J.M., & Zanna, M.P. (1982). Predicting adherence to a program of physical exercise: An empirical study. Toronto: Government of Ontario, Ministry of Tourism and Recreation.

Olson, J.M., & Zanna, M.P. (1987). Understanding and promoting exercise: A social psychological perspective. *Canadian Journal of Public Health, 78,* S1-S7.

Paffenbarger, R.S., Jr., & Hyde, R.T. (1988). Exercise adherence, coronary heart disease, and longevity. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 41-73). Champaign, Illinois: Human Kinetics Books.

Pandolf, K.B. (1978). Influence of local and central factors in dominating rated perceived exertion during physical work. *Perceptual and Motor Skills, 46,* 683-698.

Pender, N.J., & Pender, A.R. (1986). Attitudes, subjective norms, and intentions to engage in health behaviors. *Nursing Research, 35,* 15-18.

Pennebaker, J.W., & Lightner, J.M. (1980). Competition of internal and external information in an exercise setting. *Journal of Personality and Social Psychology, 39,* 165-174.

Perrier Study:Fitness in America. (1979). New York: Perrier Great Waters of France.

Perrin, B. (1979). Survey of physical activity in the regional municipality of Waterloo. *Recreation Research Review, 6,* 48-52.

Pollock, M.L. (1988). Prescribing exercise for fitness and adherence. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 259-277). Champaign, Illinois: Human Kinetics Books.

Pollock, M.L., Wilmore, J.H., & Fox, S.M. (1984). *Exercise in health and disease--evaluation and prescription for prevention and rehabilitation.* Philadelphia: W.B. Saunders.

Powell, K.E. (1988). Habitual exercise and public health: An epidemiological view. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 15-39). Champaign, Illinois: Human Kinetics Books.

Powell, K.E., Spain, K.G., Christenson, G.M., Mollenkamp, M.P. (1986). The status of the 1990 objectives for physical fitness and exercise. *Public Health Reports, 101,* 15-21.

President's Council on Physical Fitness and Sports. (1974). National Adult Physical Fitness survey. *Physical Fitness Research Digest, 4,* 1-27.

Prochaska, J.O., & DiClemente, C.C. (1983). Stage and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51,* 390-395.

Richardson, C.E. (1960). Thurstone scale for measuring attitudes of college students toward physical fitness and exercise. *Research Quarterly, 31,* 628-643.

Riddle, P.K. (1980). Attitudes, beliefs, behavior intentions, and behaviors of women and men toward regular jogging. *Research Quarterly for Exercise and Sport, 51,* 663-674.

Roberts, G.C., Kleiber, D.A., & Duda, J.L. (1981). An analysis of motivation in children's sport: The role of perceived competence in participations. *Journal of Sport Psychology, 3,* 206-216.

Robinson, T.T., & Carron, A.V. (1982). Personal and situational factors associated with dropping out versus maintaining participations in competitive sport. *Journal of Sport Psychology, 4,* 364-378.

Rosenstock, I.M. (1960). What research in motivation suggests for public health. *American Journal of Public Health, 50,* 295-302.

Rosenstock, I.M. (1974). Historical origins of the health belief model. *Health Education Monographs, 2,* 1-9.

Rosenstock, I.M., Derryberry, M., & Carriger, B.K. (1959). Why people fail to seek poliomyeltis vaccination. *Public Health Reports, 74,* 93-103.

Rosenstock, I.M., Stretcher, V.J., & Becker, M.H. (1988). Social learning theory and the Health Belief Model. *Health Education Quarterly, 15,* 175-183.

Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs, 80,* (1. Whole No. 609).

Ryckman, R.M., Robbins, M.A., Thornton, B., & Cantrell, P. (1982). Development and validation of a physical self-efficacy scale. *Journal of Personality and Social Psychology, 42,* 891-900.

Sackett, D. L., & Haynes, R.B. (Eds.). (1976): *Compliance with therapeutic regimens.* Baltimore: University Press.

Sallis, J.F., Haskell, W.L., Fortmann, S.P., Vranizan, K.M., Taylor, C.B., & Solomon, D.S. (1986). Predictors of adoption and maintenance of physical activity in a community sample. *Preventive Medicine, 15,* 331-341.

Saltzer, E.B. (1982). The weight locus of control (MLOC) scale: A specific measure for obesity research. *Journal of Personality Assessment, 46,* 620-628.

Sanne, H., Elmfeldt, D., Grimby, G., Rydin, G., & Wilhelmsen, L. (1973). Exercise tolerance and physical training of non-selected patients after myocardial infarction. *Acta Medica Scandinavian, 551* (Supplement), 1-12.

Schunk, D.H., & Carbonari, J.P. (1984). Self-efficacy models. In J.D. Matarazzo, S.M. Weiss, J.A. Herd, N.E. Miller, & S.M. Weiss (Eds.), *Behavioral health: A handbook of health enhancement and disease prevention,* (pp. 230-247). New York: John Wiley & Sons.

Shephard, R.J. (1988). Exercise adherence in corporate settings: Personal traits and program barriers. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 305-315). Champaign, Illinois: Human Kinetics Books.

Sherer, M., & Adams, C.H. (1983). Construct validation of the self-efficacy scale. *Psychological Reports, 53,* 899-902.

Sidney, K.H., & Shephard, R.J. (1976). Attitude toward health and physical activity in the elderly: Effects of a physical training program. *Medicine and Science in Sport, 8,* 246-252.

Simon, H.B. (1984). The immunology of exercise. *Journal of the American Medical Association, 252,* 2735-2738.

Siri, W.E. (1961). Body composition from fluid spaces and density: Analysis of methods. In J. Brozek & A. Henschel (Eds.), *Techniques for measuring body composition,* pp. 223-244. Washington, D.C.: National Academy of Sciences.

Siscovick, D.S., Laporte, R.E., & Newman, J.M. (1985). The disease-specific benefits and risks of physical activity and exercise. *Public Health Reports, 100,* 180-188.

Skinner, B.F. (1953). *Science and human behavior.* New York: Macmillan.

Skinner, B.F., Hustler, R., Bergsteinova, V., & Buskirk, E.R. (1973). The validity and reliability of a rating scale. *Medicine and Science in Sports, 5,* 94-96.

Slenker, S.E., Price, J.H., Roberts, S.M., & Jurs, S.G. (1984). Joggers versus nonexercisers: An analysis of knowledge, attitudes, and beliefs about jogging. *Research Quarterly for Exercise and Sport, 55,* 371-378.

Snyder, G., Franklin, B., Foss, M., & Rubenfire, M. (1982). Characteristics of compliers and non-compliers to cardiac exercise therapy programs. *Medicine and Science in Sports and Exercise (abstract), 14,* 179.

Sonstroem, R.J. (1974). Attitude testing examining certain psychological correlates of physical activity. *The Research Quarterly, 45,* 93-103.

Sonstroem, R.J. (1978). Physical estimation and attraction scales: Rationale and research. *Medicine and Science in Sports, 10,* 97-102.

Sonstroem, R.J. (1984). Self-esteem and physical activity. In R.L. Terjung (Ed.), *Exercise and sport sciences reviews* (Vol. 12, pp. 123-155). Lexington, MA: Collomore Press.

Sonstroem, R.J. (1988). Psychological models. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 125-153). Champaign, Illinois: Human Kinetics Books.

Sonstroem, R.J., & Kampper, K.P. (1980). Prediction of athletic participation in middle school males. *Research Quarterly for Exercise and Sport, 51,* 685-694.

Sonstroem, R.J., & Walker, M.I. (1973). Relationship of attitudes and locus of control to exercise and physical fitness. *Perceptual and Motor Skills, 36,* 1031-1034.

Stalonas, P.M., Johnson, W.G., & Christ, M. (1978). Behavior modification for obesity: The evaluation of exercise, contingency management, and program adherence. *Journal of Consulting and Clinical Psychology, 46,* 463-469.

Steiger, J.H. (1980). Tests for comparing elements of a correlation matrix. *Psychological Bulletin, 87,* 245-251.

Stephans, T., Jacobs, Dr.R., & White, C.C. (1985). A descriptive epidemiology of leisure-time physical activity. *Public health Reports, 100,* 147-158.

Stretcher, V.J., DeVellis, B., Becker, M.H., & Rosenstock, I.M. (1986). ??? *Health Education Quarterly, 13,*73-91.

Strickland, B. (1978). Internal-external expectancies and health-related behaviors. *Journal of Counseling and Clinical Psychology, 46,* 1192-1211.

Strickland, B.R. (1978). Internal-external expectancies and health-related behaviors. *Journal of Consulting and Clinical Psychology, 46,* 1192-1211.

Teraslinna, P., Partanen, T., Koskela, A., & Oja, P. (1969). Characteristics affecting willingness of executive to participate in an activity program aimed at coronary heart disease prevention. *Journal of Sports Medicine and Physical Fitness, 9,* 224-229.

Thompson, C.E., & Wankel, L.M. (1980). The effects of perceived choice upon frequency of exercise behavior. *Journal of Applied Social Psychology, 19,* 436-443.

Thompson, J., Wyatt, J.T.B., & Craighead, L.W. (1984). Three theoretically based interventions to increase exercise adherence in a health-promotion regimen. *Psychosomatic Medicine, (abstract), 461,* 80.

Thoreau, H.D. (1978). In R. Epstein & S. Phillips (Eds.), *The natural man: A Thoreau anthology.* Wheaton, Illinois: The Theosophical Publishing House.

Tirrel, B.E., & Hart, L.K. (1980). The relationship of health beliefs and knowledge to exercise compliance in patients after coronary bypass. *Heart Lung, 9,* 487-493.

Tolman, E.G. (1955). Principles of performance. *Psychological Review, 62,* 315-326.

Triandis, H.C. (1977). *Interpersonal behavior.* Monterey, California: Brooks/Cole.

Turner, R.D., Polly, S., & Sherman, A.R. (1976). A behavioral approach to individualized exercise programming. In J.D. Krumboltz & C.E. Thoresen (Eds.), *Counseling methods* (pp. 349-359). New York: Holt, Rinehart, & Winston.

U.S. Department of Health and Human Services. (1986). *Smoking and health: A national statistics report* (HHS/PHS/COC-87- 8396). Rocksville, Maryland.

Vallerand, R.J., & Reid, G. (1984). On the causal effects of perceived competence on intrinsic motivation: A test of cognitive evaluation theory. *Journal of Sports Psychology, 6,* 94-102.

Valois, P., Shephard, R.J., & Godin, G. (1986). Relationship of habit and perceived physical ability to exercise-behavior. *Perceptual and Motor Skills, 62,* 811-817.

Wallston, B.S., Wallston, K.A., Kaplan, G.D., & Maides, S.A. (1976). Development and validation of the health locus of control scale. *Journal of Consulting and Clinical Psychology, 44,* 580-585.

Wankel, L.M. (1984). Decision-making and social support strategies for increasing exercise adherence. *Journal of Cardiac Rehabilitation, 4,* 124-135.

Wankel, L.M. (1985). Personal and situational factors affecting exercise involvement: The importance of enjoyment. *Research Quarterly, 56,* 275-282.

Wankel, L.M. (1988). Exercise adherence and leisure: Patterns of involvement and interventions to facilitate regular activity. In R.K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 369-396.). Champaign, Illinois: Human Kinetics Books.

Wankel, L.M., & Thompson, C.E. (1977). Motivating people to be physically active: Self-persuasion versus balanced decision-making. *Journal of Applied Social Psychology, 7,* 332-340.

Wankel, L.M., Yardley, J.K., & Graham, J. (1985). The effects of motivational interventions upon the exercise adherence of high and low self-motivated adults. *Canadian Journal of Applied Sports Sciences, 10,* 147-156.

Wanzel, R.S. (1977). Factors related to withdrawal from an employee fitness program. Paper presented at the American Association for Leisure and Recreation National Conference, Seattle, Washington.

Wanzel, R.S. (1978). Toward preventing dropouts in industrial and other fitness programmes. *Recreation Canada, 36,* 39-42.

Ward, A., & Morgan, W.P. (1984). Adherence patterns of healthy men and women enrolled in an adult exercise program. *Journal of Cardiac Rehabilitation, 4,* 143-152.

Weinberg, R.S., Hughes, H.H., Critelli, J.W., England, R., & Jackson, A. (1984). Effects of preexisting and manipulated self-efficacy on weight loss in a self-control program. *Journal of Research in Personality, 18,* 352-358.

Weltman, A. (1984). Exercise and diet to optimize body composition. In J.D. Matarazzo, S.M. Weiss, J.A. Herd, N.E. Miller, & S.M. Weiss (Eds.), *Behavioral health: A handbook of health enhancement and disease prevention* (pp.509-524). New York: John Wiley and Sons.

White, C.C., Powell, K.E., Hogelin, G.C., Gentry, E.M., & Forman, M.R. (1987). *American Journal of Preventive Medicine, 3,* 304-310.

White, R. (1959). Motivation reconsidered: The concept of competence. *Psychological Review, 66,* 297-323.

Wilhelmsen, L., Sanne, H., Elmfeldt, D., Grimby, G., Tibblin, G., & Wedel, H. (1975). A controlled trial of physical training after myocardial infarction: Effects on risk factors, nonfatal reinforcement, and death. *Preventive Medicine, 4,* 491-508.

Wilmore, J. (1974). Individual exercise prescription. *The American Journal of Cardiology, 33,* 757-759.

Wilson, G.T. (1986). Cognitive factors in lifestyle changes: A social-learning perspective. In P.O. Davidson & S.M. Davidson (Eds.), *Behavioral medicine: Changing health lifestyles* (pp. 3-37). New York: Brunner/Mazel.

Wysocki, T., Hall, G., Iwata, B., & Riordan, M. (1978). Behavioral management of exercise: Contracting for aerobic points. *Journal of Applied Behavior Analysis, 12,* 55-64.

Community Health Interview Survey (CHIS) [form 3]

Interviewer Name: _____ Date: _____
Participant No.: _____ Time Began: _____ Time Ended: _____

II. EXERCISE

[" *The first few questions are about physical activity. I'll read off a list of activities, and I'd like for you to tell me which ones you have done over the* ***past 2 weeks.***"]

1. In the **PAST 2 WEEKS**, have you done any ...

[NOTE: Ask 1b-1d FOR EACH ACTIVITY MARKED "YES" IN 1a]

a. [Read activity below] YES (1) No (2)	b. How many times in the past 2 weeks did you [play/go/do] ... (*activity under a*)	c. On the average, about how many mins. did you actually spend on each occasion?	d. What usually happened to your HR or breathing? Did you have a small, mod., or large increase, or none?
(1) Walking for exercise? 1☐ 2☐	(1) _____ Times	(1) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(2) Jogging or running? 1☐ 2☐	(2) _____ Times	(2) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(3) Hiking? 1☐ 2☐	(3) _____ Times	(3) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(4) Gardening or yardwork? 1☐ 2☐	(4) _____ Times	(4) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(5) Aerobics, jazzercise, or aerobic dancing? 1☐ 2☐	(5) _____ Times	(5) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(6) Other dancing? 1☐ 2☐	(6) _____ Times	(6) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(7) Calisthenics (e.g., stretching, push-ups, sit-ups) 1☐ 2☐	(7) _____ Times	(7) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(8) Golf? 1☐ 2☐	(8) _____ Times	(8) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None

[CONTINUE ON NEXT PAGE]

a. [Read activity below]	Yes (1)	No (2)	b. How many times in the past 2 weeks did you [play/go/do] ... (*activity in 1a*)	c. On the average, about how many mins. did you actually spend on each occasion?	d. What usually happened to your HR or breathing? Did you have a small, mod., or large increase, or none?
(9) Tennis?	1☐	2☐	(9) _____ Times	(9) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(10) Bowling?	1☐	2☐	(10) _____ Times	(10) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(11) Biking?	1☐	2☐	(11) _____ Times	(11) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(12) Swimming or water Exercises?	1☐	2☐	(12) _____ Times	(12) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(13) Yoga?	1☐	2☐	(13) _____ Times	(13) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(14) Weight lifting or training?	1☐	2☐	(14) _____ Times	(14) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(15) Basketball?	1☐	2☐	(15) _____ Times	(15) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(16) Baseball or softball?	1☐	2☐	(16) _____ Times	(16) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(17) Volleyball?	1☐	2☐	(17) _____ Times	(17) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(18) Handball, racquetball, or squash?	1☐	2☐	(18) _____ Times	(18) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(19) Ice/roller Skating?	1☐	2☐	(19) _____ Times	(19) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None
(20) Water/snow Skiing?	1☐	2☐	(20) _____ Times	(20) _____ Mins.	1☐Small 3☐Large 2☐Mod. 4☐None

(21) Have you done any other exercise, sports, or physically active hobbies in the past 2 weeks that I haven't mentioned?

1. ☐ YES - What were they? [note below] 2.☐ NO (go to 2a) Increase in HR and breathing.

a. _____ 1☐Small 3☐Large

(1) _____ Times (1) _____ Mins. 2☐Mod. 4☐None

---

b. _____ 1☐Small 3☐Large

(1) _____ Times (1) _____ Mins. 2☐Mod. 4☐None

2a. Was this a TYPICAL two weeks for you, in terms of your physical activity? 1☐ Yes (go to 3a) 2☐ No

b. If *No*, were you *more* or *less* active than usual for you? 1☐ More 2☐ Less than usual

---

3a. Based on what you've told me, how would you respond to this next question? Do you NOW engage in AEROBIC EXERCISE (which would include things like swimming, stationary cycling, rowing, jogging, aerobic dance, racket sports) REGULARLY (i.e., at least 3 times/week, for at least 20 minutes at a time)? [CIRCLE activity]

1☐YES .....(too active) - ☐
[note on eligibility list]

2☐NO (go to 4a)

[If YES: CIRCLE the activity they're doing above; if there are questions concerning *another* activity not listed, note activity(s) here: _____]

b. HOW LONG have you been doing this type of activity regularly? _____ Days/Weeks/Months/Years (CIRCLE ONE)

4a. Thinking of *all* the possible types of physical activity, which type of exercise/physical activity is MOST APPEALING to you?
[Note activity here: _____] Activity # - _____

b. Which activity is the SECOND MOST APPEALING to you?
[Note activity here: _____] Activity # - _____

---

5. Which is MORE APPEALING to you, exercising in a group with an EXERCISE LEADER, or exercising ON YOUR OWN, after some instruction? 1☐ WITH OTHERS 2☐ ON OWN

6a. Which of the following 4 things do you think has the MOST INFLUENCE upon whether you exercise or not: How *Convenient* exercise is; How *Enjoyable* you find exercise to be; whether you can exercise *With Others* or not; or the *Benefits* experienced from exercising regularly?

1☐CONVENIENCE
2☐ENJOYABILITY
3☐OTHERS
4☐BENEFITS

[CONTINUE ON NEXT PAGE]

b. What has the SECOND MOST IMPORTANT INFLUENCE upon whether you exercise or not? *[read the choices again]*

1☐CONVENIENCE
2☐ENJOYABILITY
3☐OTHERS
4☐BENEFITS

7a. Do you have any *physical limitations* that would make Moderate Physical Activity DIFFICULT?

1☐YES
2☐NO (go to 8a)
3☐SOMETIMES

b. Specify Reason(s): _____

8a. Did you ever *exercise* or play sports regularly (i.e., at least 3 times/week, for at least 20 minutes at a time) IN THE PAST? 1☐YES 2☐NO (go to 9a)

b. HOW LONG AGO was that? _____ Months/Years ago (CIRCLE ONE)

c. For HOW LONG did you do it regularly? _____ Months/Years (CIRCLE ONE)

9a. Would you say that you are physically *More active, Less active, or About As Active* as other persons of your age and sex?

1☐MORE ACTIVE
2☐LESS ACTIVE
3☐ABOUT AS ACTIVE (go to 10)

b. Is that */ a lot more or a little more / a lot less* or *little less/* active?

1☐A LOT MORE
2☐A LITTLE MORE
3☐A LOT LESS
4☐A LITTLE LESS

---

10. How much Hard Physical Work (i.e., anything equivalent to brisk walking or harder) is required ON YOUR JOB or IN YOUR MAIN DAILY ACTIVITY? Would you say *a great deal, a moderate amount, a little, or none*?

1☐A GREAT DEAL
2☐A MODERATE AMOUNT
3☐A LITTLE
4☐NONE

III. SMOKING

[" *These next questions are about smoking cigarettes.* "]

1a. Have you *ever* smoked cigarettes? 1☐YES 2☐NO ...[nonsmoker] - ☐
(If NO, go to section IV-1).

b. [If YES:] For *how long?* _____ Months/Years *(CIRCLE ONE).*

2a. Do you smoke cigarettes NOW? 1☐YES (go to 3) 2 NO ...[nonsmoker] - ☐
[note on eligibility list]

b. About *how long* has it been since you LAST smoked cigarettes fairly *regularly* (i.e., at least 1 cigarette a day)?

_____ (Number of...)

1☐DAY(S) (go to 4)
2☐WEEK(S) (go to 4)
3☐MONTH(S) (go to 4)
4☐YEAR(S) (go to 5a)
5☐Never Smoked regularly (go to 4)

---

3. On the average, about HOW MANY cigarettes a day do you now smoke?

_____ CIGARETTES/DAY

00☐LESS THAN 1 PER DAY

---

4. HOW MANY TIMES have you ever made a serious attempt to quit smoking in the PAST 12 MONTHS?

_____ TIMES
(If 0, go to 6)

5a. The last time you tried to quit smoking, did you do it ON YOUR OWN or in an ORGANIZED PROGRAM?

1☐ ON OWN
2☐ ORGANIZED PROGRAM

b. The last time you decided to quit smoking, was there *anything in particular* that happened in your life that *encouraged* you to do it?

1☐YES 2☐NO

1. If YES, Describe: _____

_____

---

6. Did a physician EVER advise you to quit or cut down on smoking? 1☐YES 2☐NO

IV. WEIGHT/DIET *["The next few questions are in the area of diet and weight."]*

* [use height/weight chart]

1. How *tall* are you without shoes? _____ feet _____ inches

2. How much do you *weigh* without shoes, with normal indoor clothing on? _____ pounds

[NOTE: Look at height/weight chart to determine eligibility.] ..... (too thin) - ☐

[note on eligibility list]

3a. Are you trying to *lose weight*? 1☐YES 2☐NO (go to 4a)

b. How *much* would you like to lose? _____ pounds

4a. Are you on any *special type of diet* for weight control or *other* health reasons? 1☐YES 2☐NO (go to section V-1)

b. What *types* of special diets are you on? (check ALL that apply)

1☐WEIGHT LOSS (Specify:_____)
2☐CHOLESTEROL/FAT LOWERING
3☐LOW SALT
4☐OTHER (Specify below: _____)

V. ALCOHOL *["The next several questions have to do with alcoholic beverages."]*

1. Have you had at least ONE drink of beer, wine, or liquor during the PAST YEAR? 1☐YES 2☐NO (go to VI-1)

2a. In the PAST 2 WEEKS, *how many days* did you drink any alcoholic beverages such as beer, wine, or liquor? _____ Days (If 0, go to section VI-1)

b. On the day(s) that you drank alcoholic beverages, how many *drinks* did you have per day, on the average? _____ Drink(s)/Day

---

VI. GENERAL MEDICAL INFORMATION:

["The next few questions concern your general medical history."]

1. All in all, would you say your HEALTH is *Excellent, Good, Fair, or Poor?*
1☐EXCELLENT
2☐GOOD
3☐FAIR
4☐POOR

2a. Have you EVER been told by a doctor or other health professional that you had *High Blood Pressure* or hypertension?
1☐YES
2☐NO (go to 3a)
3☐Only during Pregnancy (go to 3a)

b. (If YES): Are you being treated for this with MEDICATION? 1☐YES ..... ☐
2☐NO [note]

3a. Do you have *Diabetes*? 1☐YES 2☐NO (go to 4a)

b. (If YES): Are you being treated for this with INSULIN? 1☐YES ..... ☐
2☐NO [note]

4a. Have you EVER been told by a doctor or other health professional that you had *High Cholesterol*? 1☐YES 2☐NO (go to 5)

b. (If YES): Are you being treated for this with MEDICATION? 1☐YES ..... ☐
2☐NO [note]

5. Have you EVER been told by a doctor that you had a *Stroke?* 1☐YES ..... ☐ 2☐NO [note]

---

6. Have you EVER been hospitalized for a *Heart Attack, Heart Surgery, Angioplasty*, or any *Heart Condition?* 1☐YES ..... ☐ 2☐NO [note]

7a. Are you NOW taking any Other Medicine prescribed by a doctor (including *estrogen* etc.)? 1☐YES 2☐NO (go to 8)

b. Name of CONDITION(s): c. Name of MEDICATION(s):

(1)_____ (1)_____ ☐

(2)_____ (2)_____ ☐

(3)_____ (3)_____ ☐

(4)_____ (4)_____ ☐

(5)_____ (5)_____ ☐

[NOTE: Make sure to put a CHECK by the following medicines:
Estrogen/hormone pills, heart medications.]

---

8. During the PAST 12 MONTHS, *how many times* were you Hospitalized for any reason? _____ times

---

9a. Are there ANY OTHER Medical Conditions for which you are presently under the care of a physician? 1☐YES 2☐NO (go to 10)

b. If YES: Would you mind telling me for what?
1☐YES . SPECIFY: _____
2☐WOULD NOT SAY

---

10. ***For WOMEN Only :***

a. Have you had ANY menstrual bleeding during the PAST YEAR? 1☐YES ..... ☐ 2☐ NO [note]

b. If YES: HOW MANY months ago was that? _____ Months

VII. SLEEP ["*The next few questions are about your sleep.*"]

1. Based on the last 6 months, how many hours of sleep do you *usually* get at night? _____ Hours

2. Based on the last 6 months, how often do you snore in any way? *Never, a few times, sometimes, quite often, or usually?*
   1☐NEVER
   2☐A FEW TIMES
   3☐SOMETIMES
   4☐QUITE OFTEN
   5☐USUALLY
   6☐DON'T KNOW

---

3. Over the last 6 months, have you fallen asleep or *struggled to stay awake* in the following situations DURING THE DAY?

a. While traveling?	1☐YES	2☐NO
b. At the movies or theater?	1☐YES	2☐NO
c. While watching TV?	1☐YES	2☐NO
d. While listening to the stereo?	1☐YES	2☐NO

---

4. Based on the last 6 months, how much of a PROBLEM do you have with sleepiness during the DAY? That is, feeling sleepy, or *struggling to stay awake* in the daytime? Would you say *None, Slight, Moderate, Fairly Great, or Very Great?*
   1☐NONE
   2☐SLIGHT
   3☐MODERATE
   4☐FAIRLY GREAT
   5☐VERY GREAT

VIII.STRESS ["*These next few questions are about the amount of stress you experience*"].

1. During the PAST 2 WEEKS, would you say that you experienced *a lot* of stress, a *moderate* amount of stress, relatively *little* stress, or almost *no stress at all*?
   1☐ A LOT
   2☐ MODERATE AMOUNT
   3☐ RELATIVELY LITTLE
   4☐ALMOST NONE AT ALL

---

2. In the PAST MONTH, how often have you felt that you were unable to control the important things in your life? Would you say *never, almost never, sometimes, fairly often*, or *very often*?
   1☐NEVER
   2☐ALMOST NEVER
   3☐SOMETIMES
   4☐FAIRLY OFTEN
   5☐VERY OFTEN

---

3. In the PAST YEAR, how much effect has stress had on your health - *a lot, some, hardly any* or *none?*
   1☐A LOT
   2☐SOME
   3☐HARDLY ANY or NONE

[CONTINUE ON NEXT PAGE]

IX. DEMOGRAPHICS *("The next several questions have to do with basic descriptive information".)*

1. What is your current *age?* _____ Years

[2. Sex]: 1☐MALE 2☐FEMALE

---

3. What is your current *Marital Status?*
1☐SINGLE 2☐MARRIED
3☐SEPARATED/DIVORCED
4☐WIDOWED

4a. Are you currently *employed?* 1☐YES 2☐NO

b. What is current occupation/status?
Write Below:
_____
1☐EXECUTIVE, BUSINESS MANAGER, PROPRIETOR, PROFESSIONAL;
2☐ADMINISTRATIVE, CLERICAL AND SALES, SMALL BUSINESS, TECHNICAL WORKERS;
3☐SKILLED MANUAL EMPLOYEES;
4☐MACHINE OPERATOR, SEMI-SKILLED AND UNSKILLED EMPLOYEES, SMALL FARMERS;
5☐UNEMPLOYED FOR A YEAR OR MORE;
6☐HOUSEWIFE
7☐STUDENT
8☐RETIRED
9☐UNKNOWN OR WOULD NOT SAY

---

5. How *long* have you been living in the Sunnyvale community?
_____ MONTHS/YEARS
(Circle One)

---

6. Do you currently have any plans to *MOVE* from the Sunnyvale or South Bay area during the NEXT 2 YEARS? 1☐YES [Plan To Move]..... ☐ [note on eligibility list]
2☐ NO

[NOTE: IF MOVING WITHIN A 30 MILE RADIUS, CHECK *NO* ABOVE.]

---

7. Is your family's *ethnic background*.... (read choices)
1☐ HISPANIC
2☐ WHITE
3☐ BLACK
4☐ ASIAN
5☐ AMERICAN INDIAN
6☐ WOULD NOT SAY

[IF QUESTIONS, NOTE WHAT THEY SAY BELOW:
_____]

[CONTINUE ON NEXT PAGE]

8. In approximately what range does your current *household income* fall?

1☐ Less than 15,000
2☐ between 15,000 and 25,000
3☐ between 25,000 and 35,000
4☐ OVER 35,000
8☐ WOULD NOT SAY

---

9. How many years of *formal education* have you had? _____ Years
(e.g., through high school=12 years; trade school not counted)

10a. *How many* individuals currently live in your *household* most of the time, that is, at least 6 MONTHS out of the year, including yourself? _____ People

b. What are their *ages* and *sexes?* [NOTE: Put respondent in slot 1]

	AGE:	SEX : (f=female; m=male)	
1)	_____	1☐ f	2☐ m
2)	_____	1☐ f	2☐ m
3)	_____	1☐ f	2☐ m
4)	_____	1☐ f	2☐ m
5)	_____	1☐ f	2☐ m
6)	_____	1☐ f	2☐ m

11a. For *confidentiality* reasons in doing the survey, we will be using people's Social Security Numbers rather than their names in putting together the information we are gathering. Can you give me your *Social Security Number?*

1☐YES; IT IS: _____ 2☐DON'T KNOW IT 3☐REFUSE (see b)

b. IF REFUSE: Record reason why-_____

X. INTEREST IN HEALTH PROGRAMS: [*"The final set of questions are on your interest in different types of health programs."*] (read the choices slowly)

	1	2	
1a. Which of the following *6 areas* are you MOST Interested in learning more about? Exercise; Nutrition; weight control; quitting smoking; stress management; or blood pressure control? [NOTE: Use column headed '1'.]	☐	☐	EXERCISE
	☐	☐	NUTRITION
	☐	☐	WEIGHT CONTROL
	☐	☐	QUITTING SMOKING
	☐	☐	STRESS MANAGEMENT
	☐	☐	BLOOD PRESS. CONTROL
	☐	☐	NONE

b. Which of these areas are you NEXT Most Interested in learning more about? [NOTE: Use column headed '2' above.]
(read the choices again)

[END OF SURVEY; DETERMINE ELIGIBILITY FOR PROJECT]

DETERMINING ELIGIBILITY FOR PROJECT:

- *"Okay. Let me take a minute here to make sure that I've completed everything."*

[NOTE: See if person is eligible for study, by noting if checks appear in the boxes below. If a box is checked, the person is NOT eligible.
***Note that BOTH BOXES in *2 need to be checked for person to be INELIGIBLE.**

	YES:
1. Too Active (see page 3)	☐
2. Insulin, Blood Pressure or Cholesterol Med. (see pg. 6)	☐
3. Cancer, Stroke, Heart Condition (see page 7)	☐
4. Other Medications Listed (see page 7)	☐
5. For Women: Not Postmenopausal (see page 7)	☐
6. Plan to Move Within 2 Years (see page 9)	☐

---

a. **IF the person is NOT ELIGIBLE for the project (i.e., 1 or more boxes, not including *2, are checked; both boxes in *2 are checked), say the following:**

1. *"Well, everything looks complete. I want to thank you very much for participating in the survey. The information we're collecting will help Stanford and Sunnyvale in the planning of health-related programs. The findings from the survey should be available through local media sources in several months."*

   [If they have any questions, answer them to the best of your ability. If something comes up that you feel you need some input on, etc., don't hesitate to talk to Andrea or Abby. Make any notes on this form.]

2. *"Would you be willing to be contacted in the future by project staff either via mail or phone to answer related sorts of questions?"* **1☐ YES 2☐ NO**

   IF YES: NAME: _____
   COMPLETE ADDRESS: _____

_____

3. *"Thank-you again for your time."* ***[End Survey. Record info. on contact form.]***

[IF ELIGIBLE, SEE NEXT PAGE]

b. **IF the person IS ELIGIBLE for the project (i.e., NO boxes are**

checked, OR only 1 BOX in #2 is checked), say the following:

1. *"Well, everything looks complete. I want to thank you very much for participating in the survey. As has been announced over the radio and in the papers, this survey is part of a larger 2-year project being run by Stanford University in cooperation with the City of Sunnyvale. The second half of the project is focused on helping individuals who have completed the survey INCREASE their OVERALL HEALTH and decrease their risk of heart disease, among other things, by becoming more PHYSICALLY ACTIVE.*

"People participating in the project will have the opportunity to, among other things, receive several years worth of FREE, comprehensive MEDICAL EVALUATIONS at Stanford. They will be able to find out about such things as their cholesterol levels, blood pressure, and body fat levels. They will also be provided with the opportunity to participate in one of several physical activity programs, either this year or next year, tailored to the needs of individuals in this age group."
[IF IT IS A WOMAN]: *"We are particularly interested in WOMEN and women's health issues related to physical activity."*

"As participants in the project, individuals will be able to contribute substantially to increasing our SCIENTIFIC UNDERSTANDING of how becoming more active can enhance people's health."

"Because individuals between 50 and 65 years old can ESPECIALLY benefit from such a program, we would like to offer you the opportunity to hear more about the project. We are holding several 1-hour informational meetings to describe the project in more detail, and to answer questions."

---

* a. *"Could we interest you in one of these sessions?"* 1☐**YES** (go to 1 below)
2☐**NO** (go to 2 on next page)

1. IF YES:

a. *"Great! Let me make sure that I have your name and mailing address:*
Name: _____

Address: _____

_____

b. "*The NEXT MEETINGS are being held on*"... [see Schedule Sheet for dates/times].

c. *"Seating will be limited, so WHAT DATE AND TIME would you like to sign up for?"*

[Note the date/time]: _____ .

d. *"The LOCATION will be the Sunnyvale Community Center, on* _____ *Rd."*
"We'll send you a MAP and MORE INFORMATION about the meeting."

"Good. We'll look forward to seeing you on (day and date), at (time). In the meantime, if you have any questions, please call us at (415) 723-2699. Ask for Andrea or Julie. Goodbye." **[End interview. RECORD outcome on contact sheet, including date and time scheduled.]**

2. IF NO:

2. IF NO:

a. *"To help us better plan for such programs in the future, it helps to know people's reasons for not being able to participate. Would you mind telling us your reasons for not being interested in this program? That kind of information is extremely useful."*

1☐ **Won't share reasons**

2☐ **Reasons Mentioned: (check ALL that apply below)**

a☐ **Too busy/not enough time**

b☐ **Not interested in physical activity or the project as a whole**

c☐ **Doesn't trust invitations delivered over the phone (*probe* to see if a letter, etc. would help).**

d☐ **Doesn't appear to understand the invitation, what's being requested, etc.**

e☐ **Other. (Specify):** _____

---

b. *"Are there any other reasons that you haven't mentioned yet?"* **[note above]**

c. *"Would you be willing to be contacted IN THE FUTURE by project staff either via mail or phone to answer related sorts of questions?"* 1☐ **YES** 2☐ **NO**

IF YES: NAME: _____

COMPLETE ADDRESS: _____

---

d. *"We're going to be continuing to recruit people over the next several months, so if you become interested in the project at a later date, we hope that you will give us a call. Our phone number at Stanford is (415) 723-2699. Again, the project is called SHIP."*

e. *"Thank-you again for your time. The findings from the survey should be available through local media sources in several months."*

END OF INTERVIEW [record outcome on contact sheet]

ANY INTERVIEWER COMMENTS/NOTES: *(write below and on back of page)*

APPENDIX B

Anthropometric Measurements

Body weight was measured to the nearest one-tenth kilogram in under-clothing and without shoes. Body density and body fat were based on the hydrostatic weighing technique which has been used in the Stanford Center for Research in Disease Prevention laboratory for 12 years. Under-water weighing is conducted in a specially designed heated and filtered pool in which a stainless steel chair is suspended from a Chatillon 15g scale. The hydrostatic weighing procedure is repeated from six to ten times until three readings agreeing within 20 grams are obtained. Water temperature is recorded after each trial. Residual volume is determined by the nitrogen washout method. Body density is calculated from the formula of Brozek et al (1963) and fat percentage according to Siri (1961).

Treadmill Exercise Testing

The treadmill protocol is designed to increase the workload 2 METS per 3-minute stage. This rate of workload increase has been determined to result in optimal test results for "normals". Initially, workloads are increased with constant speed and increasing grade. This allows adequate testing of less fit individuals unaccustomed to rapid walking. As some subjects become fit, the protocol allows achievement of peak effort through increasing speed at higher workloads. Since oxygen uptake will be directly measured by standard respiratory gas techniques, MET levels are used as a guide.

Stage	Time (min)	Speed (mph)	Grade (%)	METS
1	1-3	3	2.5	4
2	4-6	3	7.5	6
3	7-9	3	12.5	8
4	10-12	3	17.5	10
5	13-15	3.4	17.5	12
6	16-18	3.4	22.5	14
7	19-21	6	15	16
8	22-24	6	20	18

Prior to testing, a 12-lead ECG (supine) was recorded and reviewed by a physician. The ECG and blood pressure was recorded standing, prior to testing. A 12-lead ECG and blood pressure was recorded for the last 20 seconds of each workload, at peak exercise and at 2, 4 and 6 minutes of recovery. The ECG was continuously monitored on a 3-channel oscilloscope. Reasons for test termination included the subject stating that he or she wanted to stop; fatigue or shortness of breath; significant symptoms or signs of increasing ischemia (angina or ST displacement); complex PVC's or conduction defects; inappropriate systolic blood pressure response; other signs of pulmonary, cardiac, orthopedic or neurological distress; and equipment failure.

Oxygen uptake during exercise was determined by a microprocessor-based system. Expired air is routed through a dry gas meter for the measurement of inspired air volume to a low resistance Daniel's respiratory valve, then through a five-foot length of plastic tubing (3.5 cm I.D.) into a 3 liter plexiglass mixing chamber. Expired air is continuously withdrawn from the chamber at a rate of 300 ml per minute and routed through a drierite-filled polyethylene column to a model S-3A oxygen analyzer and a CD-3A carbon dioxide analyzer. Analyzers are calibrated before each test using room air and a standard gas. Analog signals from the gas meter and analyzers are transmitted through an analog-to-digital converter to an Apple Two-Plus computer. Minute average values are printed every 15 seconds for expired ventilation (MTPS), O_2 percent in expenditure and CO_2 in expired air, oxygen uptake (in liters/min and in ml/kg/min, STPD), respiratory exchange ratio (RER), heart rate (beats/min) and oxygen pulse (ml/kg/beat).

Exercise tests were supervised by a senior investigator with a physician present in the clinic area for all tests. Results were summarized, entered into the data management system and a copy provided to the subject. A complete exercise test required approximately 45 minutes for each subject which included subject hook-up, pre-exercise, exercise, recovery, data summary, and subject discharge.

APPENDIX C

STANFORD - SUNNYVALE HEALTH IMPROVEMENT PROJECT
SUPERVISED ACTIVITY CONDITION #2

Name: _____ Date: _____

During your recent treadmill exercise test you attained a maximal heart rate of _____bpm and oxygen uptake of _____ ml/kg/min. Based on this test, your training heart rate is _____ to _____ bpm or _____ to _____ beats in 10 seconds. Please follow this exercise plan, making adjustments as advised by your exercise class instructor.

Week #	Sessions/Week	Heart rate (10 seconds)	Minutes/session at THR
1 - 2	3	60% MHR = _____	20
3 - 4	3	65% MHR = _____	25
5 - 6	3	73% MHR = _____	30
7 - 8	3	73% MHR + 12 = _____ to _____	35
9+	3	73% MHR + 24 = _____ to _____	40

Do not progress to the next level if you are having problems (leg pains, long lasting fatigue) until you talk to your instructor or a Stanford Staff member.

Telephone# _____ Stanford Staff Member _____

STANFORD - SUNNYVALE HEALTH IMPROVEMENT PROJECT
HIGHER INTENSITY INDIVIDUAL CONDITION #3

Name: _____ Date: _____

During your recent treadmill exercise test you attained a maximal heart rate of _____ bpm and oxygen uptake of _____ ml/kg/min. Based on this test, your training heart rate range is _____ to _____ bpm or _____ to _____ in 10 seconds. Please follow this exercise plan.

Week #	Sessions/week	Training Heart Rate (10secs)	Minutes/session
1-2	3	60% MHR = _____	20
3-4	3	65% MHR = _____	25
5-6	3	73% MHR = _____	30
7-8	3	73% MHR + 12 = _____ to _____	35
9+	3	73% MHR + 24 = _____ to _____	40

Do not progress to the next level if you are having problems (leg pains, long lasting fatigue) until you can talk with a Stanford Staff member.

Telephone # _____ Stanford Staff Member: _____

STANFORD - SUNNYVALE HEALTH IMPROVEMENT PROJECT
LOWER INTENSITY INDIVIDUAL CONDITION #4

Name : _____ Date: _____

During your recent treadmill exercise test you attained a maximal heart rate of _____ bpm and oxygen uptake of _____ ml/kg/min. Based on this test, your training heart rate range is _____ to _____ bpm or _____ to _____ in 10 seconds. Please follow this exercise plan.

Week	Sessions/Week	Heart rate (10 seconds)	Minutes/session
1	Every other day	60% MHR = _____	20
2	Every other day	60% MHR = _____	25
3	5	60% MHR + 12 _____ to _____	30
4	5	60% MHR + 24 _____ to _____	30

Do not progress to the next level if you are having problems (leg pain, long lasting fatigue) until you talk to a Stanford Staff Member.

Telephone# _____ Stanford Staff Member _____

Name _____

Conditioning heart rate _____ to _____ beats/minute or _____ to _____ beats/ 10 sec.
Instructions: For each day that you participate in class please record each of the following:

LEVEL OF EXERTION

6 7 9 11 13 15 17 19 20
very very light fairly light hard very very hard

ENJOYMENT

1 2 3 4 5 6 7 8 9 10
not enjoyable moderately enjoyable very enjoyable

CONVENIENCE

1 2 3 4 5 6 7 8 9 10
not convenient moderately convenient very convenient

SYMPTOMS

1. breathless 2. muscle soreness 3. leg cramps 4. chest pain 5. none

INJURIES

0. none 1. head 2. neck 3. arm 4. stomach 5. buttocks 6. thigh 7. shins 8. calves 9. ankles 10. feet 11. other

Month _____

1. Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2 Target Pulse																															
3 High Pulse																															
4 R.P.E.																															
5 Enjoyment																															
6 Convenience																															
7 Symptoms																															
8 Injuries																															
9 Walking Pulse																															

APPENDIX E

STANFORD/SUNNYVALE HEALTH IMPROVEMENT PROJECT

DAILY EXERCISE TRAINING LOG

NAME_____

CONDITIONING HEART RATE___to____beats/min or ____to____beats/10 sec

INSTRUCTIONS: For each day in which you carry out any physical activity please record each of the following. (For days you carry out no physical activity record an "X" in the activity column.)

1. Type of conditioning activity as follows:
   W = Walk W-J = Walk-jog C = cycle
2. Heart rate at end of exercise session. Record # of beats/10 seconds.
3. Duration of this activity within the training range.
4. Rate of perceived exertion recorded during this activity.

LEVEL OF EXERTION

6	7	9	11	13	15	17	19	20
	very, very light	very light	fairly light	somewhat hard	hard	very hard	very, very hard	

4. Overall level of enjoyment for each exercise session

LEVEL OF ENJOYMENT

1	2	3	4	5	6	7	8	9	10
not at all enjoyable				moderately enjoyable					very enjoyable

5. Level of convenience for each exercise session

LEVEL OF CONVENIENCE

1	2	3	4	5	6	7	8	9	10
not at all convenient				moderately convenient					very convenient

6. Comments: Change in symptoms, problems, special circumstances, any additional physical activity

DAY	DATE	ACTIVITY	HR	DURATION	PEAK RPE	ENJOYMENT	CONVENIENCE	COMMENTS
1	____	____	____	____	____	____	____	_____
2	____	____	____	____	____	____	____	_____
3	____	____	____	____	____	____	____	_____
4	____	____	____	____	____	____	____	_____
5	____	____	____	____	____	____	____	_____
6	____	____	____	____	____	____	____	_____
7	____	____	____	____	____	____	____	_____
8	____	____	____	____	____	____	____	_____
9	____	____	____	____	____	____	____	_____
10	____	____	____	____	____	____	____	_____
11	____	____	____	____	____	____	____	_____
12	____	____	____	____	____	____	____	_____
13	____	____	____	____	____	____	____	_____
14	____	____	____	____	____	____	____	_____

PLEASE SEE OTHER SIDE

DAY	DATE	ACTIVITY	HR	DURATION	PEAK RPE	ENJOYMENT	CONVENIENCE	COMMENTS
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

Please fold and return by mail.
Thank you for your time!

STANFORD/SUNNYVALE HEALTH IMPROVEMENT PROJECT
730 WELCH ROAD, SUITE B
PALO ALTO, CA. 94304

STANFORD/SUNNYVALE HEALTH IMPROVEMENT PROJECT
730 WELCH ROAD, SUITE B
PALO ALTO, CA. 94304

APPENDIX F

I.D.#_____

Form # K

Visit #_____

NAME_____ DATE_____

Read each of the following statements and circle by each item the number of the alternative which best describes how characteristic the statement is when applied to you. The alternatives are:

1	2	3	4	5
Extremely uncharacteristic of me	Somewhat uncharacteristic of me	Neither characteristic or uncharacteristic of me	Somewhat characteristic of me	Extremely characteristic of me

Please be sure to answer every item and try to be as honest and accurate as possible in your responses. Your answers will be kept in strictest confidence.

	RATING: (circle one)				
1. I'm not very good at committing myself to do things.	1	2	3	4	5
2. Whenever I get bored with projects I start, I drop them to do something else.	1	2	3	4	5
3. I can persevere at stressful tasks, even when they are physically tiring or painful.	1	2	3	4	5
4. If something gets to be too much of an effort to do I'm likely to just forget it.	1	2	3	4	5
5. I'm really concerned about developing and maintaining self-discipline.	1	2	3	4	5
6. I'm good at keeping promises, especially the ones I make to myself.	1	2	3	4	5
7. I don't work any harder than I have to.	1	2	3	4	5
8. I seldom work to my full capacity.	1	2	3	4	5
9. I'm just not the goal-setting type.	1	2	3	4	5
10. When I take on a difficult job, I make a point of sticking with it until it's completed.	1	2	3	4	5
11. I'm willing to work for things I want as long as it's not a big hassle for me.	1	2	3	4	5
12. I have a lot of self-motivation.	1	2	3	4	5
13. I'm good at making decisions and standing by them.	1	2	3	4	5
14. I generally take the path of least resistance.	1	2	3	4	5
15. I get discouraged easily.	1	2	3	4	5
16. If I tell somebody I'll do something, you can depend on it being done.	1	2	3	4	5
17. I don't like to overextend myself.	1	2	3	4	5
18. I'm basically lazy.	1	2	3	4	5
19. I have a very hard-driving, aggressive personality.	1	2	3	4	5
20. I work harder than most of my friends.	1	2	3	4	5

(continued on next page)

Continued - page two

1	2	3	4	5
Extremely uncharacteristic of me	Somewhat uncharacteristic of me	Neither characteristic or uncharacteristic of me	Somewhat characteristic of me	Extremely characteristic of me

	RATING:(circle one)				
21. I can persist in spite of pain or discomfort.	1	2	3	4	5
22. I like to set goals and work toward them.	1	2	3	4	5
23. Sometimes I push myself harder than I should.	1	2	3	4	5
24. I tend to be overly apathetic.	1	2	3	4	5
25. I seldom, if ever, let myself down.	1	2	3	4	5
26. I'm not very reliable.	1	2	3	4	5
27. I like to take on jobs that challenge me.	1	2	3	4	5
28. I change my mind about things quite easily.	1	2	3	4	5
29. I have a lot of willpower.	1	2	3	4	5
30. I'm not likely to put myself out if I don't have to.	1	2	3	4	5
31. Things just don't matter much to me.	1	2	3	4	5
32. I avoid stressful situations.	1	2	3	4	5
33. I often work to the point of exhaustion.	1	2	3	4	5
34. I don't impose much structure on my activities.	1	2	3	4	5
35. I never force myself to do things I don't feel like doing.	1	2	3	4	5
36. It takes a lot to get me going.	1	2	3	4	5
37. Whenever I reach a goal, I set a higher one.	1	2	3	4	5
38. I can persist in spite of failure.	1	2	3	4	5
39. I have a strong desire to achieve.	1	2	3	4	5
40. I don't have much self-discipline.	1	2	3	4	5

Thank you

APPENDIX G

ID#: _____ Name _____
Form: _____ Date _____
Visit #: _____

Using the scale below as a "yardstick", please answer the following questions. How confident are you that you could exercise under each of the following conditions over the next six months?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I cannot do it at all.				moderately certain that I can do it.						certain that I can do it.

I could exercise.....

	Confidence Rating (0-100%)
a. when tired.	_____
b. during or following a personal crisis.	_____
c. when feeling depressed.	_____
d. when feeling anxious.	_____
e. during bad weather.	_____
f. when slightly sore from the last time I exercised.	_____
g. when on vacation.	_____
h. when there are competing interests (like my favorite TV show).	_____
i. when I have a lot of work to do.	_____
j. when I haven't reached my exercise goals.	_____
k. when I don't receive support from my family/friends.	_____
l. when I have not exercised for a prolonged period of time.	_____
m. when I have no one to exercise with.	_____
n. when my schedule is hectic.	_____
o. when my exercise workout is not enjoyable.	_____
In general, I believe I could exercise at my target heart rate three to five times per week for 30 to 40 minutes over the next six months.	_____

Rate of Perceived Exertion recorded during this activity.

LEVEL OF EXERTION

6	7	9	11	13	15	17	19	20
	very,very light	very light	fairly light	somewhat hard	hard	very hard	very, very hard	

Overall Level of Enjoyment for each exercise session

LEVEL OF ENJOYMENT

1	2	3	4	5	6	7	8	9	10
not at all enjoyable				moderately enjoyable					very enjoyable

Level of Convenience for each exercise session

LEVEL OF CONVENIENCE

1	2	3	4	5	6	7	8	9	10
not at all convenient				moderately convenient					very convenient